PROCESS MANUAL

Industrial Flow Sheets

Process Equipment

Drive Information

Case Studies

Equipment Photos

WESTECH
westech-inc.com

WesTech Engineering, Inc.

WesTech has built a solid reputation for reliable process equipment and superior service worldwide. We design, engineer, and manufacture quality equipment for municipal, mining, and industrial treatment applications.

Process Equipment. Process Driven.

Since 1973, WesTech has gained extensive experience in water and wastewater treatment for a wide range of equipment and processes. Prior to making a treatment recommendation for a particular application, WesTech works closely with you to gather necessary information for the entire process. This process driven approach, along with the combined experience of our process and application engineers, ensures a successful facility that accomplishes your essential treatment goals.

- **Municipal, Mining, and Industrial Processes**
- **Standard and Custom Designs**
- **Retrofits and Upgrades for Existing Operations**
- **Dedicated Parts and Service Department**

Global Presence

WesTech equipment is supported by a global network of experienced engineers and qualified sales agents. WesTech maintains offices and partnerships throughout the world to give you access to our products and services. Contact WesTech to arrange a visit with our local representative in your area.

Industrial

WesTech's comprehensive line of process equipment is supported by a reliable engineering staff with extensive experience in all types of industrial applications.

Complete System Packages

- **Process Support for System Design**
- **P&ID and PFD Development**
- **Pump Skids and Chemical Feed Systems**
- **Electrical Controls and Instrumentation**
- **Mechanical and Electrical Interconnects**
- **Construction Management and Support**
- **Turnkey and Installation Services**

Sedimentation

Our line of industrial sedimentation units offers multiple alternatives to ensure the best solution for your treatment needs. WesTech's clarifiers and thickeners are used for pretreatment systems, process water, and all types of industrial wastewater. In addition to providing design support for new systems, WesTech specializes in retrofitting existing systems.

Filtration

WesTech's industrial filtration products complement any system requiring treatment beyond conventional clarification.

- **Granular Media Filtration**
- **Ultrafiltration Membrane Systems**
- **Package Treatment Systems**

Oil / Water Separators

New and retrofit equipment with rectangular options designed per API 421, as well as maintenance-friendly circular units.

Biotreaters

Get aeration, digestion, and secondary clarification all in one unit. Design includes options for extended aeration and multi-stage BNR with minimal footprint and piping.

DAF / DGF

Circular and rectangular Dissolved Gas Flotation units are used for oily wastewater, algae removal, WAS thickening, filter backwash recovery, and other industrial applications.

Minerals

The unique characteristics of each slurry dictate the process design parameters of our equipment.

Thickening and Clarification

WesTech's experienced technical staff performs on-site bench-scale testing or in-house laboratory testing to determine appropriate settling rates, unit areas, and other key design parameters. WesTech's experience has been applied to many minerals applications.

- **Alumina**
- **Bauxite**
- **Coal**
- **Copper**
- **Gold**
- **Iron-ore**
- **Kaolin**
- **Kimberlite**
- **Lead**
- **Magnesium**
- **Mineral Sands**
- **Nickel**
- **Oil Sands**
- **Phosphate**
- **Potash**
- **Silica**
- **Tin**
- **Trona**
- **Uranium**
- **Zinc**
- **Others**

Paste Thickening

WesTech's paste experts offer the experience necessary to help the end user define their needs and match project requirements with an optimum paste thickener design.

- **Water Recovery Conservation / Reuse**
- **Smaller Tailings Disposal Volumes**
- **Maximum Product Recovery in CCD Circuits**

Vacuum Filtration

WesTech's line of vacuum filtration equipment provides a wide range of dewatering options for many types of industrial processing flow sheets. WesTech offers the operating flexibility to handle dewatering, washing, and clarification applications or a combination of these processes.

Carbon Retention Screens

Used in CIP / CIL plants with higher flow rates, longer basket life, increased recoveries, and low energy consumption.

Traction Thickener

An alternative to the conventional center drive thickener for high-tonnage/ high-torque applications with large diameter units.

AltaFlo™ High Rate Thickener

Provides a smaller surface area with lower capital costs. Self-diluting feed, excellent overflow clarity, and dense underflows.

WesTech Industrial and Mineral Process Products

Aeration
- Cascade Aerator
- Forced / Induced Draft Aerator
- Pressure Aerator

Barrier / Media Filtration
- AeraFilter™ Iron / Manganese Removal
- AltaFilter™ Ultrafiltration Membrane System
- AltaPac™ Ultrafiltration Package System
- Microfloc Trident® Package Treatment
- CenTROL® Cluster Filter
- Open Top Gravity Filter (Circular or Rectangular)
- Pressure Filter (Vertical or Horizontal)
- SuperSand™ Continuous Backwash Filter

Biological Treatment
- BioDoc® Rotary Distributor
- Biotreater
- ClearLogic™ MBR System
- DuoSphere™ Dual Membrane Gasholder
  - Slab or Tank Mount
- HydroDoc™ Rotary Distributor
- Oxidation Ditch
- Slow Speed Surface Aerator
- STM Aerotor™ IFAS System

Clarification / Sedimentation
- Ballasted Flocculation
- Buoyant Media Clarifier
- Conventional Clarifier
- COP™ Clarifier
- Draft Tube™ Clarifier
- Filter Backwash Clarifier
- Flocculating Clarifier
- Metallurgical Contact Clarifier
- Solids CONTACT CLARIFIER™
- Suction Header Clarifier
- SuperSettler™ Inclined Plate Settler
- CONTRAFAST®
- SPIRACONE™ Clarifier

Clarifier / Thickener Drives
- Replacement Options For All Manufacturers
- Bridge Supported Shaft Drive
- Column Supported Cage Drive
- Traction Drive

Dewatering
- Disc Filter
- Horizontal Vacuum Belt Filter
- Precoat Drum Filter
- Rotary Drum Vacuum Filter
  - Belt Discharge
  - Roll Discharge
  - Scraper Discharge

Electrical Controls
- PLC Based Control System
- UL Listed Panels (UL508A / CSA)

Lab Testing
- Bench Scale Feasibility Testing
- Field Pilot Testing / Studies

Parts / Field Service / Training
- 24 Hour Hotline
- Full Aftermarket Parts and Service Department
- Installation and Erection Services
- Mechanical and Process Evaluations / Audits
- Operator and Process Training

Oil / Water Separation
- API Type Oil / Water Separator (Circular or Rectangular)
- DAF Units (Circular or Rectangular)
- DNF Units (Circular or Rectangular)

Screens
- CleanFlo™ Element Continuous Belt Screen
- CleanFlo™ Monoscreen®
- CleanFlo™ Rotoscreen®
- CleanFlo™ Shear (Internally Fed Drum Screen)
- CleanFlo™ Spiral Screen
- CleanWash™ Screenings Washer / Compactor
- Counter Pressure Screw
- Gritt Mitt™ Grit Classifier
- Linear Trash Screen
- Media Retention Screen
  - CIP / CIL
  - RIP / RIL

Softening
- Cation Exchange Softener
- Cold Lime Softener
- Warm Lime Softener

Tankage
- Anchor Channel Tank
- Elevated Tank
- Steel Bottom Tank
- Supply and / or Field Erection

Thickeners
- AltaFlo™ High Rate Thickener
- Conventional Thickener
- Deep Bed™ Paste Thickener
- HiDensity™ Paste Thickener
- HiFlo™ High Rate Thickener
- Swing Lift Thickener
- TitanTraction™ Traction Drive Thickener
- CONTRAFAST®

Now celebrating 40 years, WesTech has enjoyed steady growth since its founding and has maintained a financially sound position throughout. With an Employee Stock Ownership Plan (ESOP) holding a large part of the company's stock, WesTech employees have a strong commitment to the success of the company. WesTech's management is progressive and responsive to the needs of its customers, employees, and the industry at large.

WesTech Timeline:

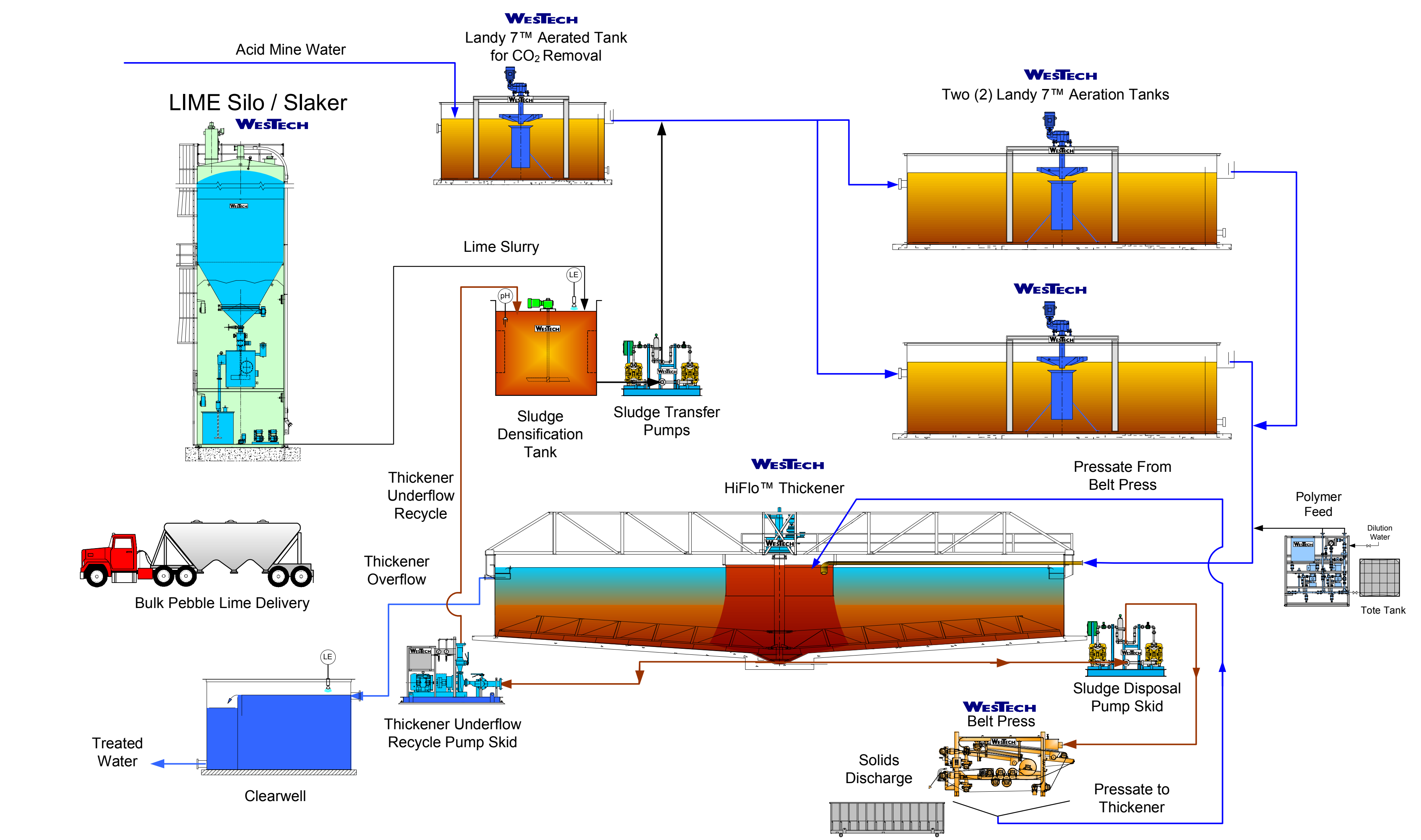
- Company Founded 1972
- Company Incorporated in California 1973
- Relocated to Sugarhouse, Utah Facility 1981
- Created ESOP Program 1982
- Constructed First Building at Current Salt Lake Location 1986
- Achieved ISO Certification 1995
- Constructed Second Building at Current Location 1998
- Opened China Office 2003
- Opened Chicago Office 2004
- Opened Brazil Office 2005
- Opened South Africa Office 2009
- Acquired WWETCO 2010
- Constructed Third Building on Salt Lake Campus 2011
- Opened India Office 2011
- Acquired PasteThick™ Associates 2012
- Acquired Microfloc® and General Filter 2012

SECTION ONE – PROCESS FLOW SHEETS

SECTION ONE – PROCESS FLOW SHEETS INDUSTRIES

SECTION ONE – PROCESS FLOW SHEETS (A-Z)

SECTION ONE – PROCESS FLOW SHEETS



Acid Mine Drainage

WesTech

DWN: **RCS** DATE:

The geometry of the ***TOP™ Thickener*** dewatering chamber provides additional solids residence time and larger inventory for compacted solids. Inclined scrapers are used for further dewatering within the chamber. WesTech's approach to elevated tank design is unique. An algorithm has been developed to simultaneously analyze parameters such as beam size, beam quantity, leg size, and leg location. Designs are verified using structural analysis software. Flow distribution patterns can be analyzed using computational fluid dynamics (CFD). WesTech uses CFD technology as a tool to optimize the feed distribution system design.

Acid Mine Drainage

Acid mine drainage (AMD) is typically characterized by low pH and high dissolved iron. The AMD may also contain high amounts of CO_2 which forms carbonic acid which further depresses the pH.

There are four chemical reactions that represent the chemistry of pyrite weathering to form AMD. An overall summary reaction is as follows:

$$2\ FeS_2 + 7\ O_2 + 2\ H_2O \rightarrow 2\ FeSO_4^{\ -} + 2\ H_2SO_4$$

Pyrite + Oxygen + Water → Ferrous Sulfate + Sulfuric Acid

The AMD waste is characterized by red water. The simplest treatment is neutralization and clarification. The ideal neutralization first combines one of the reactants with previously precipitated solids. This blend is then mixed with the other reactant. This seeding provides the opportunity for crystal growth.

It also significantly reduces the reaction time. The final pH range of most neutralization reactions is 6–9. Many heavy metals precipitate as hydroxides within this pH range. However, if these heavy metal hydroxides are subjected to a pH > 11.5 for a few minutes, they convert to a crystal-like particle that clarifies, thickens, and filters more effectively than the original hydroxide.

The most commonly used neutralization agent is lime. Lime is added to previously precipitated solids in a blend tank, commonly called the densification tank. The neutralization flowsheet with this high pH feature is a high-density sludge (HDS) flowsheet.

CO_2 Stripping

Excess CO_2 dissolved in the AMD stream can be stripped out using a surface aerator. Lowering the CO_2 levels can raise the pH as much as one point and lower the amount of lime required for pH adjustment. This step also begins to oxidize iron and manganese and assists in their precipitation.

Aeration

After stripping, the HDS slurry from the densification tank and the AMD stream are mixed in the reaction/aeration tank(s). The combination of aeration, high pH, and mixing causes the iron, manganese, and other heavy metals (if present) to precipitate to the fullest extent possible at the set pH level.

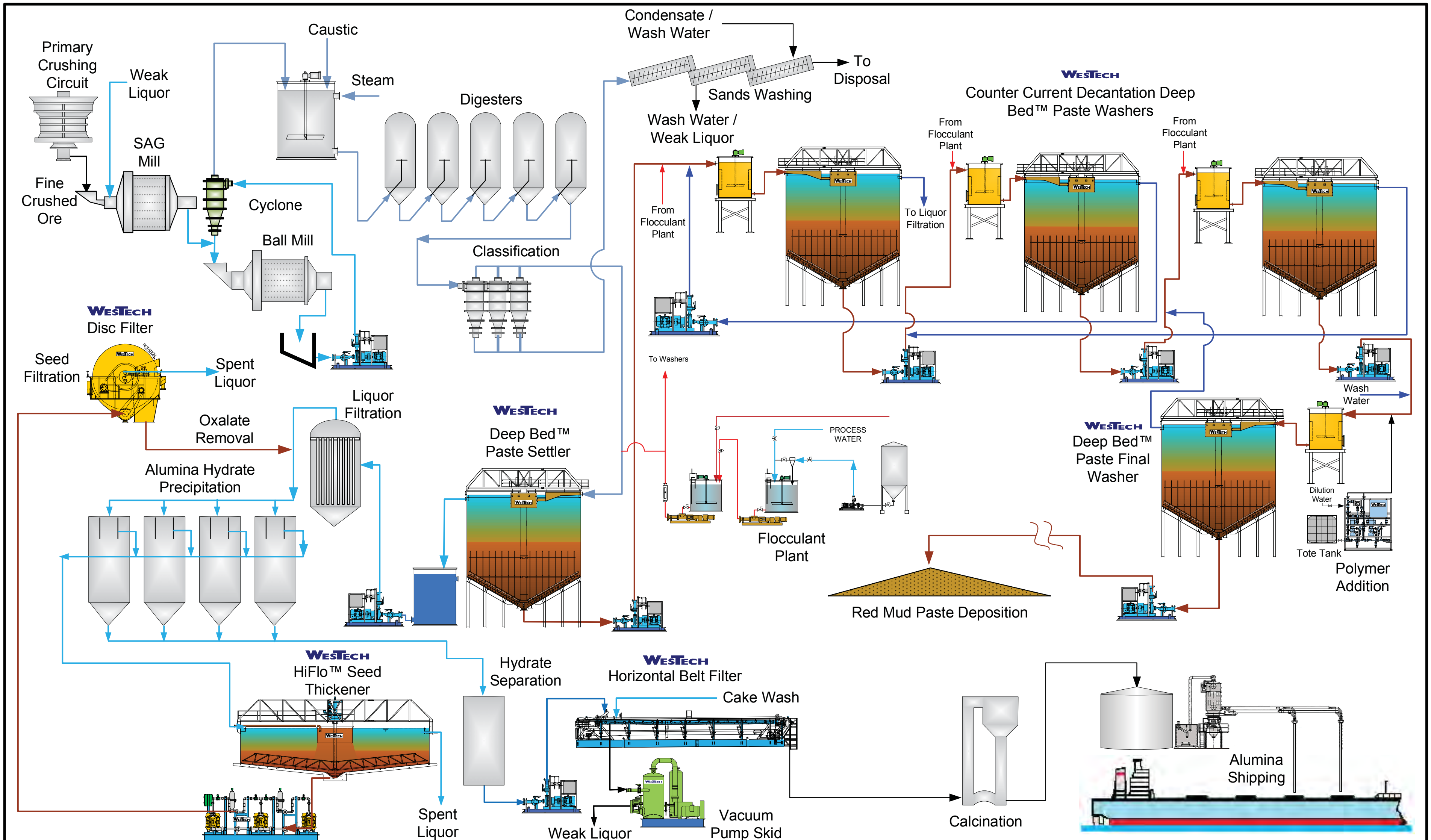
Thickening/Clarification

Treated water flows to a thickener for sludge thickening and clarification of the water. The metal precipitates as sludge, and a portion of the sludge is recycled to the sludge densification tank. The remainder of the sludge goes to disposal. Generally, the sludge will also contain gypsum and unreacted lime, which enhance the resistance to re-acidification and metal mobilization. A gravity sand filter may be used to "polish" the stream prior to discharge, depending on permit limits.

Sludge Disposal

Depending on the site conditions, the thickened waste sludge may be redirected to another portion of the mine, dewatered and deposited prior to disposal in a landfill, or concentrated to paste and stacked.

Since AMD comes from abandoned mines these sites are often in mountainous, uninhabited areas where access to the site may be difficult. Many systems have been built with ease of operation being paramount. In fact, the systems are often built for operation with no onsite operator. This has led to the use of caustic for neutralization. Caustic is a liquid and is much easier to feed than lime. However, it does not make the same crystals that lime does, so the precipitate is difficult to settle. Caustic-fed systems are much more liable to upsets and the precipitation tanks should be designed for longer holding times. Also, caustic is much more expensive than lime.



Alumina Circuit

WesTech

DWN: **RCS** DATE:

The WesTech ***Deep Bed™ Paste Thickener*** represents state-of-the-art design for alumina settlers and washers. Paste thickeners produce red mud underflow at densities much higher than conventional high-rate thickeners. This higher density reduces the number of washing stages and wash water flow rate, minimizes residence time to reduce scale precipitation, and produces low soda losses. The final washer thickens to concentrations suitable for stacking, which simplifies impoundment design and extends the life of the impoundment.

Alumina Circuit

The process of refining bauxite to produce alumina (the Bayer process) can traditionally be considered in the following steps:

Extraction →Precipitation →Calcination

Extraction

Bauxite ore is crushed and milled to reduce the particle size, making the extraction step more efficient. The crushed and milled ore is then combined with spent liquor and makeup sodium hydroxide (caustic) and sent in slurry form to heated pressurized digesters where the aluminum-bearing minerals are dissolved.

Hydrocyclones are used to desand the digested slurry. The insoluble bauxite residue (red mud) is separated in hydrocyclones from the aluminum-containing liquor. The overflow from the hydrocyclones is sent to paste thickeners to thicken the solids and recover the liquor. The liquor is sent to the liquor filters and then to the precipitation step.

The red mud is further thickened and washed with fresh water in multiple stages using a countercurrent decantation (CCD) process to recover the caustic and any remaining alumina content. The red mud from the final CCD stage is then collected as a paste and sent to a disposal site, thus eliminating tailings ponds.

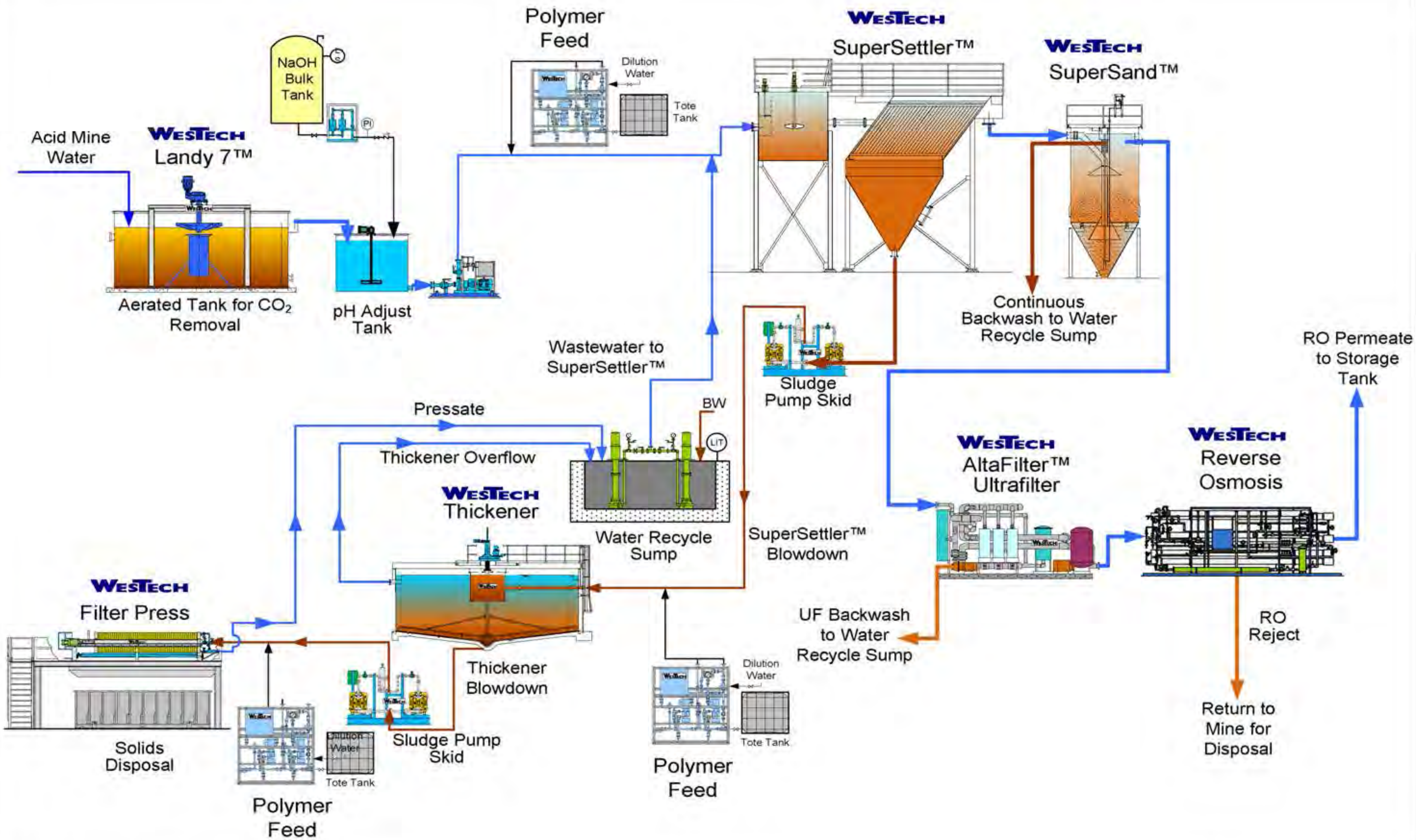
Precipitation

The cooled and filtered pregnant supersaturated liquor from the settler is sent to a series of alumina hydrate precipitation tanks. To promote the alumina hydrate precipitation, the liquor is seeded with alumina hydroxide crystals.

The hydrate crystals are classified in hydroseparators to produce a coarse product fraction and a fine seed fraction. The resulting crystals are collected and sent to the next step in the recovery process, while the fine seed fraction is filtered and used as seed in the precipitation stage.

Calcination

The coarse aluminum hydrate crystals are filtered and washed over a horizontal belt vacuum filter to remove contaminating process liquor. It is then calcined to produce the final product, alumina.



Low TDS AMD Wastewater Treatment

WesTech

DWN: RCS DATE:

WesTech inclined ***SuperSettler™ Plate Packs*** are designed for installation on support beams in rectangular concrete basins. After the inlet flow enters the basin, it is directed to inlet ports on the side of each inclined plate. Outlet launders at the top of the plate packs collect the clarified water as solids settle out on the plates and then the basin floor. The ZICKERT Shark™ is an ideal sludge removal device for SuperSettler™ basins.

Low Total Dissolved Solids (TDS)

While the majority of waste streams generated from acid mine drainage (AMD) are characterized by low pH (2-4) and high dissolved iron (1,000 – 10,000 ppm), there are some AMD streams which are not contaminated to these extremes. These streams may have relatively high pH levels (5-7) and dissolved iron levels as low as several hundred ppm.

With water sources from industrial applications, especially hydraulic fracturing ("fracing") operations, becoming harder to obtain, these marginal quality water streams are becoming more attractive for reclaim and use as process makeup waters.

Treatment Options

Depending on the quantity of water required, water quality of the existing mine pools, and the water quality required for the process, there are a number of treatment options. This process flow diagram depicts one possible treatment design for flow rates of 500 gpm or less.

Dissolved ferrous iron (Fe_2+) is first oxidized to ferric iron (Fe_3+), which readily forms the insoluble iron hydroxide complex $Fe(OH)_3$. In addition to providing the oxygen required to precipitate the iron, the use of surface aerators allows CO_2 to be stripped from the water. This increases the pH of the water stream as well.

In the case of these relatively small flows, caustic (NaOH) is used as the sodium hydroxide source. Caustic, while having its own hazardous properties, is easier to prepare and add to the stream, involves less capital cost, and produces less sludge than the addition of lime slurry which is commonly used on large AMD flows. The caustic also increases the pH to a neutral level for further treatment and subsequent use.

Polymer is added to the stream to aid in floc formation and the stream is subjected to high energy mixing either in an inline mixer or a rapid mix tank. This is done to ensure that the polymer solution is completely dispersed in the stream. The flow then enters a slow mix tank which allows the floc that is beginning to form to grow to a point where it is large enough and heavy enough to readily settle.

SuperSettler™ Lamella Plate Clarifier

A WesTech SuperSettler™ lamella type unit can be used for this purpose. This unit provides a large projected area in a relatively small footprint. In addition, it has no moving parts making for easy operation and low maintenance. Solids settled in the lamella section are collected in a bottom hopper. This hopper can have a thickening mechanism or rake added as an option to thicken the sludge.

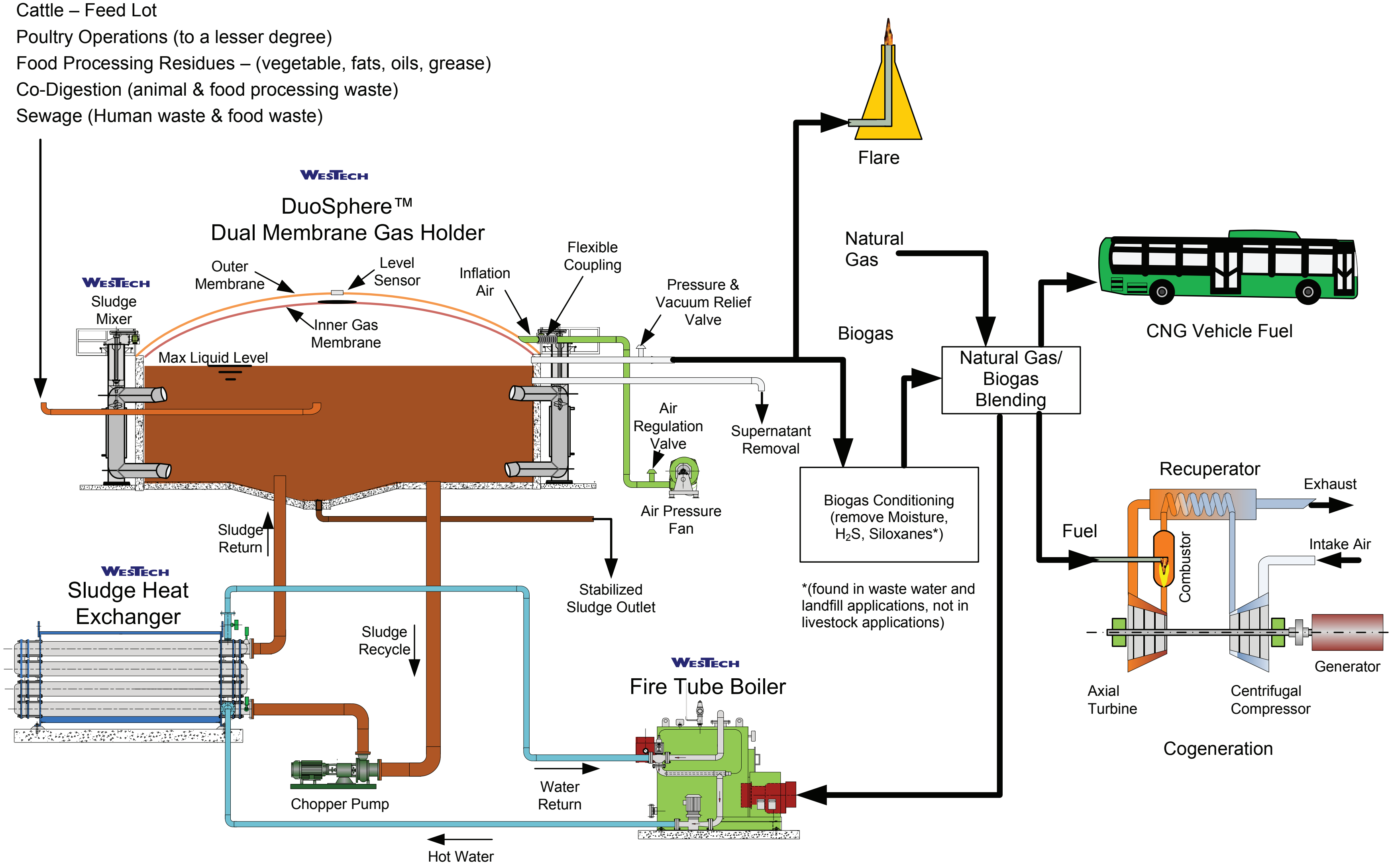
SuperSand™ Continuous Backwash

The SuperSettler™ is perfectly coupled with a SuperSand™ continuous backwash sand filter. This is due to the fact that the water can flow through both units without having to be repumped. The SuperSand™ unit creates its own filtered water backwash stream so there is no need for filtered water storage or backwash pumps. The unit generates a constant dirty backwash stream of approximately 3–5% of the inlet flow.

If low TDS water is required for downstream processes (i.e., boiler feed), then ultrafiltration and reverse osmosis can be added to the system to produce this type of high quality effluent.

Depending on the mine site, the waste streams from each treatment step may be returned to a separate section of the mine for disposal. At installations where this is not possible due to either logistics or regulations, conventional sludge thickening and dewatering technologies may be applied.

- Dairy Operations
- Swine Operations
- Cattle – Feed Lot
- Poultry Operations (to a lesser degree)
- Food Processing Residues – (vegetable, fats, oils, grease)
- Co-Digestion (animal & food processing waste)
- Sewage (Human waste & food waste)



Anaerobic Digester – CNG / Co-Gen

WesTech

DWN: **RCS** DATE:

WesTech's ***ExtremeDuty™ Sludge Mixers*** provide vigorous mixing of digester contents to prevent stratification and improve the anaerobic digestion process. Our sludge mixers reliably speed gas production for energy recovery while reducing foam and scum accumulation that typically occur in pump mix systems.Unlike pump mix and gas mix systems, the ExtremeDuty™ Sludge Mixers provide the flexibility of flow reversal. Downward pumping reduces foam and scum buildup that upsets the digestion process. Changing flow directions eliminate dead zones and stratification in your tank to optimize digester performance.

Anaerobic Digester

A variety of waste streams can be fed into the anaerobic digester in order to reduce the amount required for disposal and to generate renewable biogas. Each type of waste may be received and fed to the digester utilizing slightly different methods depending on its digestibility and handling requirements.

WesTech's ExtremeDuty™ Sludge Mixer

These mixers are an efficient and reliable way to keep the digester contents from stratifying. Since these unique mixers are reversible and can create upward or downward flows, they have a distinct advantage in preventing solids from accumulating at the top or bottom of the digester. A heat exchanger jacket can be added to provide some or all of the heat required without the need for a separate sludge recirculation pump.

Biogas Boiler & Tube-in-tube Heat Exchanger

Hot water from the boiler (or recovered from cogeneration) is pumped through the external tubes while sludge from the digester is recirculated counterflow through the inner tubes using special cast fittings. To ensure reliable performance, waste streams are not usually fed directly through the heat exchanger but are instead added directly to the digester to be mixed with the digesting sludge before being sent through the heat exchanger.

DuoSphere™ Digester Cover

Biogas is contained and stored at a constant low pressure inside of these specialized PVC-coated membrane structures. The outer membrane is kept inflated with small air fans. The inner membrane inflates and deflates depending on biogas demand and provides ample storage for any end use.

Biogas Conditioning

Biogas contains several contaminants and through several processes, H_2S, moisture, siloxane (and even CO_2, if necessary) can be removed to provide a high-quality renewable fuel that will not cause problems with the cogeneration equipment.

Biogas/Natural Gas Blending

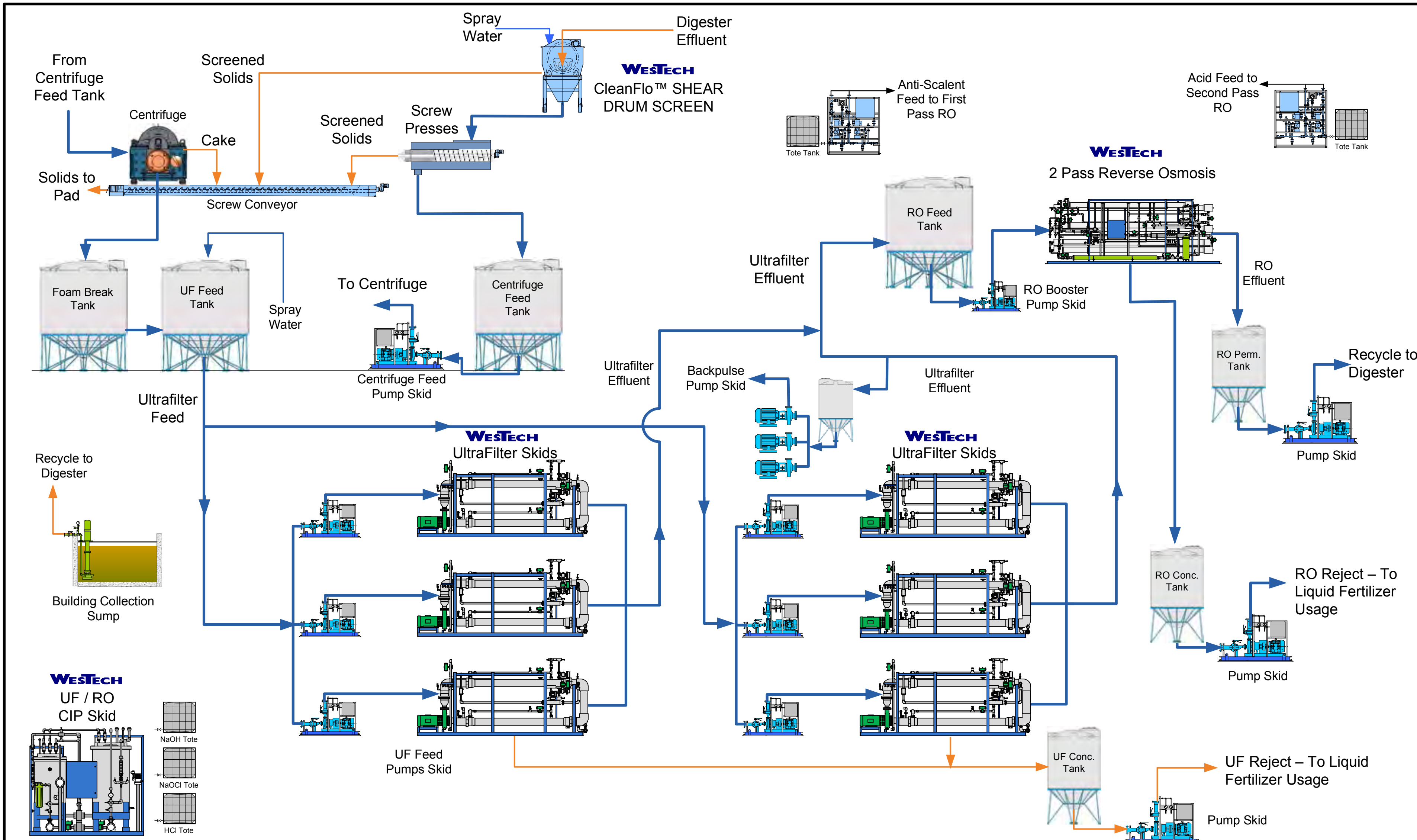
The ability to blend biogas with a natural gas can provide many benefits for sizing of equipment and opens up a variety of options for more efficient and constant operation of the cogeneration equipment.

Cogeneration – Microturbine or Internal Combustion Engine

These options for producing renewable energy and electricity from the biogas can be sized and selected based on gas production capacity and other site-specific factors. Efficiency and technology has improved substantially, making onsite cogeneration more feasible than ever before.

CNG Vehicle Fuel

This exciting option is most effective if there are fleet vehicles that operate at or near the fueling station. Offsetting gasoline costs may prove to be a very significant savings to your operation.



Anaerobic Digester Wastewater Recovery

WESTECH

DWN: **RCS** DATE:

For years, rotary drum screens have been the industry's choice for applications requiring high solids removal efficiency at low cost. The innovative features of WesTech's larger ***CleanFlo™ SHEAR™ Drum Screens*** have been incorporated into a smaller package. The primary advantage of drum screens is eliminating debris carryover. Debris remains inside the screen until discharge. Unlike conventional moving media screens, there are no seals with a drum screen. In addition, there is no chance for debris to bypass the screen medium.

Anaerobic Digester Wastewater Recovery

Anaerobic digestion as a means of generating methane for commercial use is a growing practice (see Anaerobic Digester – CNG/Co-Gen Flow Sheet). The sludge produced from the digester has traditionally been sent to sludge dryers, sludge ponds, and/or spread on fields. However, these techniques can be expensive and subject to restrictions due to regulations, seasonal conditions, etc.

This is a system to process digester sludge and produce saleable byproduct streams as well as a clean water stream which can be used for process use or even boiler feed. There are many challenges with processing this waste stream and care must be used to properly design the system to handle the various contaminants.

Feed to the drum screen is from the anaerobic digester with liquid effluent flowing by gravity to the screw press. Solids from these units move by gravity to the solids transfer screw conveyor. Periodically, water is sprayed on the drum screen to clean the screen. These two devices remove large solids, straw, and other debris which has passed through the digester.

The liquid from the screw press flows by gravity to the centrifuge feed tank and is pumped to the centrifuge. The centrifuge is the pretreatment to the ultrafiltration (UF) units and removes 50–60% of the suspended solids. The solids removed by the centrifuge are of the size distribution which would readily foul the UF units.

Two Streams

Spiral wound membranes are used in the UF units. The UF units produce two streams – the concentrate and the permeate. Both of these streams are valuable byproducts and have worth as liquid fertilizer. The concentrate stream contains the concentrated suspended solids. Although this stream is a good fertilizer, the suspended solids restrict its use to the pre-emergence timeframe of the crops due to the fact that the solids can coat the leaves and "suffocate" the plants. A means must be provided to store the liquid until it can be used in the spring. All the streams used for liquid fertilizers are most economically applied by means of a center pivot irrigation system.

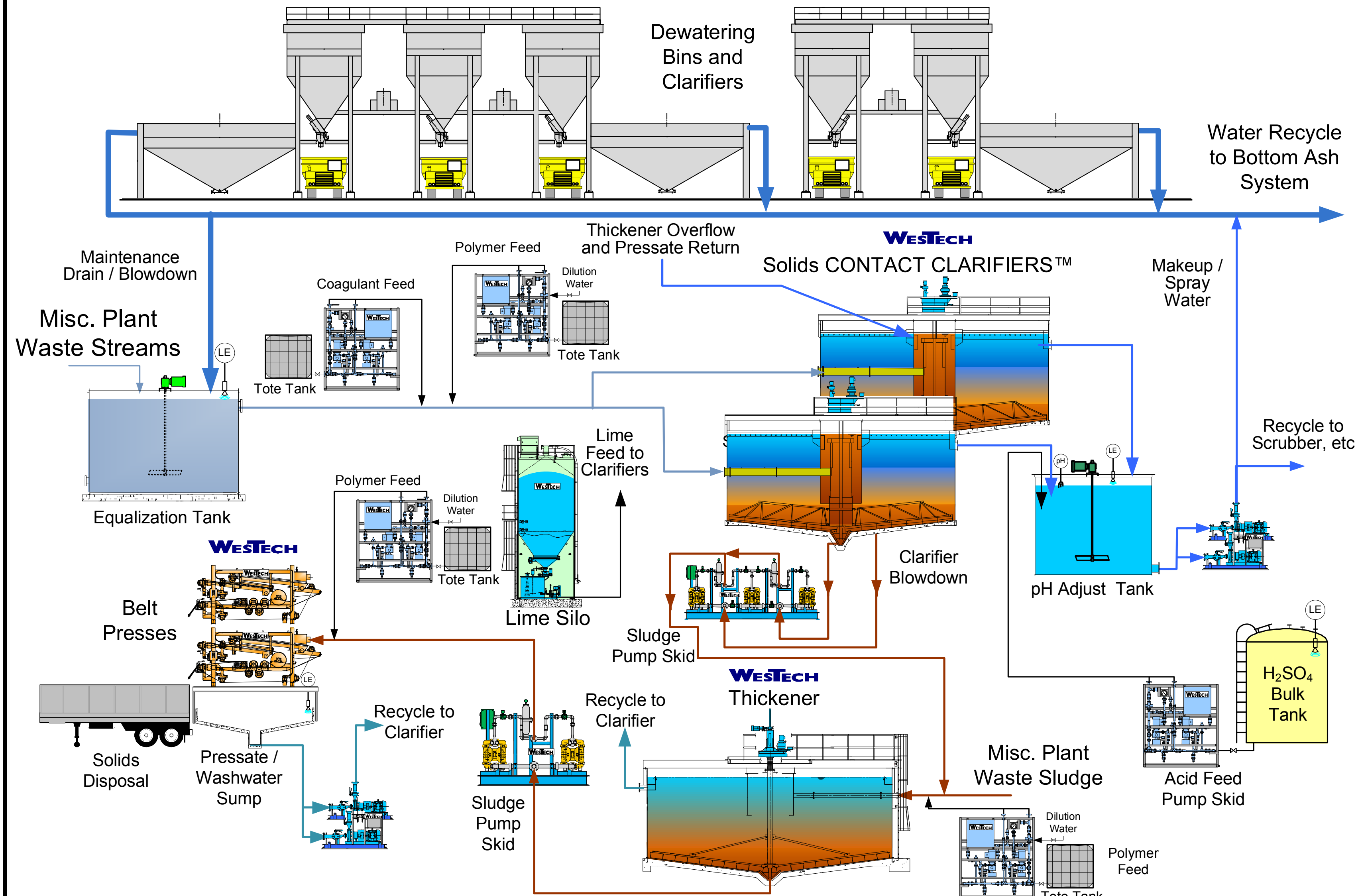
The permeate is virtually free of suspended solids and can be sprayed on crops throughout the growing season. Additionally, it makes a very good feed to reverse osmosis (RO) units if maximum water recovery is desirable. If reverse osmosis is used, the concentrate also has value as a liquid fertilizer. In this flow sheet the RO permeate is recycled to the digester.

Utilizing Reverse Osmosis Waste

In this flow sheet, the anaerobic digester is using feedlot manure as the feed source. This material requires the addition of water to prepare it to the digester. RO waste is used for this purpose since it is very low in total dissolved solids (TDS) and prevents the buildup of dissolved salts and minerals in the digesters which would have an adverse effect on their performance.

However, as noted above, this water could be used for a variety of purposes, including process water or boiler feed water.

The clean-in-place (CIP) chemicals used in cleaning the UF and RO are generated in small enough quantities that they may be recycled to the digesters. This means this treatment system generates virtually no waste products and that all liquid streams and solids generated by the system are valuable byproducts.



Bottom Ash Pond Replacement

WesTech

DWN: **RCS** DATE:

The ***Solids CONTACT CLARIFIER™*** is a mixture of old art and new process technology. Patent art dates back to the 1880's and contemporary solids contact clarifier units have their orgins in the 1940's and 1950's. The two most common applications of the Solids CONTACT CLARIFIER™ are cold lime softening, where the unit is used to maximize the rate of chemical precipitation, and surface water clarification, where the unit is used as an enhanced flocculation device.

Bottom Ash Pond Replacement

When coal is burned, two major forms of ash are produced. The fly ash is light and leaves the furnace with hot gases. The bottom ash is heavy and stays in the furnace until it is scraped out. Due to potential liability issues and/or the need to find new real estate at power plants for expansion, many utilities must replace their traditional bottom ash ponds. Utilities using traditional hydro bins can accomplish this by installing a system using solids contact clarifiers and dewatering equipment.

Equalization

In addition, ash ponds have been used in power plants to handle the many and varied waste streams which are produced. The use of a mixed equalization tank produces a somewhat uniform influent stream which can be processed by the solids contact clarifiers.

Solids Contact Clarifiers

Hydro bins coupled with gravity sedimentation are used to recover most of the water from the bottom ash handling system. The solids contact clarifier uses a sludge bed and recycling of the solids internally to build up and maintain an internal solids concentration which removes fine materials. The addition of lime slurry to this stream can also remove any oils and/or heavy metals which may cause problems for discharging the stream.

This system with lime addition can process the many and varied plant waste streams which are traditionally sent to the bottom ash pond. Since the solids contact clarifier has an internal recycle stream which is approximately 10 times the maximum influent flow and hundreds of times more solids than the influent stream, it can absorb the variations produced by the influent streams, including amount of solids and temperature. If the pH is raised above 11, there will be precipitation of heavy metals in the hydroxide form. This water must then be neutralized. Water from the system can be recycled to the bottom ash handling system or used in other parts of the plant, such as cooling tower makeup, wash down water, or dust control.

Thickener

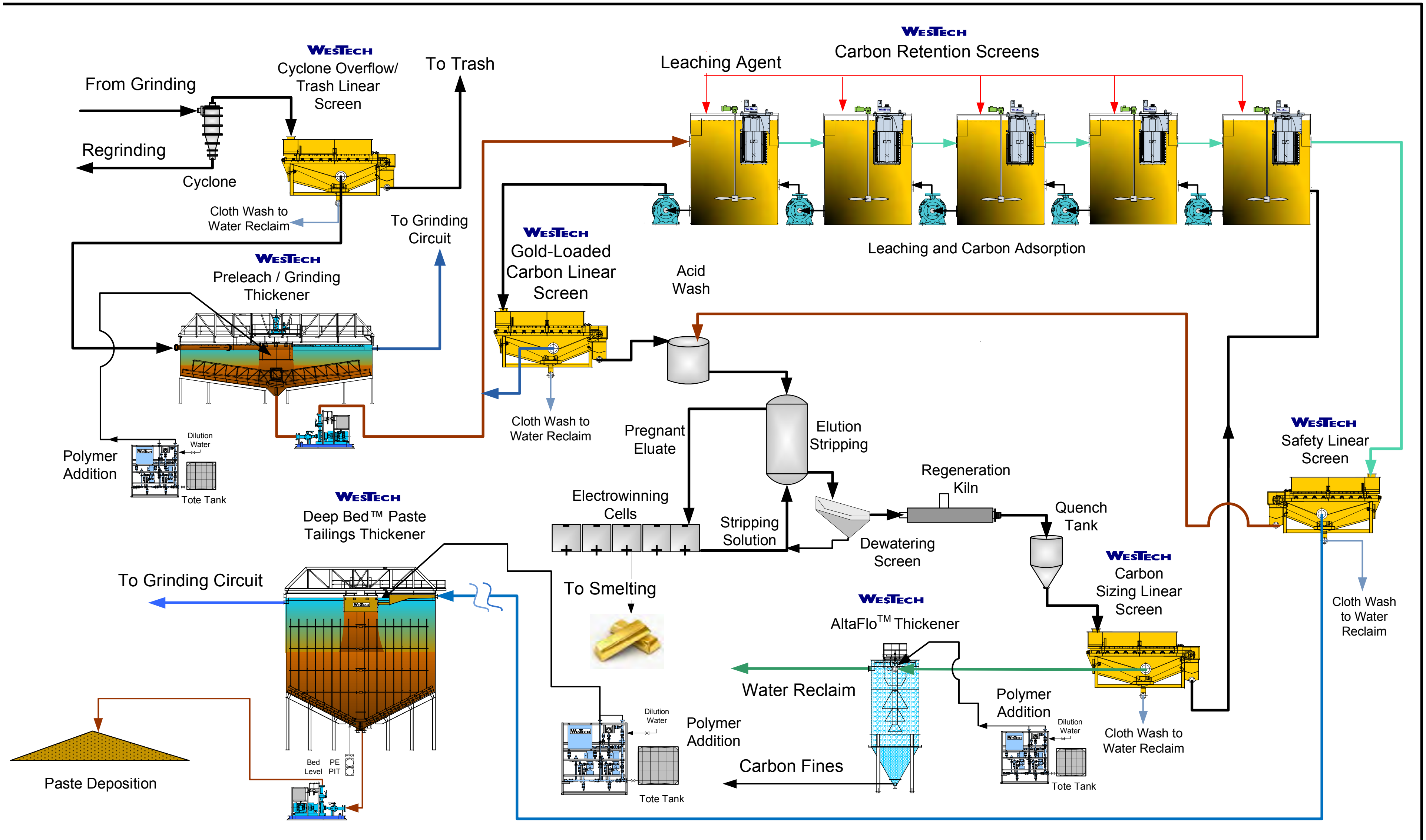
The sludge from the solids contact clarifier is sent to a thickener. By removing excess water at this stage in the process, it allows the dewatering equipment to be smaller and more economical. In this process, with the addition of lime, the sludge would enter the thickener at approximately 3–5% solids and be thickened to > 10% solids. The thickener can also be sized and used to handle other sludges produced in the power plant if it is desirable that those sludges would be dewatered also. The lime in this sludge will aid in the thickening of other sludges which otherwise might not thicken. The lime will also help these combined sludges be in such a consistency that they will dewater well.

Dewatering

Belt presses are used in the dewatering step. The belt press uses two parallel cloth belts pressed between a series of rollers to squeeze the moisture from the solids. Belt presses offer the advantage of continuous operation and minimum operator attention.

Once the chemical addition has been adjusted, the dewatering process can be monitored from the control room by means of closed-circuit television. Other options for dewatering include filter presses. In either case, lime sludges tend to dewater well and produce relatively dry cakes.

The water from the dewatering step is returned to the clarifier for retreatment through the system.



Carbon In Leach Circuit

WesTech

DWN: RCS DATE:

The WesTech ***Carbon Retention Screen*** allows for the use of larger tanks in plants with higher production tonnage. The carbon retention screen also reduces downtime incidents and operating costs associated with earlier generations of screen design. Specific flow rates for the carbon retention screen can be up to four times greater than other screening methods. Carbon retention screens are used in CIP and CIL plants worldwide, and are quickly gaining a solid reputation as the premier carbon retention screens for gold recovery.

Carbon-in-Leach Circuit (CIL)

For over a hundred years, miners have used dilute alkaline cyanide solutions (e.g., sodium cyanide [NaCN] around pH 10-11) to leach (dissolve) gold and other precious metals, from their ores. The gold is usually in the form of small flakes mixed with other minerals. It is difficult to separate mechanically, so it is dissolved and then recovered by other means.

Activated carbon removes gold out of dilute cyanide solution by adsorption (sticking). Carbon adsorption (with other extraction steps) is often the best method to follow gold cyanidation.*†

Carbon-in-leach process adds the leaching agent (cyanide solution) and activated carbon together into the slurry of ore and water. This prevents other carbonaceous materials (wood, clay, etc.) in the ores from adsorbing the gold first (“preg-robbing”).

In this step:

- **Mills grind the ore, exposing gold particles.**
- **Water joins the ore to form slurry.**
- **A trash linear screen rejects wood and debris so that it does not disrupt later operations.**
- **A high-rate thickener removes excess water from the grinding stage.**

This process includes several vessels where:

- **Cyanide solution leaches the gold from the slurry so that it can be adsorbed by carbon. ‡**
- **Slurry flows downstream (pumped or by gravity). Carbon retention screens keep the larger-sized carbon from going downstream, at each stage.**
- **Pumps force the carbon-rich slurry upstream.**
- **Countercurrent net transfer: slurry flows downstream – with less gold at each stage; carbon flows upstream – loaded with more gold at each stage.**
- **A high-rate or paste thickener dewaters the tails (waste), before disposal in a tailings pond, or as a paste deposition.**

This process includes:

- **Elution – A hot, concentrated cyanide solution pulls the gold from the carbon.**
- **Regeneration – A kiln reactivates carbon before the circuit reuses it.**
- **Electrowinning – Electricity passes through the gold-loaded (pregnant) solution, causing gold to form at a cathode, and cyanide at an anode. A smelter refines the gold.**

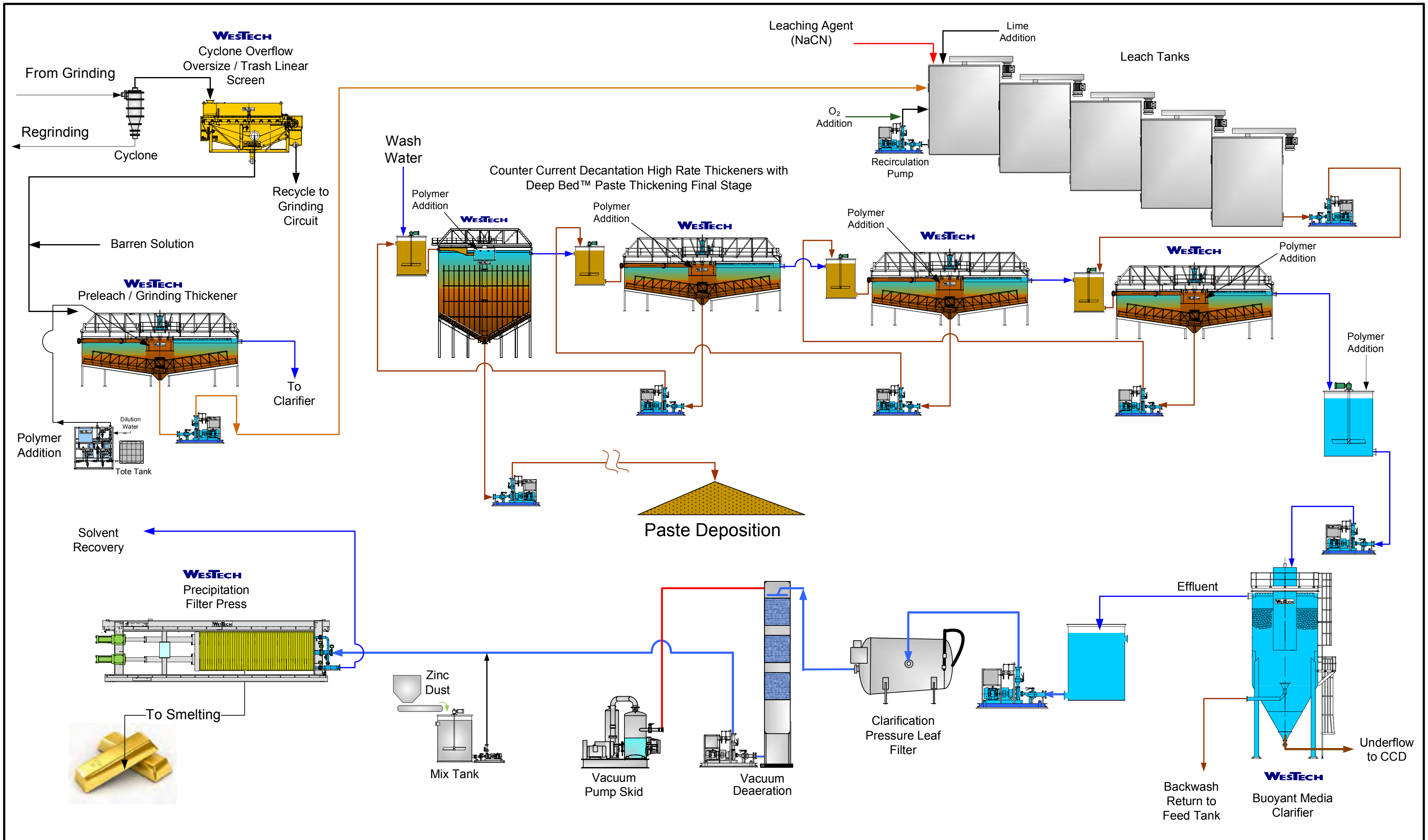
Carbon Fines Recovery

Slurry leaves the final adsorption stage through a linear screen, which catches any residual carbon fragments. These are recycled.

A carbon sizing, linear screen ejects the carbon fines from the adsorption circuit.

A settling tank (e.g., AltaFlo™ Thickener) or filter collects carbon fines, and reclaims water.

*But if the silver content in the ore is high, see “CCD – Merrill-Crowe Gold Silver” flow sheet.
†There are three subsets of the carbon adsorption approach:
Carbon-in-Pulp – Most efficient for slurries. Process leaches the gold first, adds carbon separately.
Carbon-in-Leach – Effective for carbonaceous ore slurries. Process adds leaching agent and carbon together, keeping ‘preg-robbing’ material (like wood) from adsorbing the gold.
Carbon-in-Column – For non-slurries, solution-only. Typical for heap leach applications.
‡Leaching detention time is dependent on:
Particle Size – Finer particles dissolve quicker, less time needed
Dissolved Oxygen – Rate of dissolution is directly proportional to amount of oxygen present.



CCD-Merrill Crowe for Gold and Silver

WESTECH

DWN: RCS DATE:

The WesTech ***Buoyant Media Clarifier*** represents the latest technology in clarification solutions. It contains a floating bed of filter media which acts to clarify the overflow. Overflow clarities of 20 ppm have been achieved in applications where conventional clarifier technology failed to achieve 120 ppm. The buoyant media clarifier produces overflow similar to that of traditional filters, without the high capital and running costs.

Countercurrent Displacement (CCD)

Rock passes into a dump hopper and is then transferred to a vibrating grizzly screen. The oversized material is sent to a jaw crusher. The crushed product is combined with the grizzly undersize and the ore is conveyed to the coarse ore bin.

Grinding

Coarse ore is ground, sized, slurried with pregnant liquor, and pumped to the hydrocyclone cluster. Oversized material from the hydrocyclone cluster underflow is returned to the ball mill for further grinding. The hydrocyclone overflow is sent to a trash screen which rejects oversized material and debris.

Pre-leach Thickening

The trash screen underflow slurry is fed to the high rate pre-leach thickener. Diluted flocculant and barren solution are added to the feed of the thickener to assist in solids settling and thickening. Thickener underflow is pumped to the leaching circuit. Overflow pregnant solution containing precious metals dissolved into solution is pumped to the clarifier.

Leaching

Cyanide solution is added to leach the gold from the slurry using a series of mixed leach tanks. Oxygen is injected into first leach tank using a recirculation pump to maintain sufficient dissolved oxygen in the slurry for leaching. Slaked lime slurry is used to increase pulp pH levels.

The countercurrent displacement (CCD) circuit recovers precious metals leached into solution using a multistage countercurrent thickener. Slurry from the leaching process reports to the first CCD thickener. The thickened underflow is pumped to the next CCD thickener where it is washed with recovered solution from the previous CCD thickener. Thickened underflow slurry from the final CCD thickener is pumped to the tailings paste thickener. The wash solution will flow countercurrent to the solids flow, increasing in precious metal concentration as it proceeds to the first CCD thickener. The pregnant solution from the first CCD thickener is pumped to the buoyant media clarifier.

Tailings

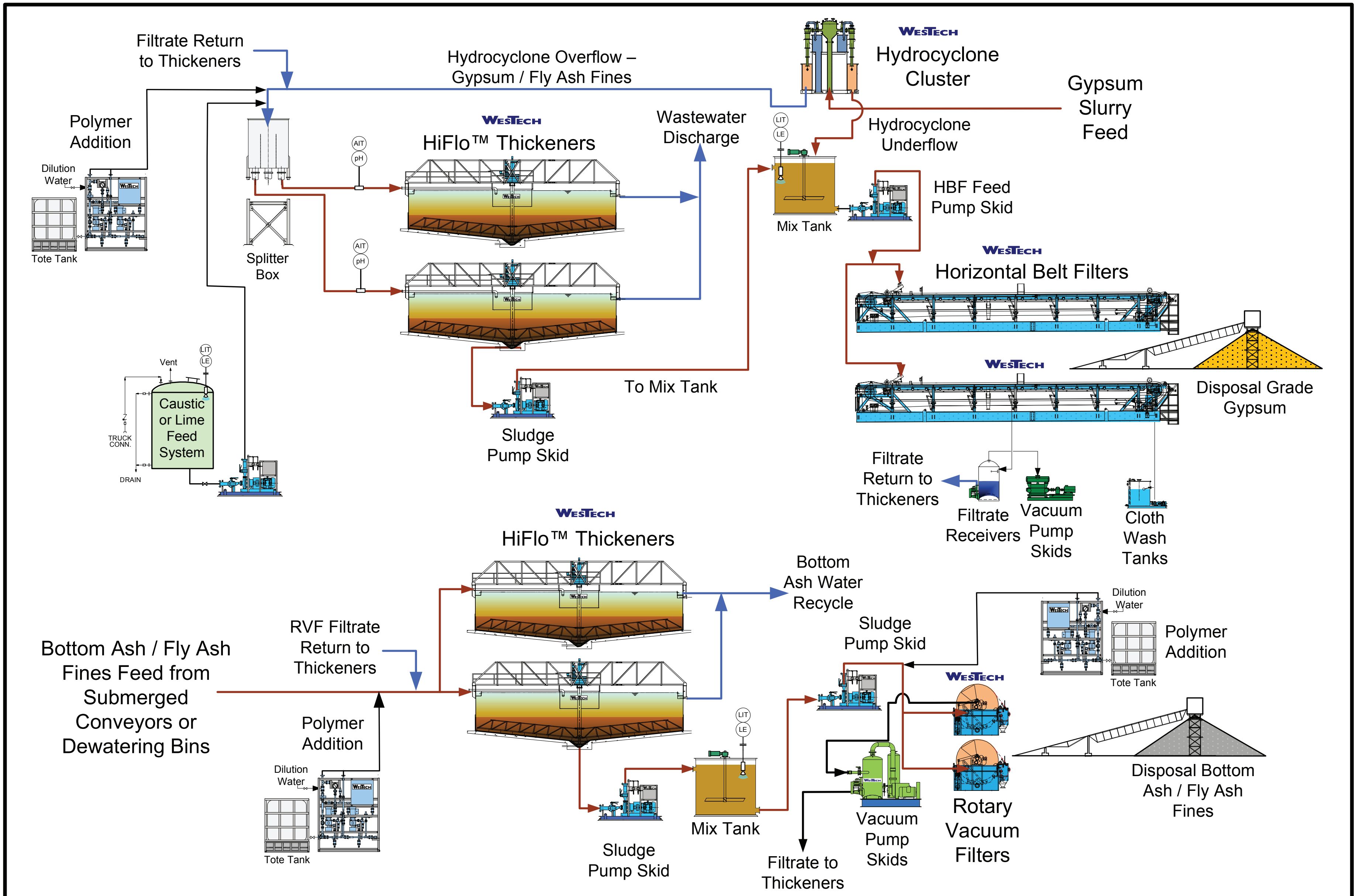
A high-rate or paste thickener dewaters the tails (waste) before disposal in a tailings pond, or as a paste deposition.

Merrill-Crowe Precipitation

A buoyant media clarifier provides initial clarification of the solution. Clarifier overflow is pumped to the polishing filter circuit. The remaining suspended solids in the clarified solution are removed by pressure leaf filters. Diatomaceous earth is used to precoat the filters and as a body feed. Filtered pregnant solution is discharged to the vacuum deaeration column which removes oxygen from the solution in a packed tower.

A zinc feeder with an auger is used for the addition of zinc. The zinc powder displaces the gold from solution. A rich pregnant solution allows for better utilization of the zinc.

Final recovery of the precious metals is accomplished by filtering the solution using filter presses. The recessed plate-type filter press collects the filter cake between the filter plates in the chambers formed by the recessed plates. At the end of the filtration cycle, the free liquid is displaced from the filter cake by an air blow step. The filter press is opened and the cake falls from between the plates. It is then collected and sent to the smelter.



Coal Combustion Residuals – Waste Pond Replacement

WesTech

DWN: **RCS** DATE:

WesTech's ***Horizontal Vacuum Belt Filter*** is a continuous vacuum filter unit operating on a horizontal plane. Slurries are fed from above onto a filter cloth supported by a traveling drainage belt. The unit utilizes both vacuum and gravity to effect rapid separation of liquids and solids. A full range of slurries from coarse granular materials to fine slimes can be filtered. The horizontal belt filter is especially adaptable to the process flow sheet for applications where low cake moisture and multistage or countercurrent cake washing is desirable.

Coal Combustion Residuals (CCR) Waste Pond Replacement

In the wake of dike failures on retention ponds and in the face of new legislation, many coal-fired power plants are opting to eliminate all waste storage ponds. These ponds are mainly for the storage of coal combustion residuals which include gypsum, fly ash, and bottom ash.

This process is further complicated by the fact that pending EPA classification may deem fly ash and bottom ash as hazardous materials. Therefore, some utilities have opted to keep their non-toxic gypsum streams and potentially toxic coal ash streams isolated from one another. This strategy also makes sense if one is going to sell the dewatered gypsum to the wallboard market.

Gypsum

The major process steps for gypsum recovery are:

A. Hydrocyclones

The first step in this process is to send the gypsum stream to a bank of hydrocyclones. Here the solids are separated by means of centrifugal force. The hydrocyclone underflow containing the majority of the solids flows to the sludge mixing tank. The hydrocyclone overflow goes to the thickeners. If this were not done, the percent solids in the thickener underflow would be too great to pump the sludge to the belt filters. Removal of these solids and associated liquid also allows the thickeners to be smaller in diameter, saving valuable real estate and reducing capital expenses.

B. Thickeners

The thickeners receive the overflow from the hydrocyclones as well as the filtrate returned from the horizontal vacuum belt filters. Polymer is added to facilitate thickening in addition to caustic if pH adjustment if required. The sludge is pumped to the sludge mix tank and combined with the underflow from the hydrocyclones. In this application, the thickeners have a dual role of not only settling and thickening solids, but also of clarifying the wastewater stream prior to its discharge. The solids level in this stream must meet the discharge limits of the power plant. This treatment process does not remove heavy metals.

C. Horizontal Vacuum Belt Filters

The combined gypsum sludge streams are mixed and then sent to horizontal vacuum belt filters. Typically gypsum for disposal has a moisture level of 15%. Gypsum for wallboard use has a final moisture level of less than 10%. The filtrate from this dewatering step is returned to the thickeners.

Bottom Ash and Fly Ash

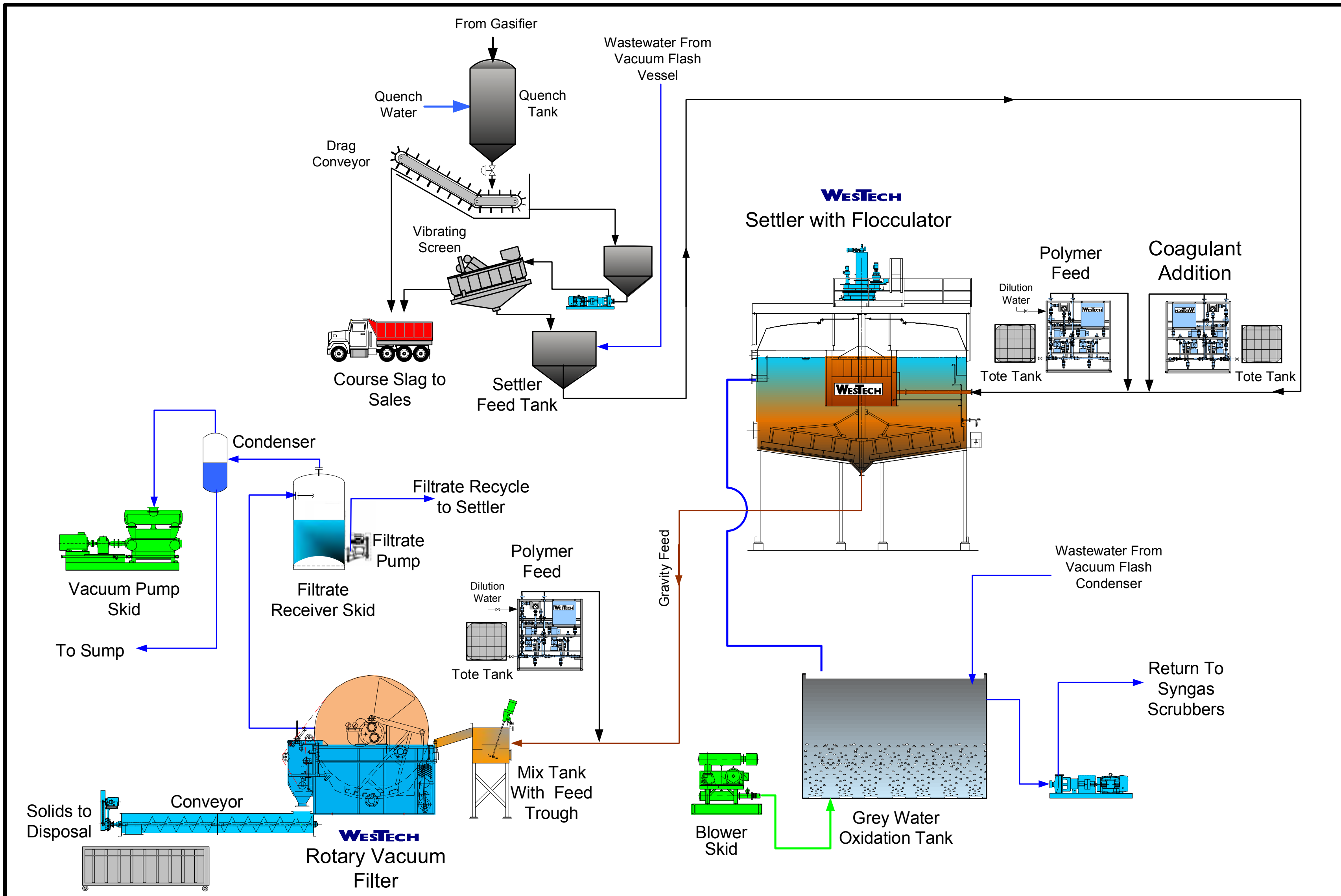
Due to the concern for cross-contamination of either the liquid streams or the residual solids, the ash streams are kept separate from the gypsum stream.

A. Thickeners

The nature and amount of stream solids do not require hydrocyclone treatment, so thickeners are the first step in the ash handling system. Polymer addition promotes solids settling and creates a liquid stream suitable for recycling to the ash handling system.

B. Rotary Vacuum Drum Filters

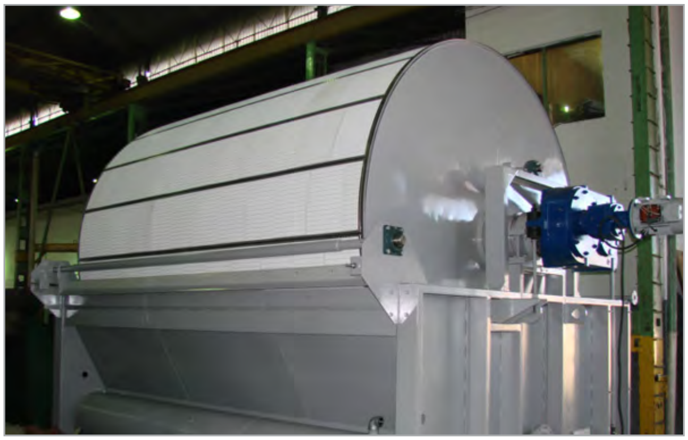
The nature of the ash solids allows dewatering by rotary vacuum drum filters. This saves in capital and installation costs as well as the installation area required. This processed ash contains approximately 15% moisture. It is suitable for sale or landfill disposal.



Coal Gasification – Black Water

WesTech

DWN: **RCS** DATE:



WesTech's ***Continuous Rotary Drum Filters*** offer the operating flexibility to handle dewatering, washing, and filtration applications. WesTech offers a full laboratory with the ability to test water samples from any process. With precise assessment data, WesTech offers process optimization, design, and sizing of the equipment supplied. WesTech Drum Filters are available in sizes up to 13.5 feet in diameter and 36 feet in length. They are engineered for ease of operation and durability to meet the most demanding expectations.

Coal Gasification – Black Water Treatment

The roots of modern coal gasification date back to 1920s Germany where Franz Fischer pioneered the first of what would later be called the Fischer-Tropsch reactions. The Fischer-Tropsch process transforms coal into liquid fuels, including automobile fuel. Sources of feed product may vary and include coal, petroleum coke, tar sands, and biomass. Fischer-Tropsch converts the fuel to a gaseous phase at high temperature and pressure in the presence of oxygen. Hot slag (unburned material) is produced and quenched in water prior to disposal. The "black water" from this quenching process is then treated to remove residual solids and other contaminants prior to reuse.

Coarse Solids Removal

From the gasifier the hot slag passes through a lock hopper mechanism which liberates hydrogen gas while converting paraffin and naphthenes into aromatics and isomers. Quench tank slurry flows to a tank with a drag conveyor which moves the large chunks of slag. Residual water and solids then flow over vibrating screens for further solids removal. The slag from these two steps is then discarded or sold. The vibrating screen effluent is fed back to the settler prior to recirculation.

Settler with Flocculation Mechanism

The stream containing the fine solids from the settler feed tank is treated with a polymer prior to entering the settler. The settler feedwell houses the flocculation mechanism which turns at slow speed, imparting enough energy to facilitate floc formation and rapid settling. The settler tank is covered and insulated to maintain constant temperature. This minimizes temperature differentials between the tank walls and interior which cause unwanted mixing currents that inhibit proper settling.

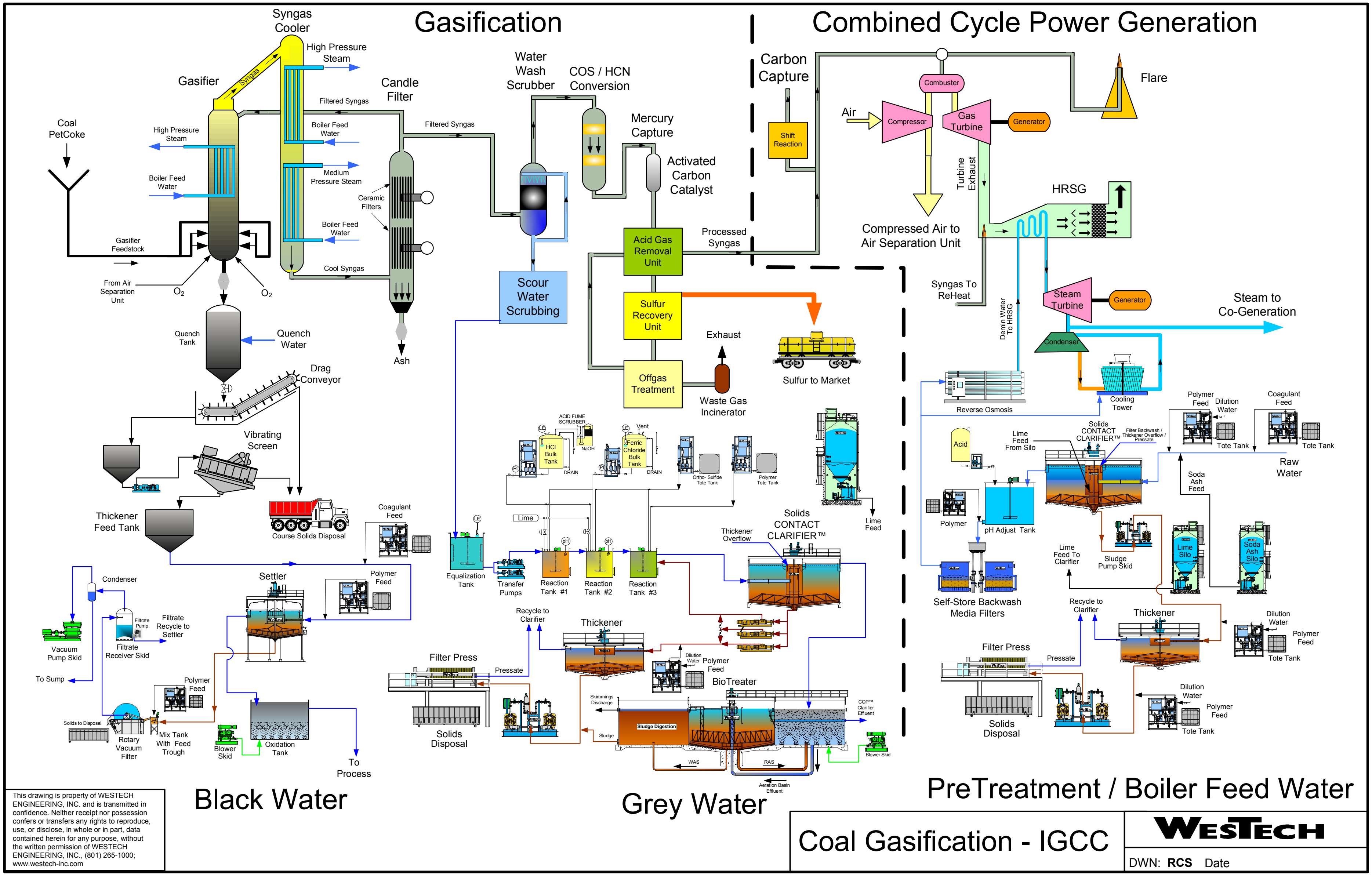
The rake drive for this unit is equipped with a lift mechanism. This lift raises the entire mechanism off the tank bottom if the torque increases. Typical lift is two feet in one-foot increments at preset torque limits. Should this occur, an alarm sounds and a light flashes during each lift sequence. If the increased torque persists, a final alarm is sounded and the mechanism is automatically shut down. Correction of the cause then allows an operator to restart the mechanism. The settler performs three processes in one: it flocculates, clarifies, and thickens in a combined single process step.

Rotary Drum Vacuum Filter

Underflow solids from the settler are gravity-fed to a mix tank where polymer is added. The slurry is then allowed to overflow the mix tank to a rotary vacuum drum filter. Feeding the slurry through a trough eliminates the need for pumping and the possibility of pulp plugging a feed pipe. This gentle handling of the solids allows them to be more easily dewatered on the vacuum filter. The dewatered solids are then collected for disposal.

Grey Water Oxidation Tank

Settler effluent may require oxidation to strip organics or other contaminants. If oxidation is not required, the grey water tank serves as a collection tank settler overflow. In either case, the water is recycled to a variety of steps, including quench water and syngas scrubber feed.


Gasification
Combined Cycle Power Generation
Syngas Cooler
High Pressure Steam
Gasifier
Syngas
Candle Filter
Filtered Syngas
Coal PetCoke
High Pressure Steam
Boiler Feed Water
Medium Pressure Steam
Ceramic Filters
Boiler Feed Water
Gasifier Feedstock
Cool Syngas
From Air Separation Unit
O_2
O_2
Quench Tank
Quench Water
Ash
Drag Conveyor
Vibrating Screen
Thickener Feed Tank
Course Solids Disposal
Coagulant Feed
Water Wash Scrubber
COS / HCN Conversion
Filtered Syngas
Mercury Capture
Activated Carbon Catalyst
Scour Water Scrubbing
Acid Gas Removal Unit
Processed Syngas
Sulfur Recovery Unit
Offgas Treatment
Exhaust
Waste Gas Incinerator
Sulfur to Market
Carbon Capture
Shift Reaction
Air
Compressor
Combuster
Gas Turbine
Generator
Flare
Compressed Air to Air Separation Unit
Turbine Exhaust
HRSG
Syngas To ReHeat
Demin Water To HRSG
Steam Turbine
Generator
Steam to Co-Generation
Condenser
Reverse Osmosis
Cooling Tower
Polymer Feed
Dilution Water
Coagulant Feed
Tote Tank
Tote Tank
Raw Water
Acid
Lime Feed From Silo
Solids CONTACT CLARIFIER™
Filter Backwash / Thickener Overflow / Pressate
Soda Ash Feed
Polymer
pH Adjust Tank
Lime Feed To Clarifier
Sludge Pump Skid
Lime Silo
Soda Ash Silo
Self-Store Backwash Media Filters
Recycle to Clarifier
Thickener
Dilution Water
Polymer Feed
Tote Tank
Filter Press
Pressate
Solids Disposal
Dilution Water
Polymer Feed
Tote Tank
Condenser
Vacuum Pump Skid
Filtrate Receiver Skid
Filtrate Recycle to Settler
Settler
Polymer Feed
To Sump
Polymer Feed
Solids to Disposal
Rotary Vacuum Filter
Mix Tank With Feed Trough
Blower Skid
Oxidation Tank
To Process
ACID FUME SCRUBBER
HCl Bulk Tank
NaOH
Ferric Chloride Bulk Tank
Vent
DRAIN
DRAIN
Ortho- Sulfide Tote Tank
Polymer Tote Tank
Lime
Lime Feed
Solids CONTACT CLARIFIER™
Thickener Overflow
Equalization Tank
Transfer Pumps
Reaction Tank #1
Reaction Tank #2
Reaction Tank #3
Recycle to Clarifier
Thickener
Filter Press
Pressate
Solids Disposal
Dilution Water
Polymer Feed
BioTreater
Skimmings Discharge
Sludge Digestion
Sludge
WAS
RAS
COP™ Clarifier Effluent
Blower Skid
Aeration Basin Effluent
Black Water
Grey Water
PreTreatment / Boiler Feed Water
Coal Gasification - IGCC
WESTECH
DWN: RCS Date
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Paste Thickeners are used within existing coal plant operations to thicken product and to handle coal refuse. Reclaimed water at the paste thickener reduces makeup water costs as compared to high-rate thickening. High operating and chemical costs of filters can be eliminated with the use of paste technology. Coal refuse paste provides safe impoundment of tailings without the requirement, expense, and safety hazards of a water-retaining dam. Operations to extract coal from existing refuse ponds have also successfully used paste technology.

Integrated Coal Gasification with Combined Cycle Power Generation (IGCC)

Coal gasification, the conversion of coal to liquid fuel, has a long history. One innovation to the process is the addition of a combined cycle power generation system. As in the traditional combined cycle power plant, a gas turbine is used as the first means of power generation. In this case, the gas turbine is fired by the syngas of the gasification plant. The syngas is also used to heat the exhaust of the gas turbine, and this heated stream is sent to a heat recovery steam generator (HRSG). The HRSG produces steam which drives a steam turbine, generating further electricity. The waste steam from this process can be used in other parts of the coal gasification process.

Syngas Scrubbing

The syngas produced by the gasifier is scrubbed to remove sulfur and other contaminants. The gas stream then moves on for mercury removal with activated carbon. The waste stream produced by this syngas scrubber is analogous to the wastewater produced in flue gas desulfurization (FGD) at a coal-fired power plant. This is to be expected since the gasifier is "burning" coal or some other fuel source and releasing the same types of contaminants produced in a coal-fired boiler. The scrubber's downstream flow must therefore be treated to remove heavy metals such as selenium, cadmium, and mercury, as well as other process contaminants. However, unlike FGD, there are no gypsum solids produced.

Metals Precipitation

The first step in the treatment process is to precipitate heavy metals. This is most commonly done through the addition of lime slurry, but depending on the size of the waste stream it can also be accomplished with the addition of caustic. In either case, the pH is raised to a level above 11 where metals precipitate as hydroxides. Further reduction of heavy metals may be achieved with organosulfide addition. This precipitates metal sulfides which have much lower solubility limits than hydroxides. This process allows mercury removal down to parts per trillion levels. The resulting pH is normalized with hydrochloric acid. Using hydrochloric acid to adjust the pH prevents the sulfide reintroduction that would accompany the use of sulfuric acid.

Solids CONTACT CLARIFIER™

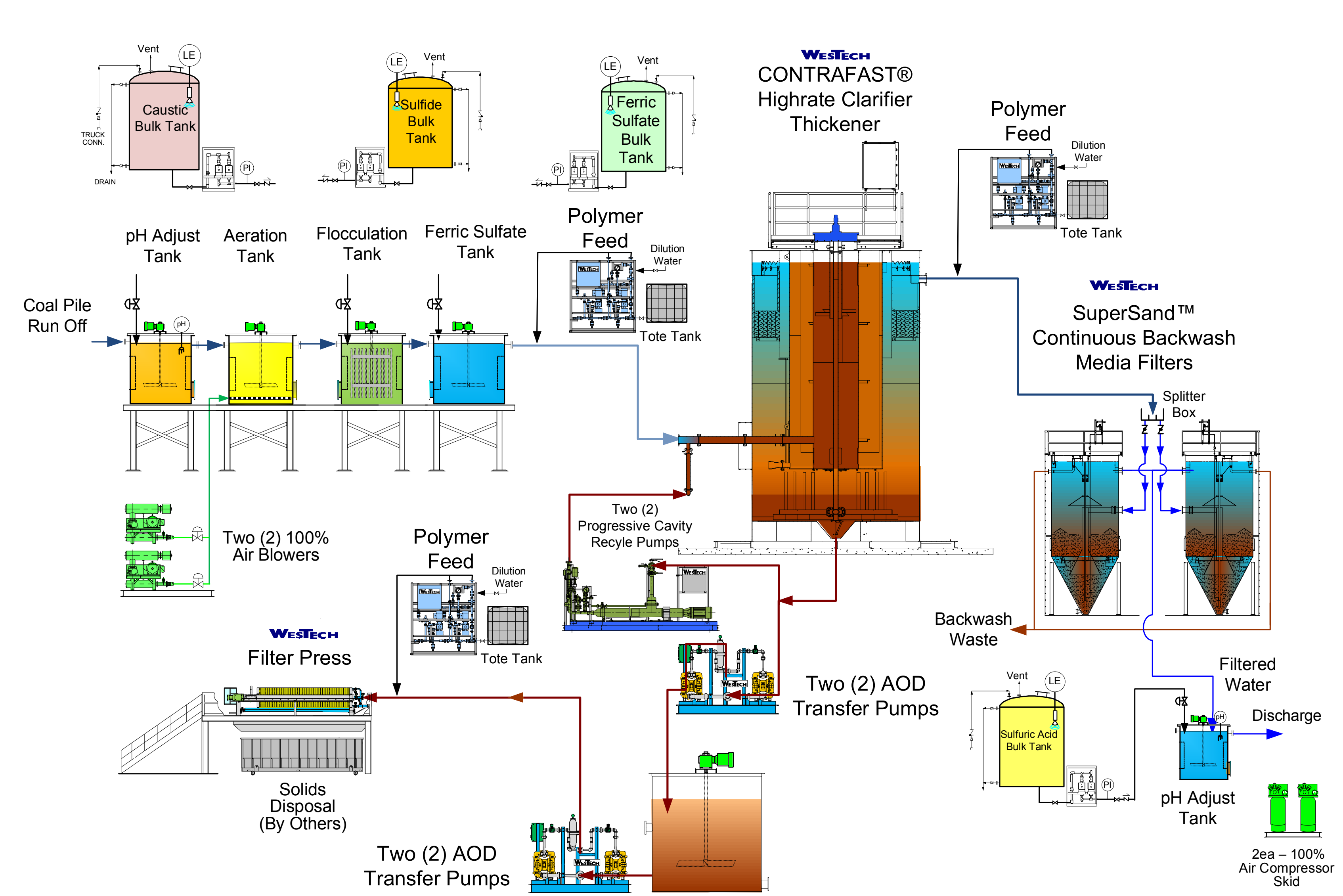
The metal precipitates must now be removed from the waste stream. A Solids CONTACT CLARIFIER™ removes the precipitates from the now very dilute stream. The Solids CONTACT CLARIFIER™ employs an impeller which draws sludge from the tank bottom through a draft tube and into the reaction well. This impeller imparts high flow with low shear. The recycle stream is sized for 10 times the inlet flow and has a suspended solids level of 10,000 ppm. Incoming solids contact previously-flocculated and settled solids resulting in high solid removal rates. A portion of the blowdown sludge from the Solids CONTACT CLARIFIER™ is recycled to a mix tank. This promotes additional floc formation and solids removal.

Sludge Thickening and Dewatering

Sludge from the solids contact unit flows to a traditional thickener and then to a conventional dewatering process. Dewatered sludge containing mercury, metal hydroxides, and sulfides is sent to hazardous waste landfills.

Combined Cycle

The combined cycle power generation portion of the plant has the same water requirements as any combined cycle power plant. The water may require pretreatment prior to ion exchange or reverse osmosis. This pretreatment can take the form of clarification and filtration or may even require lime softening.



Coal Pile Runoff Wastewater Treatment

WesTech

DWN: **RCS** DATE:

The WesTech ***SuperSand™*** is an upflow, moving bed filter that is constructed with various media depths for different applications and configurations. Raw water enters near the bottom of the tank by means of a stainless steel water distributor. Suspended solids are filtered out as the raw water flows up through the media bed. As the filtrate reaches the top of the filter, it passes over the effluent weir and is discharged. A portion of the filtrate is diverted through the sand washer and used for cleaning and transferring the waste solids. SuperSand™ is available as a freestanding unit or as modules for installation in a concrete basin.

Coal Pile Runoff

Pile runoff basins have historically been used for the removal of suspended solids (coal fines) prior to discharge to wastewater streams. However, it was soon found that other contaminants were in this waste stream. Sulfur compounds contained in coal were oxidized by rainwater and produced sulfuric acid. This is analogous to the production of "acid rain" drainage from mine tailings. Water tinged with sulfuric acid leached other impurities from the coal, producing an acidic runoff contaminated with heavy metals.

The desire to eliminate all types of basins and ponds has prompted industry to use more refined treatment systems. Acidic streams containing iron, aluminum, and sulfate are treated for removal of these contaminants. Another driver for segregating and treating this stream is ever-decreasing mercury limits. These limits make it desirable to treat the stream prior to comingling with more conventional wastewater streams.

Wastewater characteristics change with rain events. Streams start out highly acidic but dilute with added rain. Dissolved metal levels also decrease the longer it rains.

Heavy Metal Removal

Some heavy metals are removed as hydroxides by raising the pH. The pH is raised by adding chemicals, typically lime or caustic. Since the waste stream flow rate is small, pH adjustment is usually accomplished through caustic addition rather than lime slurry.

For heavy metals effluent requirements that cannot be met by precipitating the metals as hydroxides, sulfide can be added in addition to the pH adjustment. Metal sulfides have lower solubility than metal hydroxides. In these cases, organosulfides or sodium sulfides dosed into the stream precipitate as heavy metal sulfides. These compounds effectively remove mercury down to parts per trillion levels.

Coagulation / Polymer / pH Adjustment

The addition of ferric chloride neutralizes charged particles, promoting flocculation and enhancing clarifier performance. Ferric chloride also precipitates mercury and organic matter. Polymer addition yields larger flocs, further enhancing clarifier performance. The wastewater is clarified by a CONTRAFAST® Clarifier, while pH is normalized with hydrochloric acid.

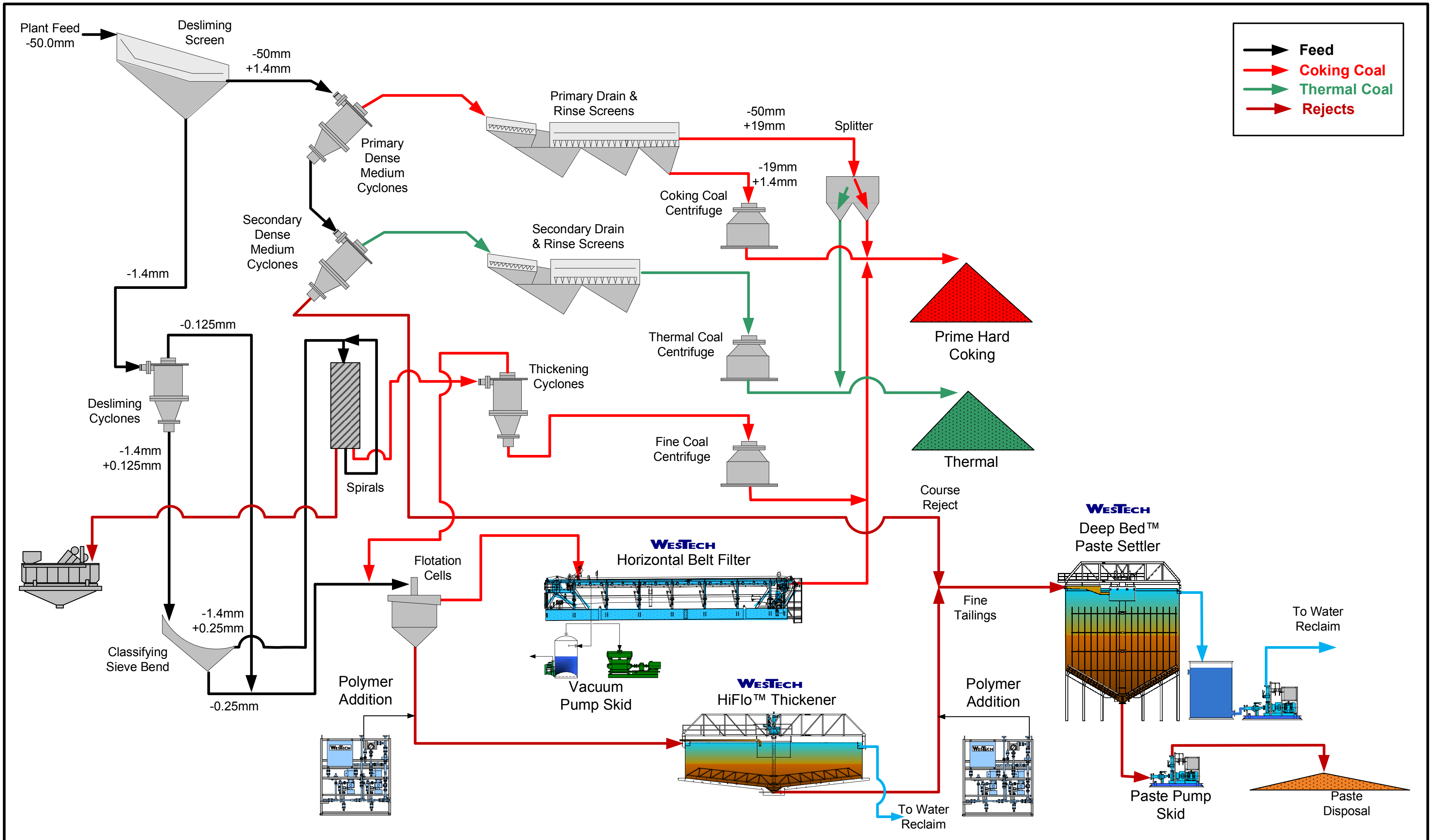
CONTRAFAST®

Raw water, recirculated sludge, and treatment chemicals enter the center draft tube. They are mixed and recirculated within the reactor by a variable speed impeller. The impeller accelerates solids formation and densification. A high-velocity upflow port prevents settling and moves water to the settling chamber.

The water passes under a baffle then upward through settling tubes and into the effluent collection launder. Dense sludge settles to the basin floor where it is continually scraped and further thickened prior to removal. Gravity filtration may be used to achieve even lower suspended solid levels prior to water discharge. In this case, filter backwash is returned to the front of the wastewater treatment system.

Solids Dewatering

Thickened CONTRAFAST® solids are dewatered with recessed chamber filter presses or belt presses without the need for a separate thickening unit. Press choice is determined by sludge volume.



Coal Prep Plant

WesTech

DWN: RCS DATE:

WesTech ***Horizontal Belt Filters*** provide a continuous vacuum on a horizontal plane. Slurries are fed onto a filter cloth supported by a traveling drainage belt. They are especially adaptable to applications where low cake moisture is desirable. WesTech Horizontal Belt Filters have been developed and improved in mechanical design by working closely with engineers and operators with widely variable applications worldwide.

Coal Preparation Circuit

Three quarters of American coal is mined east of the Mississippi River. Half of this is "prepared" coal. Coal preparation offers a number of commercial and environmental benefits. These include increased quality and commercial value of saleable coal by achieving 75-80% ash reduction and 15-80% trace element reduction. Cleaned coal reduces transportation costs as well as reduced quantities of combustion ash requiring disposal. Coal preparation can also make marginal coal supplies suitable for sale.

Conventional coal preparation involves cleaning and separation of coal-rich from mineral-matter-rich particles by size. Typical processes include:

- **Raw Coal Pretreatment**
- **Coal Cleaning**
- **Coal Sizing and Classification**
- **Coal Dewatering**
- **Tailings Treatment and Water Clarification**

Tailings Treatment and Water Clarification

The majority of coal preparation processes require large quantities of water. Exceptions to this include crushing, screening, and transportation. Coal is separated from inert materials using flotation. This yields wastewater rich in coal fines. This water must be treated for solids removal before it can be reused in the plant or discharged.

Horizontal Vacuum Belt Filters

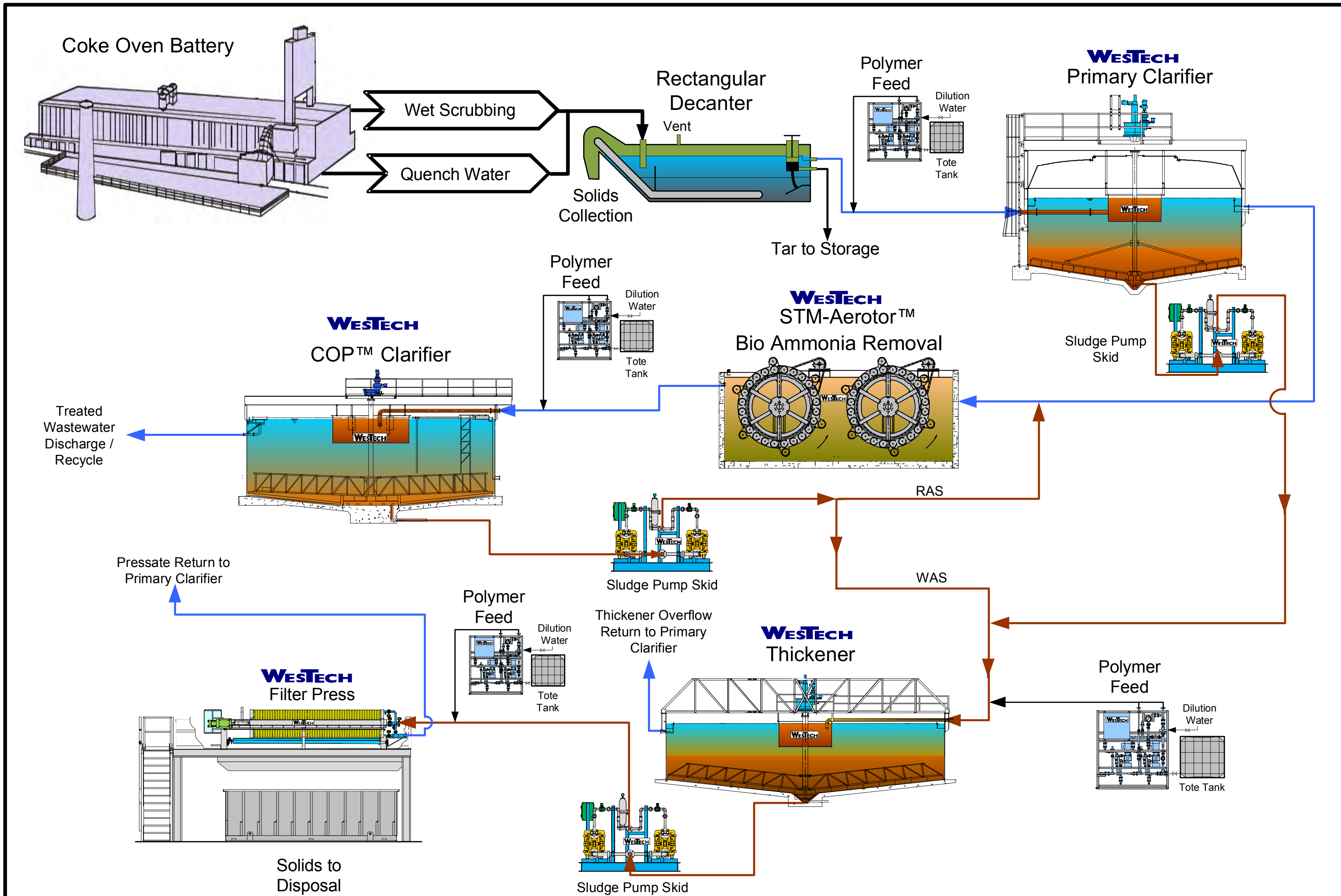
Horizontal vacuum belt filters dewater froth overflow from flotation cells and other process streams. Flotation overflow contains washed and classified coal which must be dewatered prior to sale. Horizontal vacuum belt filters can process large amounts of prepped coal with minimum operator attention.

Thickener

Hydrocyclone overflow and flotation unit underflow solids are removed in a high-rate thickener. The thickener also receives horizontal vacuum belt filtrate that is rich in fine solids. The thickener allows the solids to settle and produces a clarified water stream which can be recycled back to the plant. Polymer is used in the thickener to facilitate large floc formation and increase effluent quality. Thickener underflow has traditionally been sent to an impoundment or tailings pond.

Paste Thickener

Paste thickeners have been placed downstream of conventional thickeners as a result of recent improvements in paste technology. Paste thickeners produce thick underflow "paste" which is stable and will not flow or leach material when exposed to rain. This allows coal waste impoundment elimination along with the associated costs and risks of maintaining such waste ponds.



Coking Wastewater Treatment

WesTech

DWN: **RCS** DATE:

WesTech's ***STM-Aerotor™ Biological Nutrient Removal*** compact treatment system uses integrated fixed film and activated sludge (IFAS) technology as part of a process that provides biological nutrient removal for industrial wastewater treatment. With each rotation the STM-Aerotor™ captures atmospheric air, transfers it down into mixed liquor, and slowly releases it as coarse bubble aeration. During the rotation, additional cascade aeration elevates the dissolved oxygen in the upper layer of the basin. The slow rotation, intense air release, and peripheral mixing paddle of the STM-Aerotor™ create the optimum biological conditions for nutrient removal.

Coke Wastewater Treatment

Heating coal over 1100 C° in the absence of oxygen produces metallurgical coke. This process provides both heat and carbon (coke) required for iron production. During this process the volatile materials contained in the coal are driven off, leaving coke as the product.

Gas produced by coking is withdrawn by means of blowers to recover energy-rich byproducts, including methane. Ammonia stills are the principal means of recovery. Recycled scrubber water is used as a coolant. Scrubber waste streams contain tars, organic matter, sulfides, cyanides, inorganic salts, suspended solids, phenols, and ammonia. Treatment of this wastewater involves removal of suspended solids and chemicals that are toxic to biological systems, followed by biological treatment.

Primary Clarifier

Coking wastewater is fed into a rectangular decanter to remove large particles, including tar. Wastewater exiting the decanter is treated with polymer and coagulant before entering a primary clarifier. The primary clarifier facilitates suspended solids settling out from the wastewater stream. This unit is normally covered to prevent the escape of ammonia and volatile organics, which are regulated by EPA and may be explosive.

STM-Aerotor™

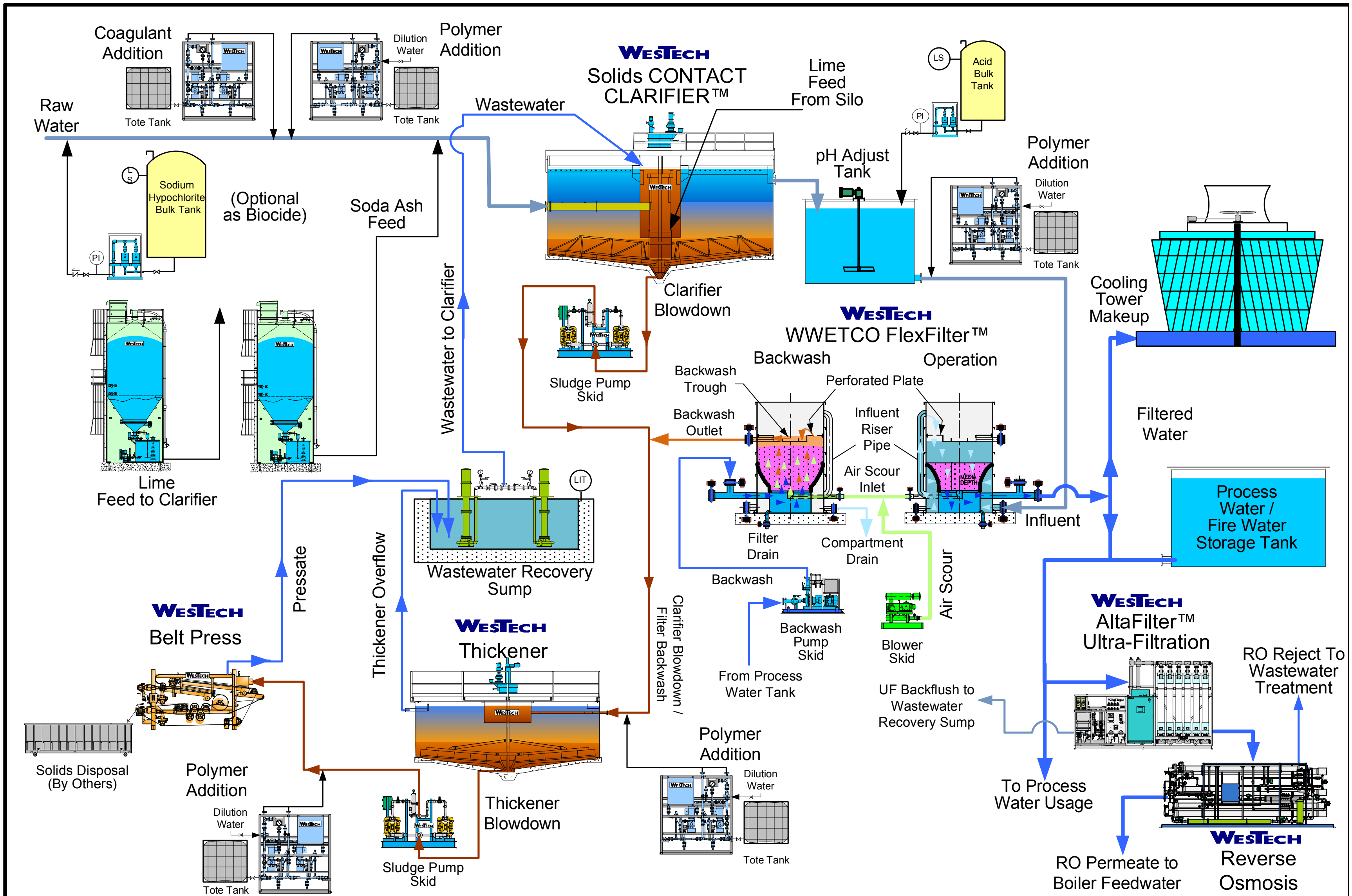
The primary clarifier effluent flows to biological treatment in an STM-Aerotor™. The STM-Aerotor™ removes the ammonia and organics from the wastewater with a fixed film and activated sludge process. Supplementing this wastewater with phosphate promotes proper microbial growth. WesTech recommends an STM-Aerotor™ instead of an activated sludge system for the following reasons:

- **It has lower operating costs.**
- **It is easier to operate since no blowers are needed.**
- **The combination of fixed film and activated sludge makes the system more robust and more resistant to toxic shock.**

COP™ Clarifier

Wastewater exiting the STM-Aerotor™ flows to a COP™ Clarifier for organic matter removal. COP™ Clarifier underflow is split into return activated sludge (RAS) and waste activated sludge (WAS). RAS flows to the STM-Aerotor™, while WAS is sent to a thickener. COP™ Clarifier effluent may be recycled or safely discharged. This effluent may also be polished by a multimedia filter for better clarity.

The primary clarifier's underflow and the waste activated sludge from the COP™ Clarifier are treated with polymer and then fed into a thickener to thicken the solids. The thickener effluent overflow is recycled back into the primary clarifier. The thickener's underflow is again treated with polymer and sent to a filter press for dewatering. Filter pressate is recycled back into the primary clarifier while the solids are disposed of.



Cold Lime Softening

WesTech

DWN: **RCS** DATE:

The ***WWETCO FlexFilter™*** from WesTech provides an innovative solution for industrial water pretreatment and/or tertiary treatment. The combination of tapered media compression, porosity gradient within the media bed, and a low flow backwash system make the WWETCO FlexFilter™ one of the most versatile and efficient filters on the market.

Cold Lime Softening

Hard water is water that has high mineral content. The name comes from the hard scale that forms when this water is boiled. It is not harmful to human health, but in the industrial setting it causes costly breakdowns in boilers, cooling towers, and other water handling equipment. The divalent cations Mg and Ca are the most frequently found minerals causing hard water. These ions enter water supplies by leaching from minerals in underground aquifers.

Cold lime softening is the addition of chemicals to remove the calcium and magnesium ions by precipitation. Cold (ambient temperature) lime softening is used when the mineral content of the source water ranges from 150 ppm – 500 ppm. Treatment consists of five steps: Chemical Pretreatment, Clarification, Recarbonation, Filtration and Sludge Treatment.

Chemical Pretreatment

Sodium hypochlorite (bleach) is added to kill any living organisms that may be in the raw water. Coagulant (usually ferric or aluminum salts) is sometimes added to aid particles to come together. Polymer acts as glue and turns individual particles into larger clusters. The larger particles settle faster and form a more concentrated sludge.

Softening and Clarification

Softening is the removal of calcium and magnesium from the water that could leave hard water deposits called "scale." After the chemical pretreatment, the water flows into the Solids CONTACT CLARIFIER™ softener. The softener provides a reaction zone for the hardness causing ions to precipitate. The lime and (sometimes) soda ash are added in the reaction zone just before the feed enters the clarifier. Lime is added to increase the pH to remove calcium and magnesium hardness. Soda ash may be added to remove calcium hardness if the raw water doesn't contain sufficient alkalinity for complete removal of hardness. Settled solids react with lime and soda ash to form larger and faster settling particles. The clarified water flows over weirs and the solids (sludge) are scraped to the center for removal and dewatering. The overflow typically has less than 10 mg/L of suspended solids. The amount of hardness remaining will depend on the water chemistry and proper chemical addition.

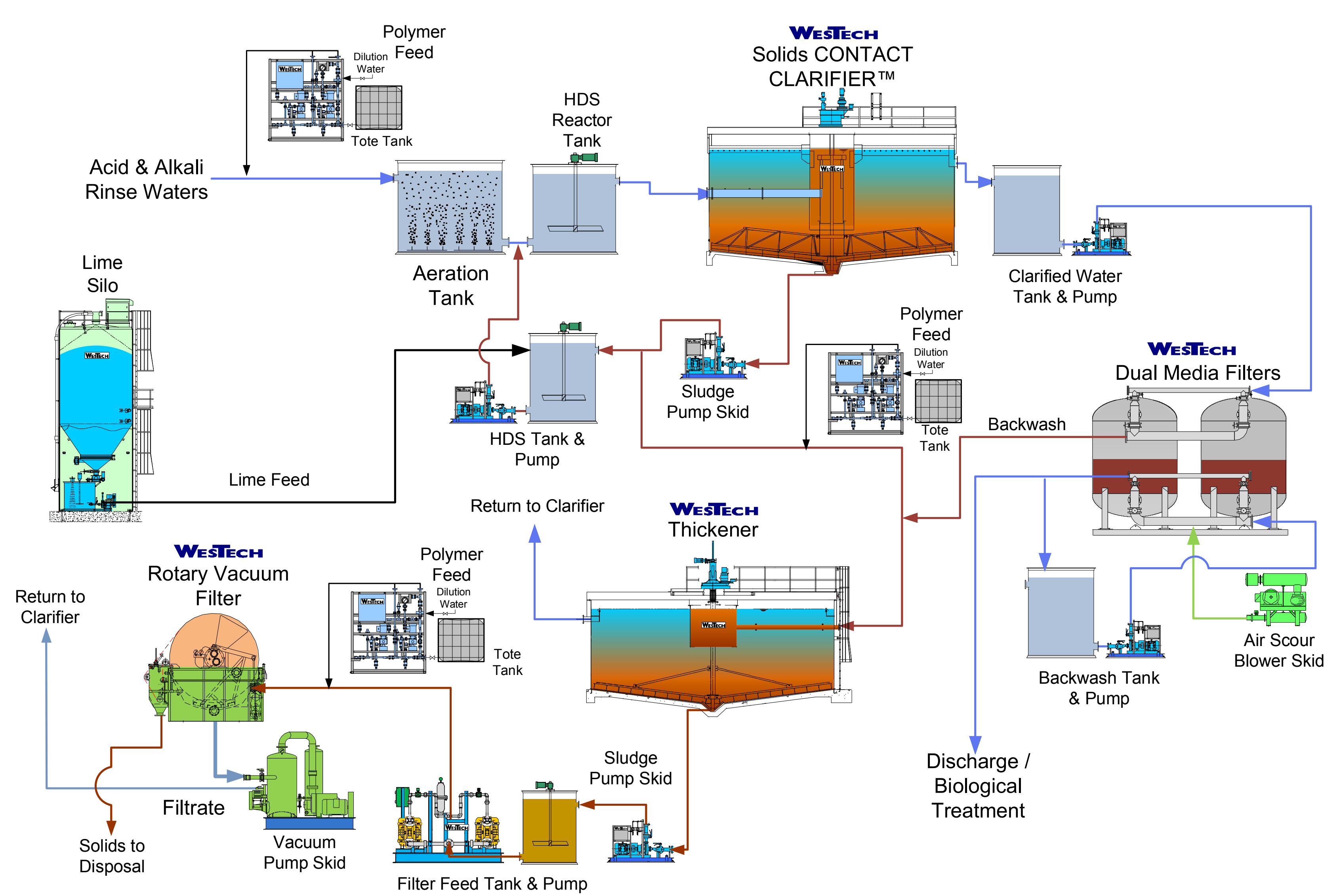
Recarbonation

After softening, the pH is lowered to less than 8 to stop the softening reaction. This prevents what is called "post-precipitation" where softening continues in the pipe and eventually the pipe fills with scale.

Clarifier overflow may be treated by filtration. As the water flows to the WWETCO FlexFilter™, polymer may be added to improve filtration. Filtered water typically has less than 1mg/L of suspended solids. Intended use directs the stream either to a cooling tower or further filtration.

Sludge Treatment

Solids CONTACT CLARIFIER™ underflow is pumped into a thickener. Typically underflow solids are much denser than the clarifier feed with 3-4% solids being typical. Polymer may be added to improve settling and clarity. The thickened underflow is sent to a belt press or other type of vacuum or pressure dewatering filter. The belt press places the solids between two belts and squeezes the water out through a series of rolls. The belt press requires additional polymer to function properly. The resulting cake is then hauled off for disposal. The pressate and cloth wash water are pumped to the wastewater recovery sump along with the ultrafiltration system's backwash and the R.O reject before recycling into the clarifier.



Cold Rolling Wastewater

WesTech

DWN: **RCS** DATE:

WesTech ***Granular Activated Carbon (GAC)*** contactors are an effective means for removal of low-molecular-weight contaminants from aqueous solutions such as those generated in cold rolling mills. They are especially suited for removal of chlorine from industrial waters. When used as pretreatment equipment, these contactors will prolong the life and efficiency of demineralizing ion exchange resins and reverse osmosis membranes.

Cold Roll Mill Wastewater

Industry uses steel cold rolling to harden, reduce thickness, and provide special finishes on steel. Acidic, alkaline, and oily wastewater are discharged during cold steel rolling. Non-degradable organic pollutants are emulsified in the discharged wastewater. These contaminants are introduced by rolling, coating, annealing, pre-pickling, and alkaline cleaning of the steel. Differing steel varieties may also contribute zinc, nickel, copper, tin, chromium, and iron.

The waste streams are combined and aerated to oxidize sulfide to sulfate and ferrous to ferric ions. This decreases their solubility. This step can also provide some preliminary pH adjustment as the rinse stream reacts.

Aeration basin effluent is then sent to the high density sludge (HDS) reaction tank. Here it is mixed with slurry composed of fresh lime and recycled sludge. HDS systems precipitate metals in acidic streams. Recycled sludge mixes with fresh lime slurry in the HDS tank. Sludge particles are coated with lime as pH rises and flocs form. The HDS stream is fed to a Solids CONTACT CLARIFIER™. An internal sludge recycle rate of up to ten times the inlet flow rate facilitates the reaction. The combination of sludge recycling with lime addition reduces heavy metal levels down to dischargeable limits.

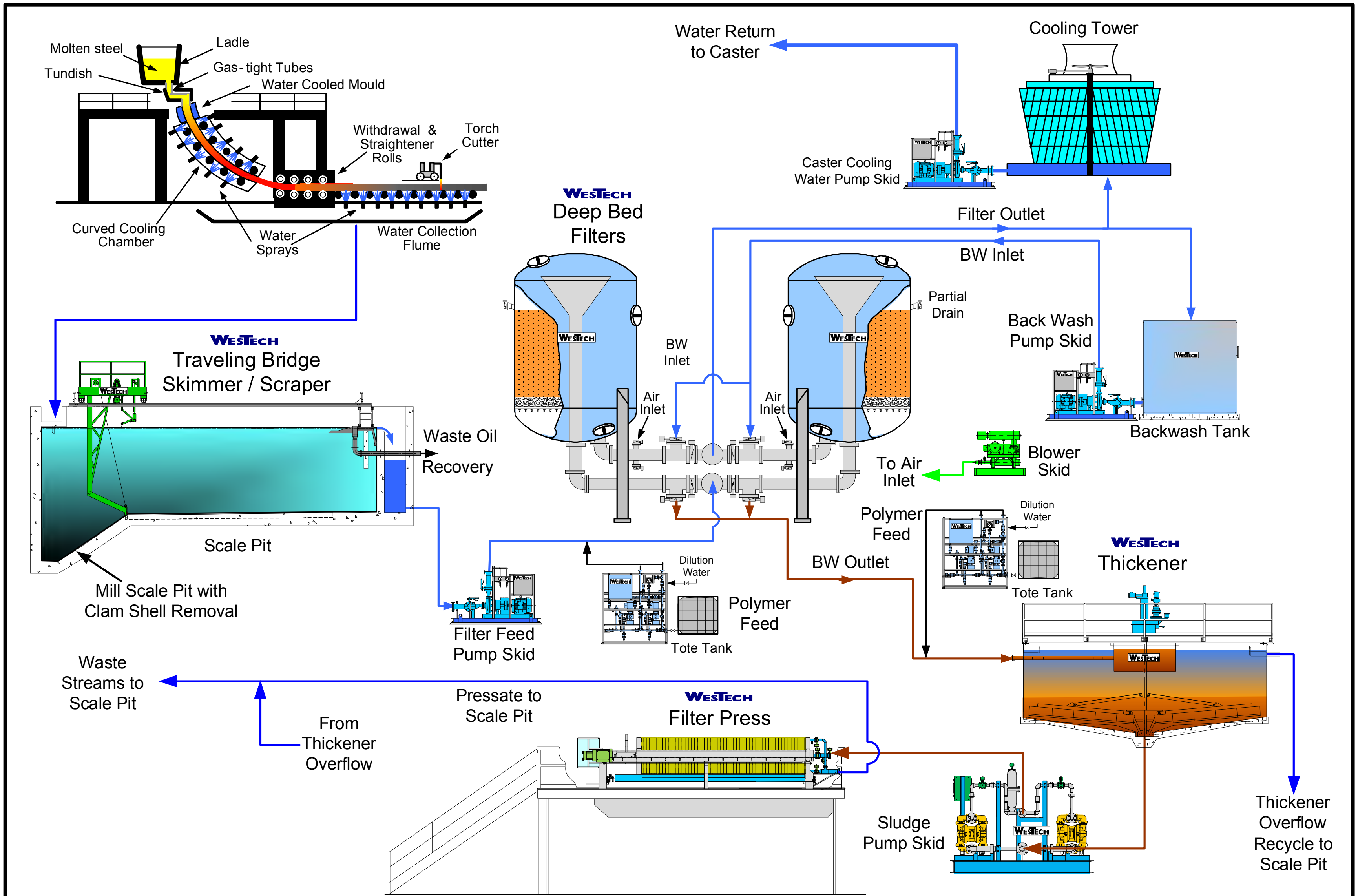
Solids CONTACT CLARIFIER™ effluent is pumped to pressure filters to remove any remaining suspended solids. Activated carbon or biological treatment units may be added if organics are present.

Process sludge is sent to a thickener for densification prior to dewatering. Dewatering may be accomplished using a filter press, belt press, or rotary vacuum filter. A rotary vacuum filter is depicted here. It has the advantage of semi-continuous processing, very dry cake production, and minimal chemical addition requirements.

Additional Treatment(Not Depicted)

Scale removal effluent contains suspended solids and coarse scale. Iron oxides are allowed to settle in a sedimentation basin. Oils rise to the surface and are removed with skimmers and discharged to a collecting basin. Rolling process coolant streams are also collected, treated, and recycled.

Coolant and lubricant streams emerge as emulsions. Emulsion breaking may be accomplished by thermal, chemical, or physical means such as a dissolved air flotation (DAF) or induced gas flotation (IGF). Separation of water and oily phases follows. Electrolytic chemical pre-pickling processes necessitate additional effluent treatment. This typically incorporates chromium (VI) reduction using sodium bisulfite or iron compounds. This converts the chromate to chrome (III) which is much less hazardous and easier to precipitate.



Continuous Caster Cooling Water

WESTECH

DWN: **RCS** DATE:

Pressure filters operate under the same principle as gravity filters, with a few distinct advantages. They require no repumping after filtration, high head losses, and allow for longer periods between backwashes. WesTech's ***Deep Bed Filters*** offer these advantages in addition to allowing the units to process water with even higher suspended solids. The deep bed filters also remove oil from process water. With more than 40 years' experience in pressure filtration, WesTech takes a holistic approach to filtration by offering complete systems.

Continuous Caster – Water Recycle

Since the 1960s, continuous casting has become increasingly important in modern steel production. Today more than 80% of the worldwide production uses this process. Liquid steel flows out of the ladle into the tundish, and then into a water-cooled copper mold. Solidification begins in the mold and continues through the caster and the strand, as it is now called, is straightened, torch-cut, and then discharged for intermediate storage or hot charged for finished rolling.

During the continuous casting process, water and oil are used as coolants. As the steel cools and solidifies, a scale forms on the exterior. This scale, as well as the oil used to cool the steel, combines with the water used in continuous casting to form a wastewater stream. In addition, the caster mold sections are held in place by a high pressure (2,000 psi) hydraulic system. It is not uncommon for a hydraulic line to break, sending hundreds of gallons of hydraulic fluid into the wastewater collection system. Because the wastewater contains these high amounts of scale, particulate, oil, and other possible contaminants, it must be treated before being reused.

Scale Pit

Initially the wastewater is sent to a scale pit with an oil skimmer and solids scraper. The scale pit is used to remove the larger scale and particulate, as well as to skim the oil from the water and is normally sized for 30–45 minutes of retention time. In some mills, this pit also receives wastewater from the hot roll and other miscellaneous processes throughout the mill. This can contribute organics, heavy metals, and other contaminants to the scale pit which must be accounted for in any treatment process.

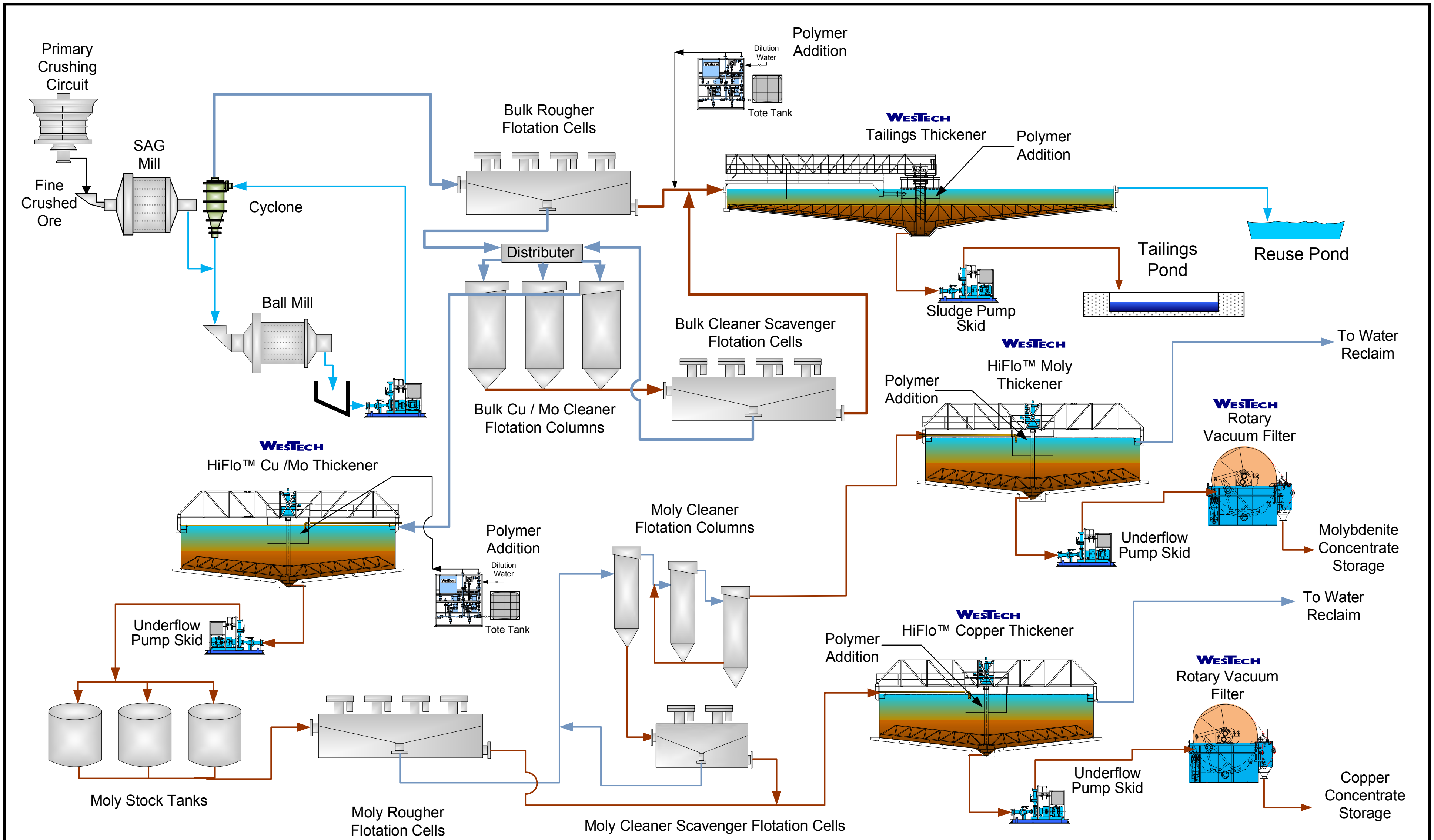
Deep Bed Filter

The pretreated wastewater is then sent to deep bed filters. These filters normally have a single media consisting of a course media bed. The deep bed filters are used to remove the fine particulates suspended in the water and to coalesce the remaining oil. The treated water from the deep bed filter is sent to a cooling tower prior to being reused in the continuous caster process.

Thickener and Filter Press

In order to reuse as much water as possible, the deep bed filter's backwash water is further treated. This water stream is treated by a thickener which is followed by a filter press. The underflow from the thickener enters the filter press. The effluent from the thickener and the pressate from the filter press are both recycled to the scale pit.

The EPA is currently revising the water effluent guidelines for the iron and steelmaking industries. These revisions may result in a reduction in the allowable limits for discharges from the continuous caster water treatment facilities. It is expected that these changes will reduce the discharge limits of metals such as nickel, chromium, lead, and zinc, and could well require additional water treatment equipment for continuous casting operations.



Copper / Molybdenum Flotation Circuit

WesTech

DWN: RCS DATE:

The copper-molybdenum flotation circuit requires multiple thickeners. WesTech has a worldwide installation base with application experience across the spectrum for minerals and industrial high rate thickening applications. ***HiFlo™ High Rate Thickeners*** are designed to operate at a high solids throughput with a smaller surface area compared to conventional thickeners. Achieving consistent underflow and a clear supernatant is made possible in high rate thickeners with the efficient use of flocculant, proper feed dilution, and sufficient time for solids retention and clarification.

Copper / Molybdenum Flotation Circuit

Molybdenum (moly) is often produced as a byproduct of copper mining. Copper is used for electronics, construction, and metal alloys. Moly is mostly used to make metal alloys, and as a catalyst.

As markets need copper and moly, their ores are separated, concentrated, and sold separately. This separation and concentration of copper and moly is called the "copper-moly flotation circuit."

Flotation – Sulfides

Copper and moly are often found together as sulfides*†. Sulfides in solution will float or sink with the right combination of chemicals and gas bubbles (froth flotation).

These sulfide ores are separated from gangue (waste) material, then from each other, by froth flotation.

Copper /Molybdenum Flotation Circuit Steps:

Grinding

Grinding mills liberate the ore from the gangue material (non-ores: silica, organics), and reduce it to an optimal size for flotation. Water mixes in to form slurry. This helps both in the transportation and separation of the solids.

Bulk (Copper-Moly) Flotation

Both the copper and moly sulfide ores together (bulk) float in rougher flotation cells, then cleaner column cells, and often scavenger cells. These groups of flotation cells work together to give a high total yield of the bulk ore, which is sent on to be thickened.

Tailings (Gangue) Thickening / Dewatering

The underflow gangue (waste) from the rougher and scavenger cells flows to a tailings thickener to recover water for the process. Filters dewater these tails further, or a tailings pond stores them.

Bulk (Copper-Moly) Thickener

A high-rate thickener dewaters the bulk of copper-moly concentrate before more separation.

Moly Flotation

The moly flotation circuit has similar groups of flotation cells with chemicals to float the molybdenite (moly concentrate), and settle out the copper sulfides (copper concentrate).

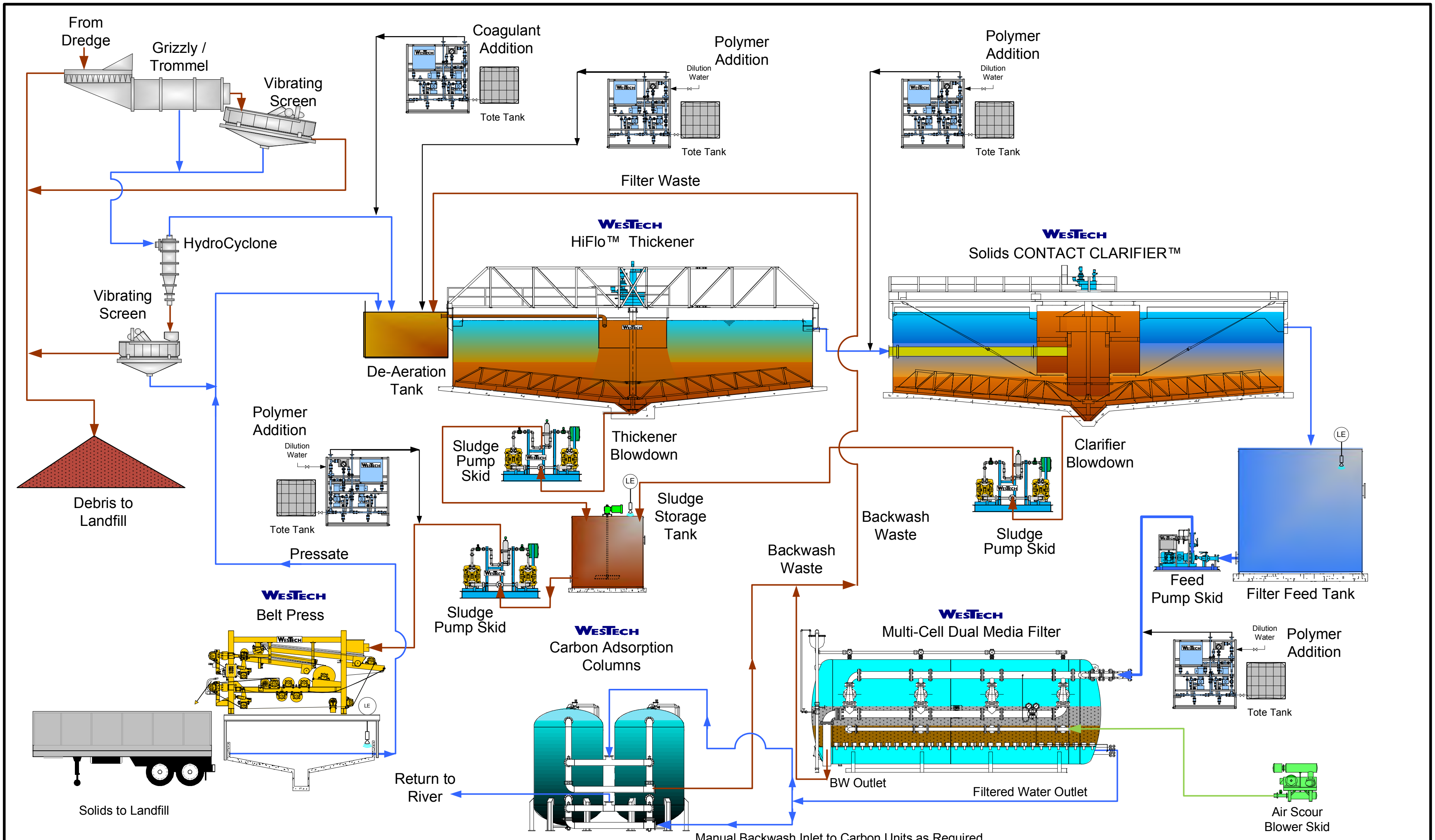
Copper Thickening / Dewatering

A high rate thickener thickens the copper concentrate. A vacuum drum (or other) filter dewaters the copper concentrate further before refining or storing until sale.

Moly Thickening / Dewatering

A high rate thickener thickens the moly concentrate. A vacuum drum (or other) filter dewaters the moly concentrate further before refining or storing until sale.

*Moly is found as Molybdenite (MoS_2), and copper is in various combinations with sulfur (eg. Chalcocite (Cu_2S)).
†If copper is found as an oxide, it is not as easy to float. It is typically heap leached with sulfuric acid (dissolved), then removed from solution and concentrated by solvent extraction (SX) and electrowinning (EW).



Dredging for Contaminant Remediation

WesTech

DWN: RCS DATE:

WesTech ***Industrial Filtration Products*** complement any system requiring treatment beyond conventional clarification. Offering more than ten types of granular media filters allows WesTech to provide the appropriate filtration design for your specific application. This flexibility means you get the right solution at the lowest cost.

Dredging for Contaminant Removal

Contaminated sediment is soil, sand, rocks, organic matter, or other minerals that accumulate on the bottom of a water body and contain toxic or hazardous materials at levels that may adversely affect human health, aquatic life, or the environment. Major contaminants include polychlorinated biphenyls (PCBs), metal hydroxides, mercury, pesticides, and herbicides. Contaminated sediment is typically dredged, then processed for contaminant removal and solids disposal. The solids are disposed of in a hazardous waste landfill. Many sites present unique challenges and require that site-specific conditions be considered when determining an appropriate site remedy and treatment flow plan.

Initial Treatment

Initially, the dredge slurry passes through a screening process to remove coarse debris which is usually not hazardous. This process can include grizzly screens, washing trommels, vibrating screens, and hydrocyclones which remove large solids and reduce the load on the downstream treatment system.

The liquid phase from this initial treatment is pumped to the deaeration tank prior to the thickener. This tank allows any entrained air to be released from the liquid. It is here that return streams rejoin the process. The remaining solids in the influent stream are coagulated and flocculated for removal in a thickener.

Clarification and Filtration

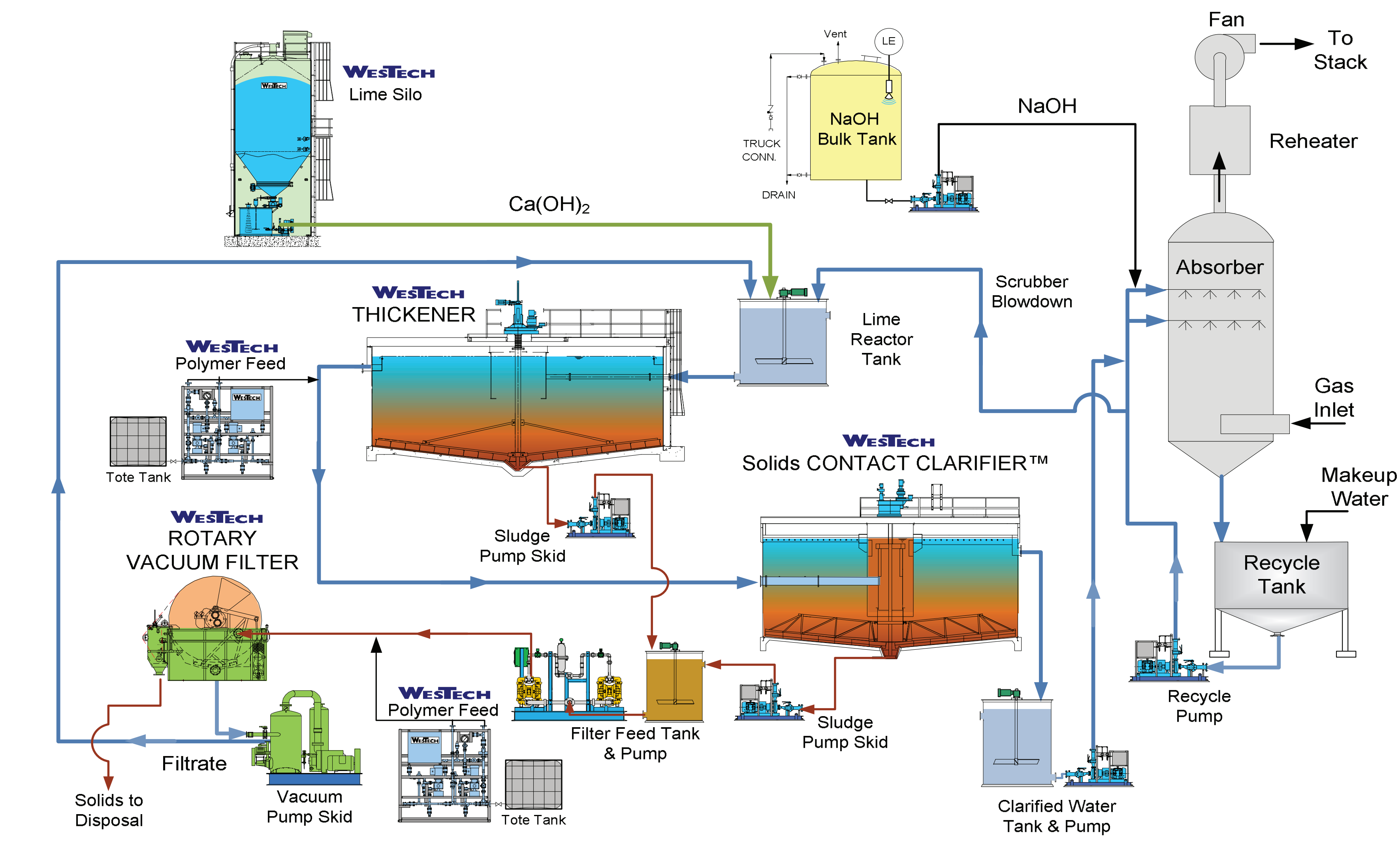
Thickener effluent is further clarified in a Solids CONTACT CLARIFIER™ specially designed with a high internal recirculation rate for optimum flocculation and settlement of fine colloidal solids. The clarifier effluent is polished in a granular media filter to remove any remaining suspended solids. An equalization tank is provided ahead of the filter to allow for periodic filter shutdown and backwash.

Wastewater flow stoppage is avoided by using a MULTICELL® Horizontal Pressure Filter. This filter design divides the filter into as many as eight (8) separate sections. Each section can function separately as an individual filter. This allows the use of the filtrate from multiple sections to be used as the backwash for a single section. The filter thus continues to receive inlet flow, while all of the filtered effluent becomes the backwash outlet flow. This backwash flow is directed to the thickener for solids removal and water recovery.

Volatile Organic Carbon

Activated carbon units are used to remove any remaining volatile organic carbon (VOC). Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, adhesives, petroleum products, pharmaceuticals, and refrigerants. They often are compounds of fuels, solvents, hydraulic fluids, paint thinners, and dry-cleaning agents commonly used in urban settings. VOC contamination of drinking water is a human health concern because many are toxic and are known or suspected human carcinogens.

The solids from the thickener and the Solids CONTACT CLARIFIER™ are dewatered in a belt press or filter press. Solids which will contain toxic or otherwise hazardous materials are disposed of in hazardous waste landfills.



Dual Alkali Scrubber System

WesTech

DWN: RCS DATE:

The ***EvenFlo™ Feedwell*** from WesTech represents the latest advancement in feedwell technology. A properly designed feedwell should provide energy dissipation as well as even distribution of the feed into the thickener. WesTech's EvenFlow design consists of a two part feedwell system. An inner chamber coverts the feed energy into a concentric radial flow. The main feedwell chamber then evenly distributes the feed into the sedimentation zone of the thickener. The result is an efficient, low cost, high rate thickener with a clear effluent.

Dual Alkali Scrubber Wastewater Treatment

Sulfur in the coal is converted to sulfur dioxide (SO_2) when the coal is burned. If the SO_2 is left in the stack gas, it will react with water in the air to form sulfuric acid. This acid is the main cause of acid rain. Sulfur removal from the stack gases has been required since the late 1970s. Scrubbers are one way to remove the sulfur from the stack gas.

The dual alkali design of scrubbing flue gas has been widely used since the early 1980s. As the name implies, two alkalis (sodium and calcium) are used to capture sulfur dioxide (SO_2). This employs an indirect lime process for removing acid from the gas with a sodium-based absorbent.

The sorbent liquor is regenerated with a zero liquid discharge (ZLD) system and is recycled back to the scrubber. Depending on the size of the system, the sodium-based absorbent is most commonly either caustic (NaOH) or soda ash ($Na2CO_3$). Sodium-based alkalis improve mass transfer rate when compared to calcium-based reagents.

Reducing Airborne Pollutants

This process can be effective and economical to reduce SO_2 and other airborne pollutant emissions from process plants such as ore smelters, chemical plants, refineries, paper mills, cogeneration boilers, and hazardous waste incinerators. Operating costs prevent wider use on utility boilers and other larger applications. Gypsum is not a byproduct of this process. Smaller applications often use NaOH as the sodium alkali source.

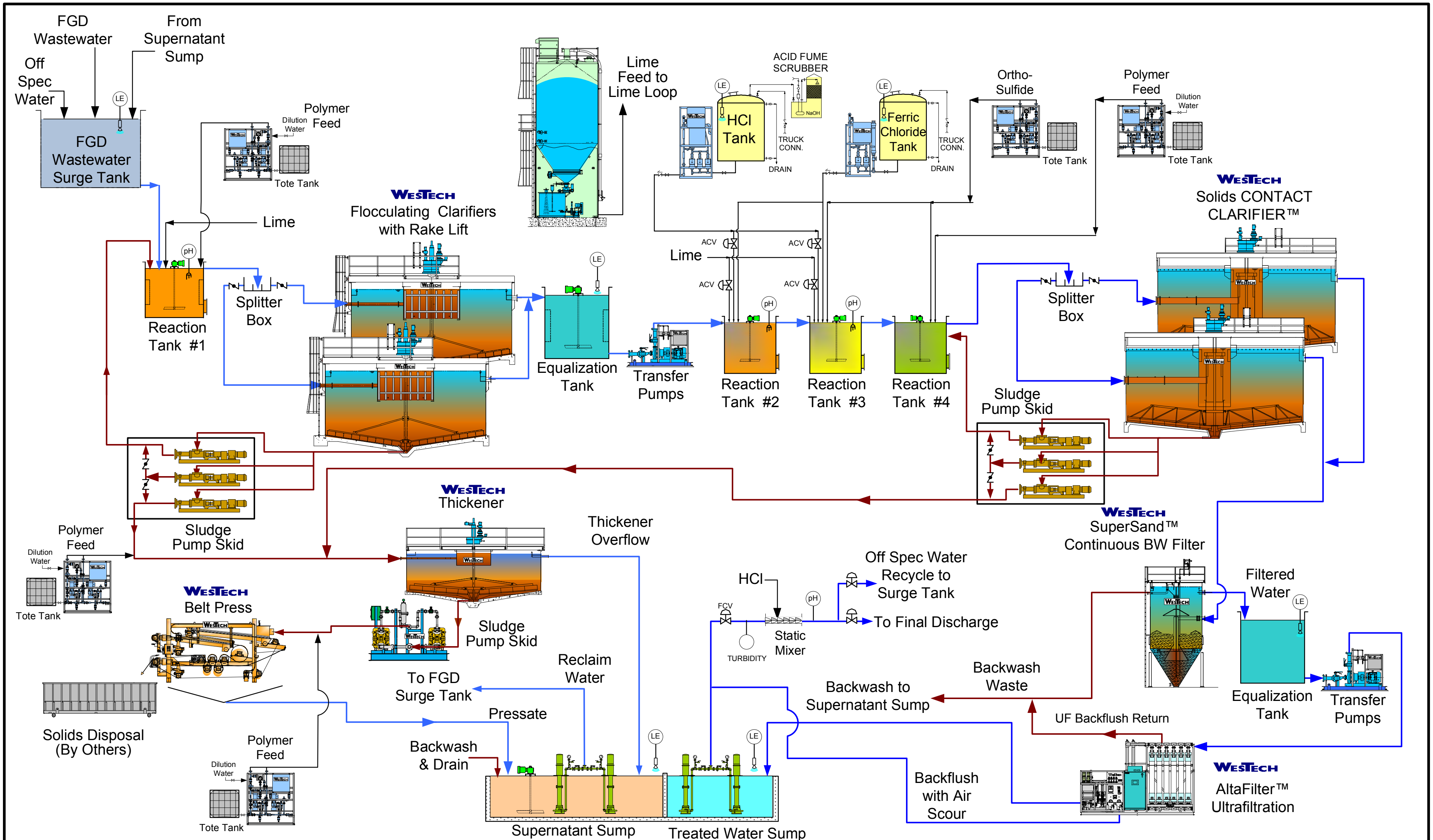
A concentrated dual alkali system may also be used when flue gas sulfur levels vary widely (0.5 – 6%). This absorbent solution concentration does not precipitate gypsum during the absorbent regeneration. The system operates in an unsaturated state with respect to gypsum. A concentrated mode dual alkali plant dissolves sulfur dioxide yielding mostly $NaHSO_3$ as a product.

Lime Reactor Tank

The solution from this absorber section is pumped to the lime reactor tank for regeneration. Slaked lime ($Ca(OH)_2$) is added to increase the pH and precipitate $CaSO_3$. $NaHSO_3$ reacts to regenerate NaOH and Na_2SO_3. Filtrate from the vacuum dewatering filter is also returned to this tank. Sulfates in the system form $CaSO_4$. The final product from the dual alkali plant is a mixture of $CaSO_3$ and $CaSO_4$ in an 80/20 ratio.

Lime reactor tank effluent flows through a two stage clarification process consisting of a HiFlo™ High Rate Thickener and a Solids CONTACT CLARIFIER™. Solids are removed and all reactions are taken to completion. Sludge from these units is combined in a sludge holding tank then fed to the dewatering system.

The mixture of $CaSO_3$ and $CaSO_4$ is filtered using a rotary vacuum drum filter to a moisture content of 30% to 40%. Caustic or soda ash feed replenishes sodium lost in the filter cake. Lime slurry replenishes calcium lost in sludge formation.



Flue Gas Desulfurization (FGD) Wastewater Treatment

WESTECH

DWN: RCS DATE:

The ***SuperSand™ Filter*** employs a backwash rinse that is performed continually while the tank is processing water. An air lift pump located at the center of the module draws the media from the bottom of the filter up into the wash box. As the media is released into the wash box, it falls into the sand scrubber where the filtered solids are separated from the sand. From there, the filtrate carries the solids out as waste. The washed sand falls down into the media bed for continued use.

Flue Gas Desulfurization (FGD), Wet Scrubber, Wastewater Treatment

Flue gas desulfurization removes sulfur dioxide from fossil fuel flue gases. Wet-scrubbing transfers the pollutants to a liquid which is treated before waterway discharge. The scrubbing solution is usually lime and a concentrated solution of calcium sulfate is produced. Blowdown is required to keep the solution below saturation so that scaling does not occur.

5 Steps of FGD Wastewater Treatment

1. pH Elevation / Metal & Gypsum Desaturation

Desaturating the stream of metals and gypsum is important to prevent scaling on equipment and is performed by dilution and lowering the temperature (remember that calcium salts are inversely soluble). The pH of the wastewater stream is then raised to between 8-10 using calcium hydroxide ($Ca(OH)_2$) or sodium hydroxide (NaOH). Dissolved metals form hydroxides which precipitate as solids.

The lime or caustic is added to precipitate gypsum from the stream. Sludge is recycled from the downstream clarifier to provide seed for gypsum crystallization.

2. Heavy Metal Removal

Some heavy metals are removed as hydroxides as pH is raised. Small waste stream pH adjustment is normally accomplished through caustic addition rather than lime slurry. The use of caustic saves capital costs and reduces sludge production.

Organosulfides or sodium sulfides may be added to further precipitate heavy metals. Metal sulfides have much lower solubility than metal hydroxides. These compounds are also very effective in removing mercury down to parts per trillion levels.

3. Coagulation / Polymer / pH Adjustment

Ferric chloride is added to neutralize charged particles, allowing flocs to form and enhancing clarifier performance. This may also precipitate other metals and organic matter. Polymer addition aids in larger floc formation, further enhancing clarifier performance. The wastewater is clarified by a WesTech Flocculating Clarifier. A rake lift is provided since inlet solids can be as high as 2%. The pH is adjusted to normal using hydrochloric acid (HCl). HCl is used because no additional sulfate needs to be added.

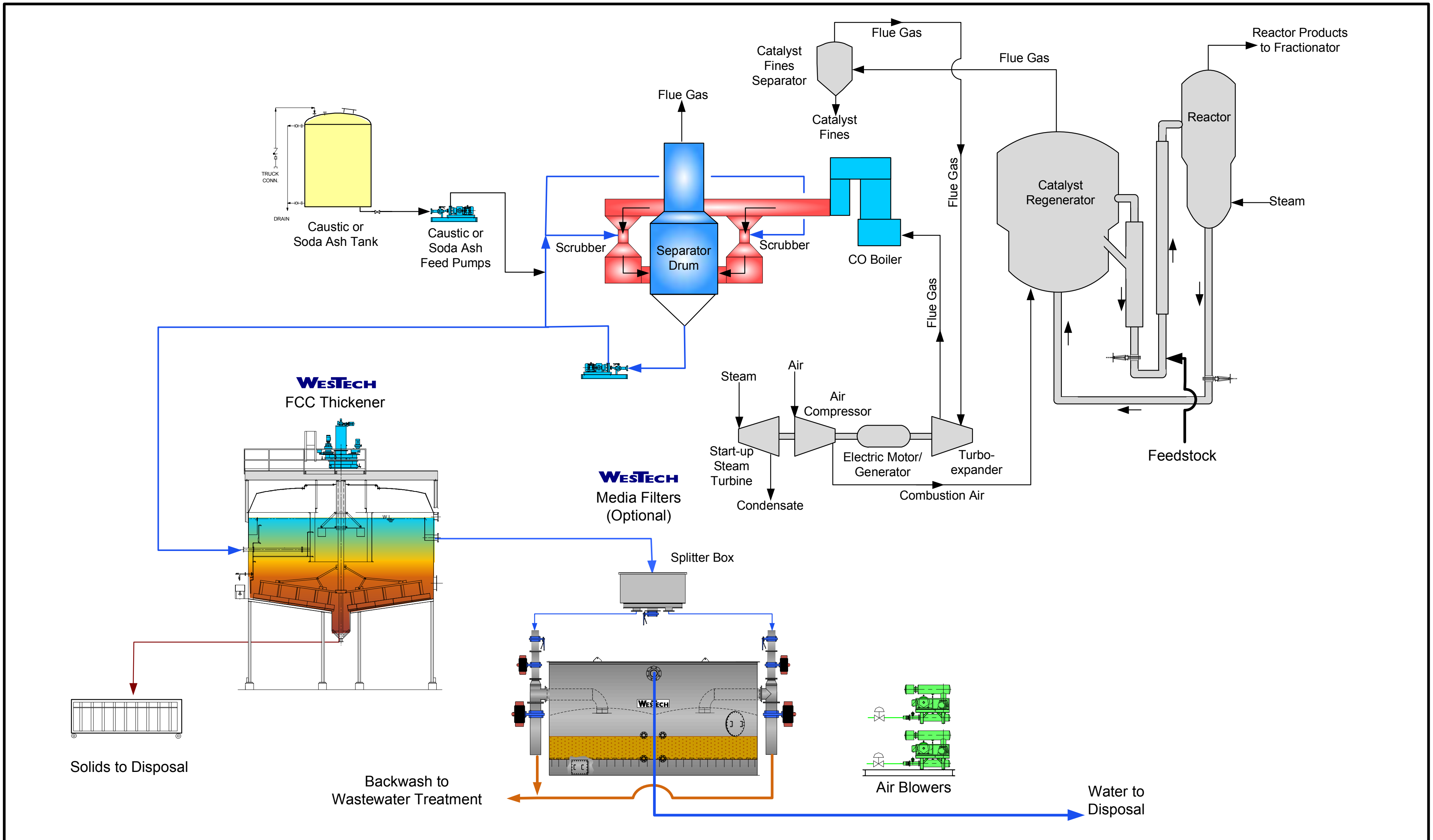
4. Solids CONTACT CLARIFIER™

The metal precipitates must now be removed from the waste stream. Since there is a relatively low amount of solids, it is necessary to use a Solids CONTACT CLARIFIER™ for this purpose. The Solids CONTACT CLARIFIER™ has an impeller-driven sludge recycle stream. This draws sludge from the tank bottom through a draft tube into the reaction well. This impeller acts as a high flow, low shear pump. The recycle stream is sized to 10 times the inlet flow and has suspended solids of 10,000 ppm. Incoming particles contact previously flocculated solids, yielding high removal rates. Blowdown sludge from the Solids CONTACT CLARIFIER™ is recycled to a mix tank in the feed stream. This promotes additional floc formation and solids removal.

Gravity media filtration may be used if a low suspended solids level is required prior to wastewater discharge. In this case, filter backwash is returned to the front of the wastewater treatment system.

5. Solids Dewatering

The clarifier sludge typically contains 3-5 weight percent of solids. This contains inert material and precipitated metals which are pumped to a thickener to increase the solids percentage. Volume dewatering requirements determine the choice of recessed chamber filter presses or belt presses.



Fluidized Catalytic Cracker – Scrubber Blowdown Treatment

WesTech

DWN: **RCS** DATE:

The ***fluid catalytic cracking process*** breaks large hydrocarbon molecules into smaller molecules by contacting them with powdered catalyst at a high temperature and moderate pressure which first vaporizes the hydrocarbons and then breaks them. The cracking reactions occur in the vapor phase and start immediately when the feedstock is vaporized and contacts the catalyst. Flue gasses contain contaminants that are scrubbed out with aqueous liquid. WesTech has developed as an industry leader in clarifying this water, allowing for process recycling and safe environmental discharge.

Fluid Catalytic Cracking (FCC)

Cracking in a refinery is a process where the long organic chains in oil are broken to produce shorter chain organics that are more valuable than the oil. Fluid catalytic cracking (FCC) has generally replaced thermal cracking of petroleum hydrocarbon feed stocks. FCC produces more gasoline with a higher octane rating. FCC's byproduct gases are more olefinic and valuable than those produced by thermal cracking.

The FCC process can also convert heavy oils such as oil sands into lighter, more valuable fuel products such as gasoline. This increases refinery profit and allows a wider range of process feed stocks. The byproduct gas emissions are classified as hazardous waste. Increasingly stringent environmental regulations require the scrubbing of exhaust gases prior to environmental discharge.

Scrubbing

Scrubbing removes particulates including sulfur dioxide (SO_2) and nitrogen oxides (NOx) by washing them from the flue gas stream. NOx is a generic term for the mono-nitrogen oxides NO and NO_2 (nitric oxide and nitrogen dioxide). If released to the atmosphere, NOx reacts to form smog and acid rain. Scrubbing is accomplished by spraying an aqueous scrubbing liquid within the flue gas in a vessel that is part of the stack system. This process is much the same as flue gas scrubbers in other applications such as flue gas desulfurization (FGD). After scrubbing, the clean flue gas is vented to the atmosphere and the SO_2 and NOx-laden liquid flows to the thickener for treatment.

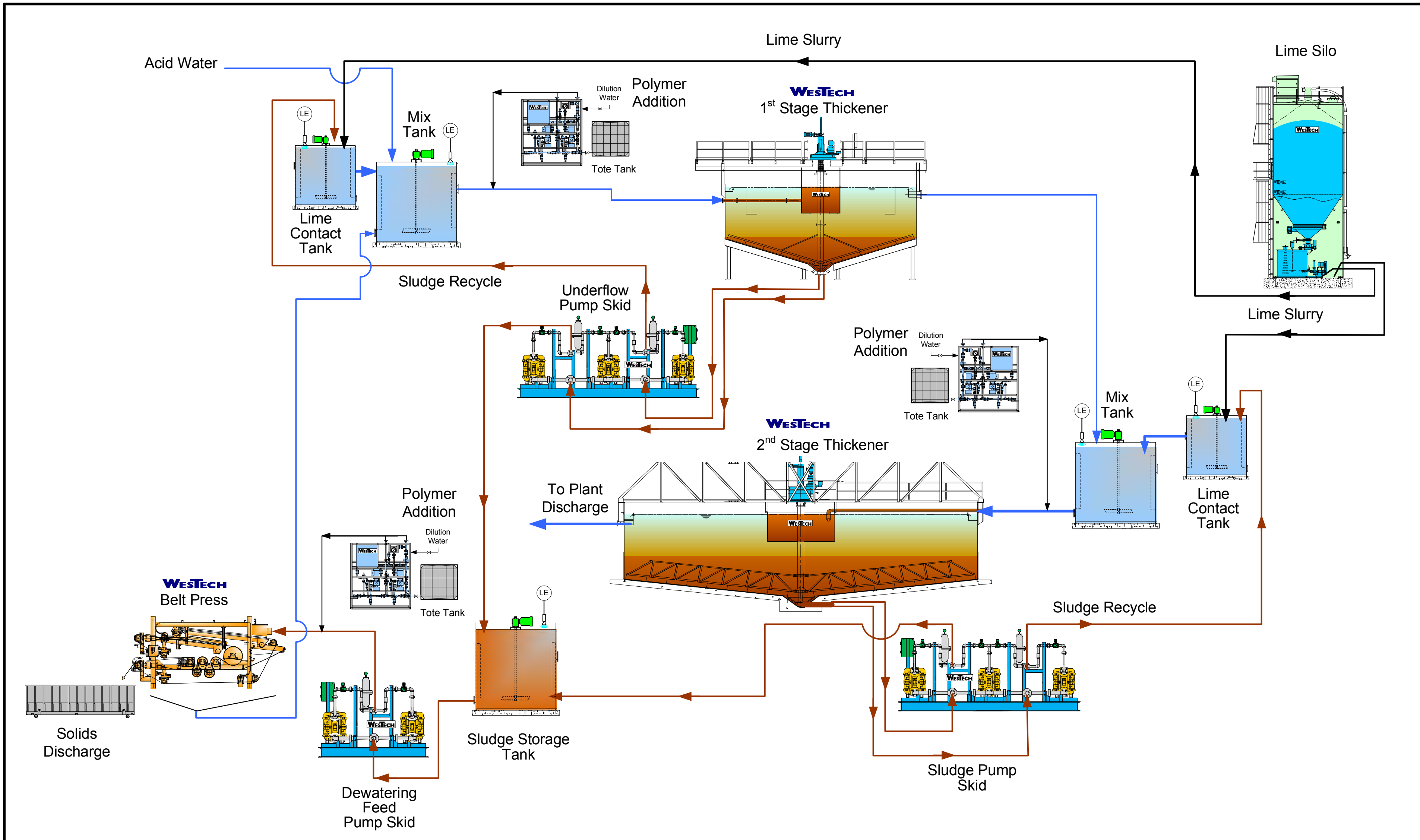
The thickener's flocculating turbine turns at low speed imparting the mixing energy required for inlet stream particles to contact one another in order to form flocs. The mixing energy is carefully engineered so as to avoid shearing the newly formed flocs.

Torque Sensor

A sludge layer is formed in the thickener as solids settle. This is expected and engineered into the thickener design. Nevertheless, it can grow quite heavy in the event of an upstream process upset. This can result in an increased torque load on the rake mechanism. Inadequate sludge removal can also cause torque to increase. In either case, the unit is equipped with a torque sensor which will activate the rake lift motor at preset torque levels. This mechanism will raise the rake assembly twice in one-foot increments, each time actuating an alarm in the control room. If the torque continues to rise after the second lift and alarm sequence, the unit sounds a third alarm and shuts off the rake drive until the problem is corrected.

Insulation

The thickener tank's top and sides are insulated. This is to prevent the liquid near the perimeter and top of the tank from cooling at unequal rates compared with the liquid at the center of the tank. If the liquids are allowed to cool at different rates, thermal currents cause unwanted mixing. If not insulated, these currents would adversely affect the thickener's efficiency. If enhanced clarity is desired, a gravity filter may be used to polish the thickener effluent.



Two Stage Fluoride / Phosphate Removal From Gypsum Stack

DWN: RCS DATE:

The WesTech **_Belt Filter Press_** is used for the separation of solids from liquid. Belt filter presses are primarily used in the dewatering of sludges in the chemical industry, mining, and water treatment. Filtration is obtained by passing a pair of filtering cloths and belts through a series of rollers. The flocculated feed sludge to be dewatered is introduced from a hopper between two filter cloths which pass through a series of rollers. As the belts are fed through the rollers, flocs are sheared, and water is squeezed out of the sludge. When the belts pass through the final pair of rollers in the process, the filter cloths are separated and the filter cake is scraped off both cloth belts into a suitable container. Filter cloths are cleaned throughout the operation of the process by means of water sprays positioned on the return section of the belt.

Two Stage Fluoride / Phosphate Removal From Gypsum Stack

WesTech has experience in the phosphoric acid industry includes clarification, thickening, and dewatering. Calcium fluoride and calcium phosphate slurries present specific challenges. Another challenge is found in plants with hydrofworic acid in their discharge.

Hydrofluoric acid is extremely corrosive and is toxic to humans. At these plants, solids contact clarifiers have been applied instead of external reaction tanks and flocculating clarifiers. These units are designed to prolong the period of precipitation. Solids growth is enhanced by the high level of precipitated solids present during the reaction. This has resulted in denser underflow and lower fluoride levels in the effluent than laboratory predictions. The underflow is sent to a gravity thickener and then to filter presses.

The waste from phosphoric acid plants usually consist of gypsum pile drainage. It is highly acidic with a pH of 1.0 to 1.8.

Two Stage Neutralization

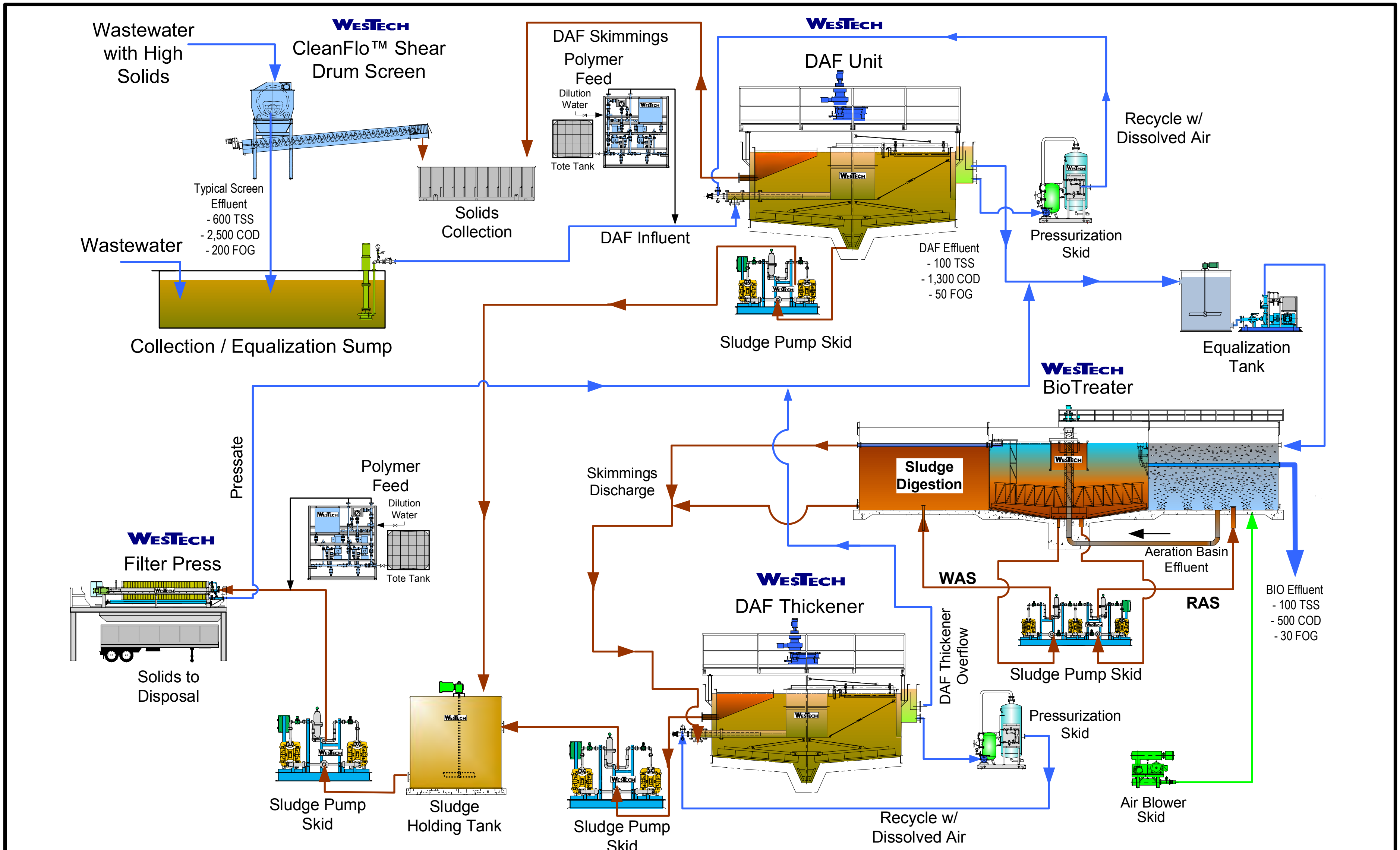
The extremely acidic drainage requires a two stage neutralization system. Clarification occurs between stages. The first stage uses lime to capture fluoride and elevate the pH to 4.5. The second stage pH is then raised to exceed 10.5. This approach reduces fluorine levels well below the mandated levels of 25 ppm. Phosphorus levels are similarly reduced below the 35 ppm limit. Alternative single stage processes fail to reduce fluoride levels below the required maximum.

Historically, calcium fluoride (CaF_2) precipitation required a 60 minute reaction time. Adding previously precipitated and thickened CaP_2 solids to the lime slurry improves the process. Resulting reaction time is reduced and the sludge precipitate is denser. WesTech testing suggests the recirculated solids should be three to five times the precipitated solids. Others have advocated higher recirculation rates.

The reaction slurry contains most of the fluoride plus a good portion of the phosphate. This thickens to produce an underflow with up to 40% suspended solids. Effluent fluorine is now less than 40 ppm and is fed to the second stage. The underflow is discarded usually in ponds, but this practice is being reviewed by EPA.

The second stage recirculates precipitated solids reducing reaction time. Solids, phosphate quantity, and settling characteristics make it impractical to recirculate solids more than once per pass. The solids are thickened to 10% suspended solids. Clarified effluent is discharged to waterways and the underflow is discarded.

Second stage feed liquor and underflow contains phosphate that is essentially free of fluoride. Some of this may be recycled through the process if the plant water balance permits.



Food Processing Wastewater Treatment

WesTech

DWN: RCS DATE:

WesTech ***Rotary Drum Fine Screens*** have been the industry's choice for applications requiring high solids removal efficiency at an economical cost. WesTech's innovation offers direct drive propulsion for drum rotation, eliminating the messy and maintenance-prone chains and sprockets. The primary advantage of drum screens is eliminating debris carryover. Debris remains inside the screen until discharge. Unlike conventional moving media screens, there are no seals with a drum screen. In addition, there is no chance for debris to bypass the screen medium.

Food Processing Wastewater

Copious wastewater is generated in food production. Effluent characteristics and constituents vary widely and require different processing technologies to achieve the required discharge limits. Discharge limits vary further by state and local regulations.

Screening

Food production plant waste streams contain large chunks which require separation. The simplest and most economic process for removing these solids is screening. A number of screen designs exist and facility layout should be a basis for the selection. Models include rotary drum screens, climber screens and channel screens with shaftless conveyors.

Screened effluent is sent to an equalization sump. It may be combined with streams not requiring screening. The various waste streams are seldom continuous in either quantity or quality. Process flows may vary by shift, by product and by cleaning schedules. Stream flow equalization is almost always advantageous. Equalizing flow rates also reduces wastewater treatment equipment size and cost.

FOG

Some plants produce high amounts of fats, oil and grease (FOG). A dissolved air flotation (DAF) unit is an effective means of reducing the FOG and solids levels. DAFs are especially effective for food solids since most food particles float. Floating FOG and solids are skimmed from the DAF unit and recovered for disposal or sale. Skimmed solids do not require thickening.

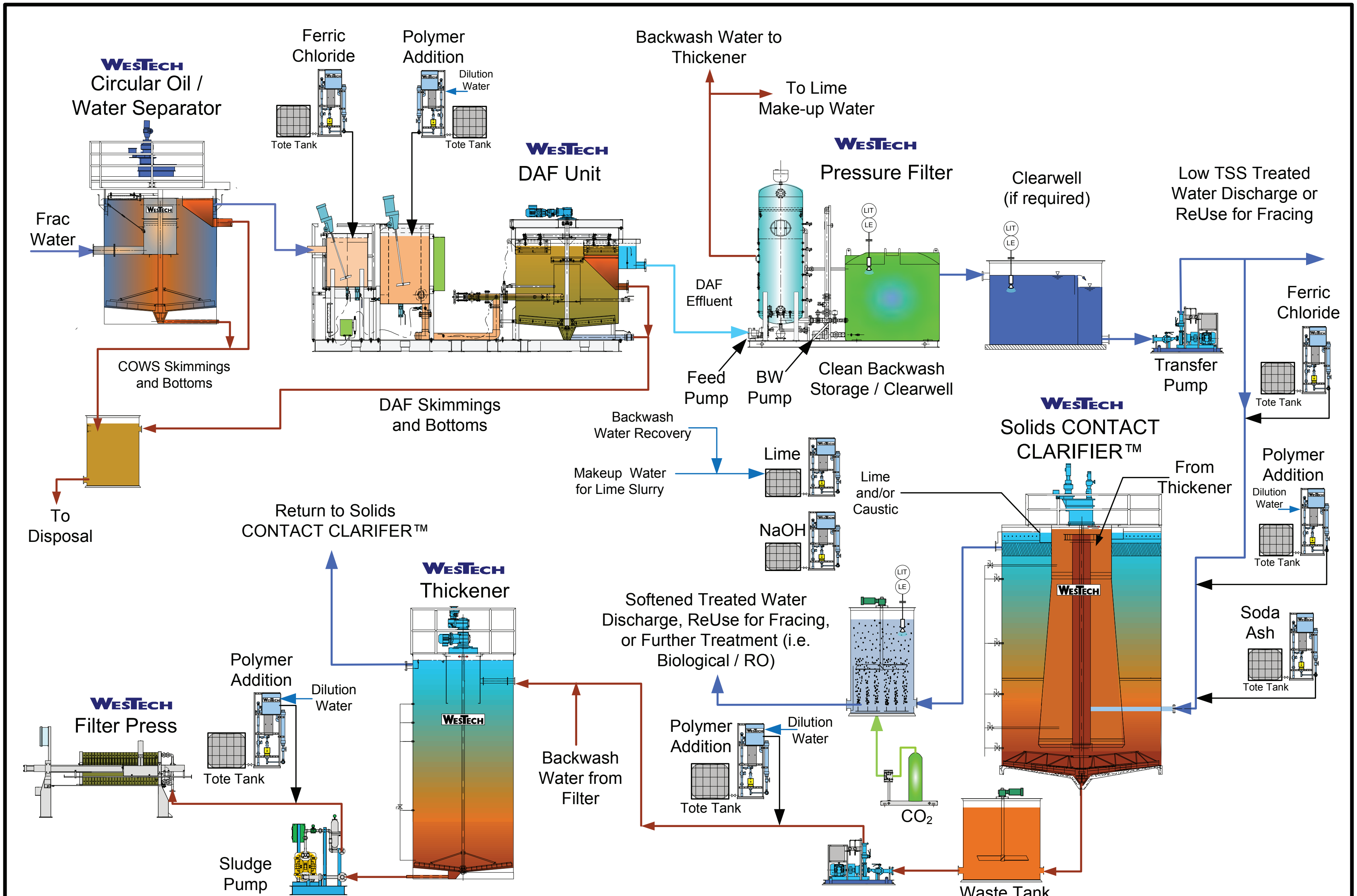
Total suspended solids (TSS), FOG, and biological oxygen demand (BOD) are all significantly reduced by screening and DAF treatment. Nevertheless, there may still be levels of these contaminants which will require further treatment prior to discharge. Contaminant type and level determine treatment options. Waste stream volume, reuse possibilities, and available space will also influence the choice of treatment designs.

Almost all food processing facilities will require biological treatment for BOD removal. If the stream is small or BOD is low, the plant may elect to send the screened waste to a municipal treatment plant. Some wastewater will contain very high BOD (dairy, cheese, etc.) and anaerobic as well as aerobic systems will be necessary.

BioTreater

A WesTech BioTreater™ is an aerobic treatment system that conserves real estate by combining a number of operations. BioTreater is a general term describing a variety of individual treatment processes. The basic concept is that of a tank within a tank using common wall construction. The central tank is normally a COP™ Clarifier which treats the effluent prior to discharge. The outer tank is divided into sections, each performing a separate operation.

Operations may include: equalization, aeration, sludge storage, digestion, and anoxic treatment. Common tank wall design with separated exterior tank sections effectively reduces the tank footprint. Gravity-driven flow reduces the piping and pumping required resulting in capital cost savings. BioTreater sludge is then dewatered on a filter press.



Frac Water Treatment

WesTech

DWN: **RCS** DATE:

Hydraulic fracturing as a method to stimulate shallow, hard rock oil wells began in the 1860s. It was used in Pennsylvania, New York, Kentucky, and West Virginia. Initial efforts used explosive nitroglycerin in oil, water, and gas wells. Non-explosive acid for well stimulation was introduced in the 1930s. Acid etching prevented fractures from closing completely, enhancing recovery. The same phenomenon was later discovered with water injection.

Frac Wastewater Treatment System

Slick water hydraulic fracturing ("fracing") is a technology used to extract natural gas and oil that lies within a shale rock formation thousands of feet beneath the earth's surface. It is done by pumping water, sand, and chemicals at very high pressures into the well. The pressure cracks the rock around the injection site and the sand holds the cracks open after pressure is released.

Fracing Process

The actual process uses multiple steps and several different chemicals. The chemicals will change depending on the company doing the fracing and the characteristics of the formation. In addition, each company has steps that are proprietary, so very little information is available on the chemicals used.

When the pressure from fracing is released, some of the fluids pumped into the well flow back to the surface. In addition to this "flowback" water, naturally occurring (produced) water also flows to the surface. After a short while, natural gas or oil will also flow. With time, the amount of injected water flowing back decreases while the produced water flow increases. A typical frac will use 3–5 million gallons of water and about 1/3 of the water injected will return to the surface.

With all of these variables there is no way to predict water quality and it will change rather quickly for the first two weeks of flow. After two weeks, the majority of the flow is produced water which is regulated differently than frac water.

Methods of Disposal

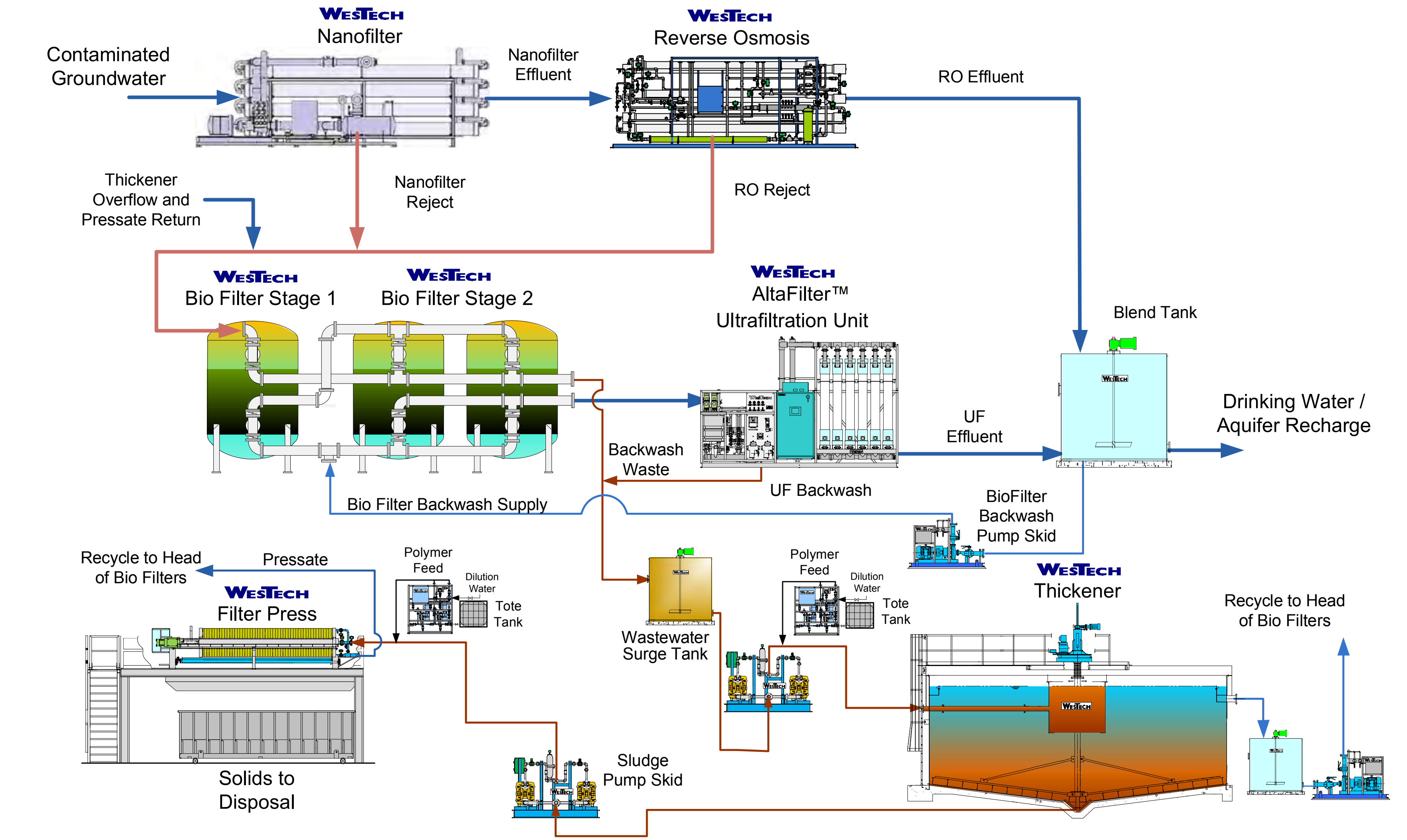
For successful treatment of frac water, the fate of the wastewater must be known. In many states the frac water is injected into regulated deep wells – usually old drained gas or oil wells. The only water treatment usually necessary is filtration. This can be as simple as "sock" filters or as extensive as clarifiers depending on the solids loading.

If no deep wells are available, the preferred method of disposal is reuse. The frac water will be blended with fresh water and used at another site. This seems simple until makeup water requirements are considered. Every fracing company has different requirements, but in general they want low:

- **TSS**
- **Hardness**
- **Metals – particularly barium, strontium, and iron**
- **TDS**
- **Bacteria counts**

If there are a lot of new wells being drilled, the drilling companies will dilute 20:1 with fresh water and not worry about chemistry. When fresh water is not available, or only a few wells are being drilled, the water will have to be treated to meet the service companies' specifications. Since each company has different requirements, treatment processes vary but usually include filtration, chemical precipitation, and softening. Chemical usage is extremely high and sludge production may exceed 20 tons/day for a 200 gpm flow.

When no opportunity for dilution is available, the first few days of wastewater flow can be treated and reused. When the total dissolved solids in the wastewater exceed 10,000 ppm, it can no longer be reused. The only options are deep well injection or zero liquid discharge by using evaporators and crystallizers. Some of the dry waste has been used for road salt but most has to be encased and buried.



Groundwater Contamination Treatment

WesTech

DWN: **RCS** DATE:

WesTech ***Pressure Filtration Systems*** are designed for industrial water treatment where the removal of suspended solids such as particulates, iron, manganese, free oils, mill scale, and other precipitates in ground or surface water is required. Pressure filters are commonly placed after WesTech clarification equipment. When used as pretreatment equipment, these filters will prolong the life and efficiency of granular activated carbon, ion exchange, and membrane systems.

Groundwater Contaminant Removal

The number of contaminants and possible treatment methods for groundwater are vast. Physical, chemical, and biological treatment methods are all used with regularity. Concentrations of contaminants and regulations both vary widely.

Biological treatment has proven to be a low cost and sustainable solution for many water treatment applications. Advantages of biological treatment include low energy consumption, little or no chemical addition requirement, and non-hazardous waste products. Operational challenges exist; balanced biological systems are easily disrupted, and are sensitive to physical and chemical conditions.

Concentration may be necessary in some cases where biological treatment is desired. Solutions include ultrafiltration (UF), reverse osmosis (RO), ion exchange (IX), and electrodialysis reversal (EDR).

If concentrations are low, the contaminated water can be filtered for suspended solids removal and then passed through activated carbon beds (see the VOC removal page for more information).

Groundwater Contamination Steps

Concentration

A number of possibilities exist for concentrating solids to a level that is suitable for biological treatment including UF, RO, IX, and EDR. Evaluation of these processes is based on influent water quality, contaminant to be removed, and chemicals required for the biological process.

Biological Treatment

Biological processes can be fixed-film or suspended growth. They may be aerobic or anaerobic with varying oxidation/reduction potential (ORP).

A number of reactor types have been successfully utilized for biological reactions. These include aeration tanks, trickling filters, bio filters, and rotating biological contactors (RBC). The removal mechanism varies based on the contaminant. It may include substrate utilization, reduction, assimilation, or adsorption. Concentrated water characteristics may require addition of carbon sources, electron acceptors, or nutrients to facilitate biological growth.

Effluent Polishing

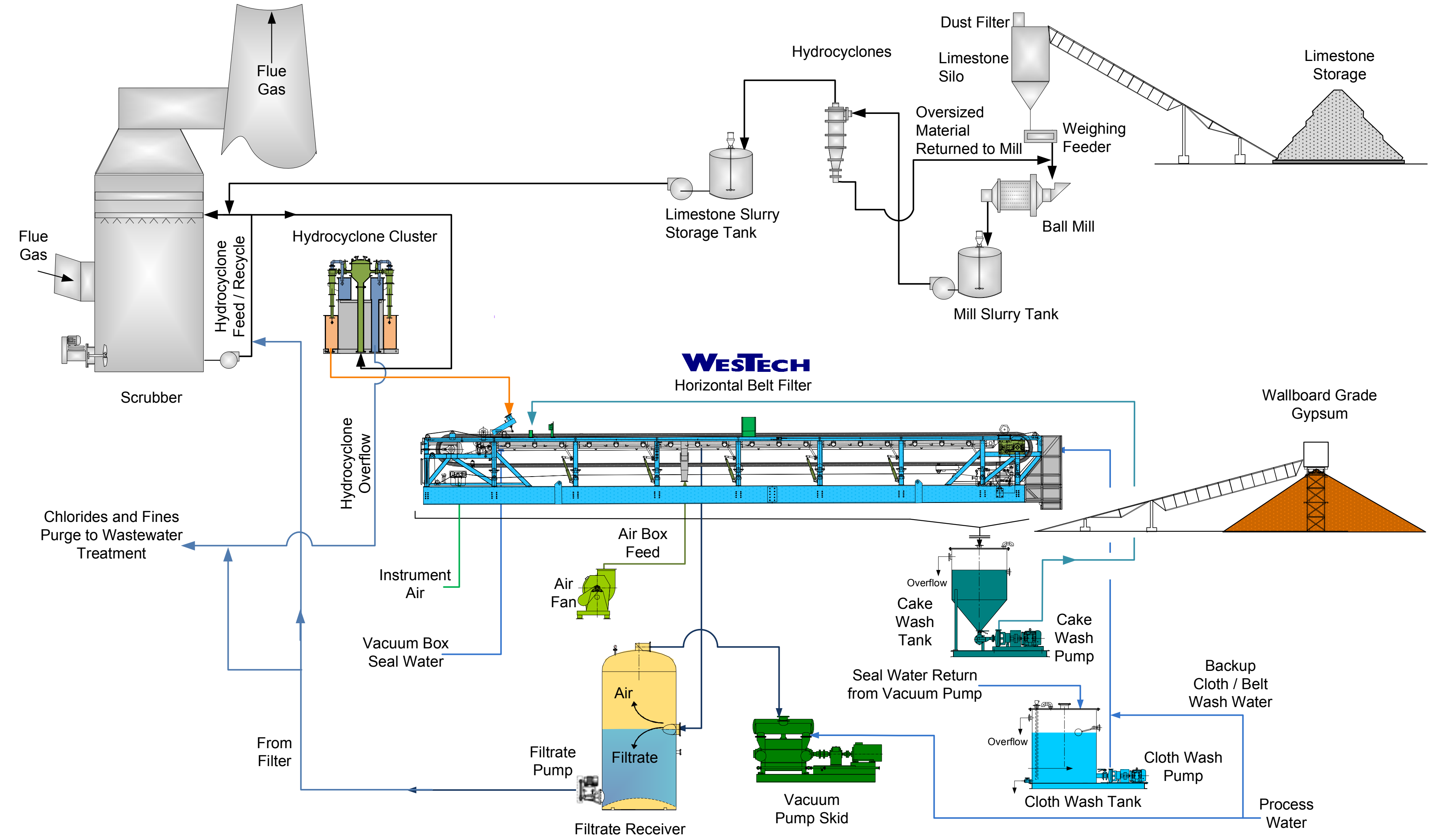
An effluent polishing step may be required. This is generally dictated by reactor configuration and effluent requirements. This step could include filtration, UF, RO, disinfection, chlorination, or UV.

Backwash Thickening

Biological reactions yield waste biomass resulting from substrate utilization. Typical separation techniques include gravity thickening, dissolved air flotation (DAF), and centrifugation. Polymer and coagulant addition enhances process performance.

Solids Dewatering

Dewatering has the advantage of waste solids weight reduction which reduces disposal costs. Dewatering can be accomplished by a number of technologies including belt press, filter press, and dewatering filters.



Gypsum Dewatering

WesTech

DWN: **RCS** DATE:

With extensive background in filtration technology, WesTech has successfully applied this experience to develop horizontal belt filters which excel in industry-specific applications. WesTech offers filter sizes from lab-scale to 150 square meters. The minerals and power industries demand robust design and rigorous performance requirements. WesTech's ***Horizontal Belt Filters*** meet or exceed demanding production rates, low cake moisture and cake washing requirements, while minimizing process upsets. WesTech employs the right balance of conservative design and experience to provide a cost effective and high performance filter.

Gypsum Dewatering

Wet flue-gas desulfurization (FGD) systems generally operate in a pH of 5.0 or above and require feed of reagent to remove sulphur. Limestone slurry is the most commonly used reagent. The quantity of slurry depends mostly on the sulfur levels in the coal. It is common for modern FGD systems to achieve 99% removal of SO_2. Scrubbers not only capture the SO_2, but also capture up to 98% of mercury and 99% of fine particles associated with lung problems such as asthma.

This reaction produces gypsum ($CaSO_4$) as a byproduct. The gypsum is removed either by thickeners or hydrocyclones and then dewatered. In general, gypsum is either disposed of in a landfill or sold for the manufacture of wallboard.

Disposal grade gypsum typically has a specified moisture of 15%. WesTech scraper discharge filters offer a simple, yet effective, means of dewatering disposal grade FGD gypsum.

Wallboard grade gypsum is specified as having less than 10% moisture. To achieve this low level of moisture, a horizontal belt filter is used. A major influence on obtaining this performance is the aspect ratio of the gypsum solids.

For a square cross-sectional area and crystals of equal volume, an 8:1 aspect ratio has 35% more surface area than a 2:1 aspect ratio. So, if crystals with 2:1 aspect ratio give 10% surface moisture, 8:1 aspect ratio will give 13.5% moisture under the same filtration conditions. This is approximately what has been observed in the field.

The system must start with limestone of high purity, generally greater than 95% $CaCO_3$, which will then contribute less than 3% inert fines in the gypsum.

The oxidation step is run with long residence time (for gypsum growth), high solids concentration (for low aspect ratio) and low pump shear (for low mechanical nucleation rate). Keeping fly ash out of the gypsum and using makeup water with low silt content will also produce a lower moisture filter cake.

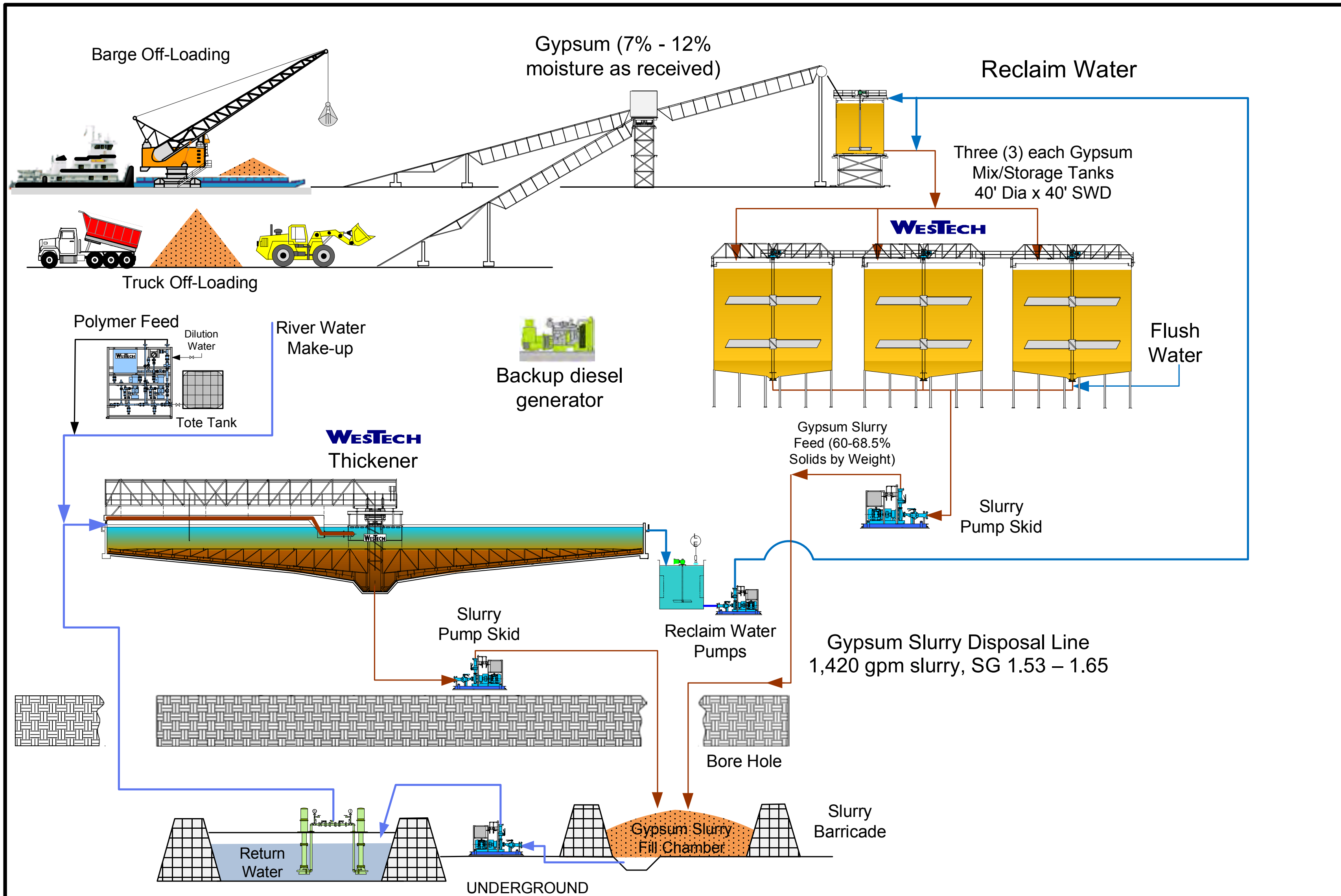
Horizontal Belt Filter Design for Gypsum Dewatering

The filter must be sized accurately for the gypsum specifications. Filtration rates vary from 150 to 400 lb./hr./ft^2 depending on particle size distribution and desired moisture content of cake.

High feed solids concentration are required, typically 50 to 55 wt. % solids to avoid segregation of fine and coarse particles. High vacuum air flow rates of 15 to 25 cfm/ft^2 are used to provide pressure drop to strip off surface moisture for 10% moisture or less.

Chloride removal is accomplished by two to three wash displacements to achieve the over 90% wash efficiency for required wallboard quality. Good feed distribution is essential. Even a slight flow bias gives cake thickness variation side to side with corresponding wash and dry differences.

Gypsum cake leaves a heel on the cloth. The cloth wash slurry contains about 1–2% of gypsum. This stream can be returned to the system as cake wash water. This allows the recovery of the water and the gypsum solids and reduces the total suspended solids (TSS) of the wastewater from the process.



Gypsum Disposal Facility

WESTECH

DWN: **RCS** DATE:

WesTech's ***Drive Units*** are proven workhorses in the mineral and industrial processing industries. Under the harshest operating conditions, WesTech's drives perform with minimal operator attention and provide long-lasting service. WesTech has upgraded many existing thickeners with our precision bearing drive units. With every drive retrofit, WesTech visits the site to inspect the existing equipment, record detailed measurements, and plan for any special installation requirements. Our drives are engineered to meet the demands of extreme environments, last for decades, and replace drives from any previous manufacturer.

Gypsum Disposal Circuit

Gypsum produced from flue-gas desulfurization (FGD) has been used as a valuable byproduct which was sold as a feedstock for wallboard manufacturing. Economic trends in housing starts affect the demand and price of gypsum. There is also a trend among utilities to close waste ponds at their power plants. These combined trends have fueled the need to find alternate gypsum disposal methods.

Mine Disposal

One method makes use of abandoned mine sites. This disposal method has the added advantage of neutralizing acid mine drainage (AMD). Gypsum has a high pH and can therefore neutralize AMD streams.

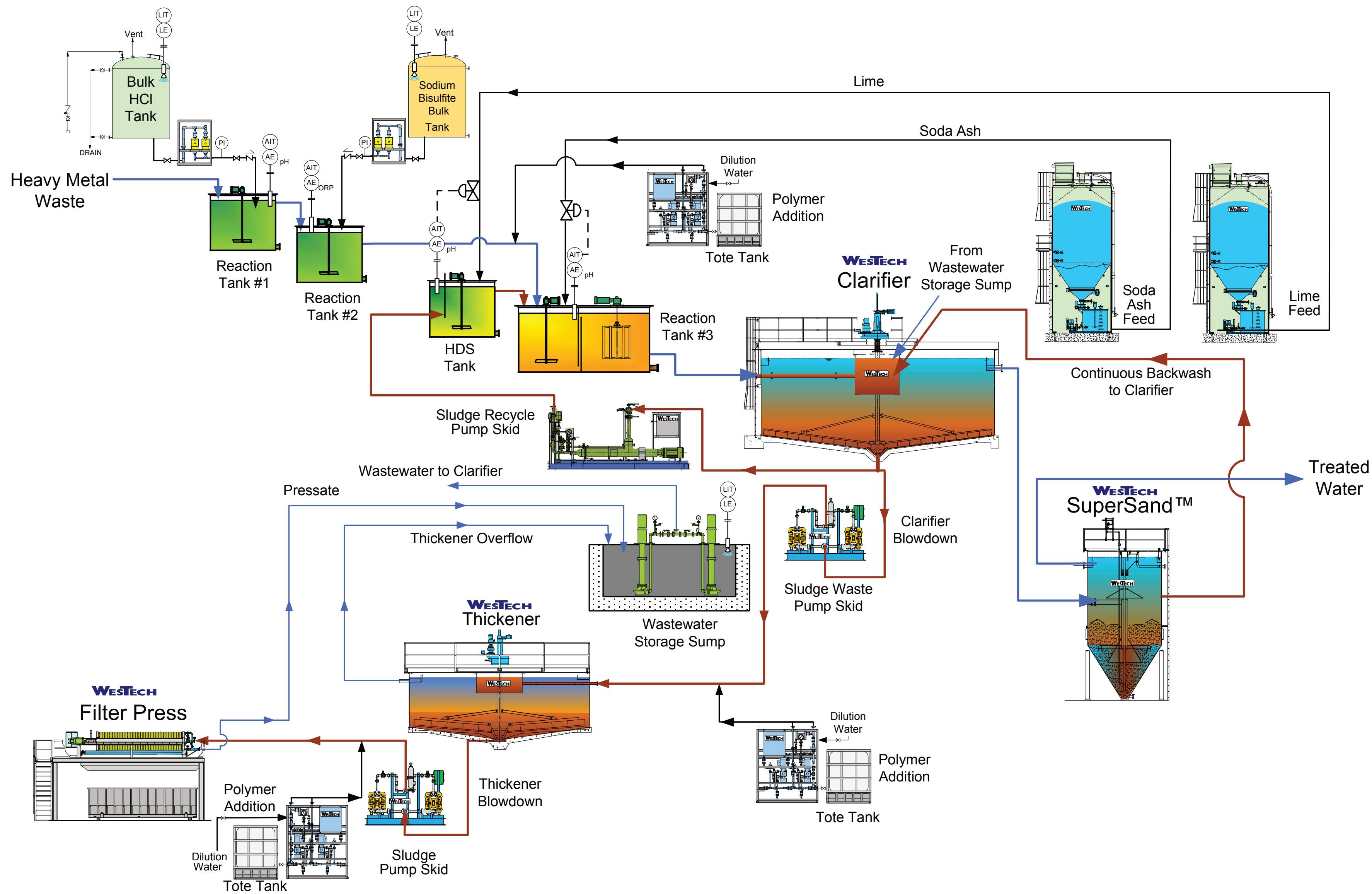
Flue-gas desulfurization effluent is dewatered to facilitate gypsum transportation. Mine disposal decreases the required level of dewatering. Wallboard grade gypsum requires a solids level greater than 90%. Disposal grade gypsum has a solids level of 85%. Mine disposal grade gypsum must only fail to have any free liquid. This substantially reduces dewatering costs, but results in more system water loss and increased shipping weight and bulk.

Transporting Gypsum

The gypsum is shipped to the disposal facility by barge, truck, or train and offloaded for feeding to a conveyor system. The conveyor transports the "dry" gypsum to the reclaim tank where it is mixed with water reclaimed from the process. Water may also be added to the effluent of this tank to ensure the proper solids content in the gypsum mix and storage tanks.

Solids settling is prevented in the gypsum mix and storage tanks by using mixers while the other tanks are sequentially pumped to the mine. The slurry solids level is monitored to avoid slurry line plugging as well as excess water usage. Slurry barricades allow the deposited slurry to dewater via gravity.

Water from this phase is collected in a mine pool then pumped to an aboveground thickener. The thickener settles excess solids while the water may be reclaimed as slurry makeup. If river water is used as makeup water, it may also be treated by the thickener.



Heavy Metals Removal

WesTech

DWN: **RCS** DATE:

Since its beginning in 1973, ***WesTech*** designs, engineers, supplies, and installs water, wastewater, and process equipment for municipal and industrial customers around the world. From headworks to tertiary treatment, from petrochemical processes to water reclamation and drinking water, from small communities to large cities and factories, WesTech offers a wide array of custom process solutions for any application.

Heavy Metals Wastewater Treatment System (Chrome Removal)

Chromium is present in the wastewaters of a number of industries, including: stainless steel manufacturing, protective coatings on metal, magnetic tapes, chrome plating, tanneries, textile dyes production, pigments and paint production, production of cement, paper, rubber, etc. Chromium is typically precipitated in two steps: reduction and precipitation.

First Step

In the first step (Reaction Tank #1) acid is added to lower the pH to < 3 so that the reaction may take place. The reaction is conducted in Reaction Tank #2 where hexavalent chromium (Cr+6) is reduced to trivalent chromium (Cr+3). In this step, compounds such as ferrous sulfate ($FeSO_4$), sodium bisulfite ($Na_2S_2O_5$), or sulfur dioxide (SO_2) are used as reducing agents. The trivalent chromium is precipitated as $Cr(OH)_3$.

Second Step

In the second step (Reaction Tank #3), lime is typically used for the precipitation reaction. In this flow diagram, a process known as high density sludge (HDS) is employed to help promote precipitation. The heart of the HDS process is the pH in the HDS or densification tank which needs to be at a pH of 11.5 or higher. A change of state takes place at the higher pH and the process works better. The actual precipitation of chrome hydroxide takes place under mildly caustic conditions. Thus, there will always be some $Cr(OH)_3$ in the clarifier feed, but these hydroxides will eventually be recirculated through the densification tank and undergo a change of state.

In this process, previously settled sludge is recycled to the reaction tank (HDS tank) where it is mixed with fresh lime slurry. This lime slurry coats the sludge, making it more reactive and able to form stable flocs with the incoming solids in Reaction Tank # 3.

The effluent concentration is 0.2 ppm Cr at pH 7.5. If additional metals are present, the pH is raised to approximately 10 to promote further precipitation.

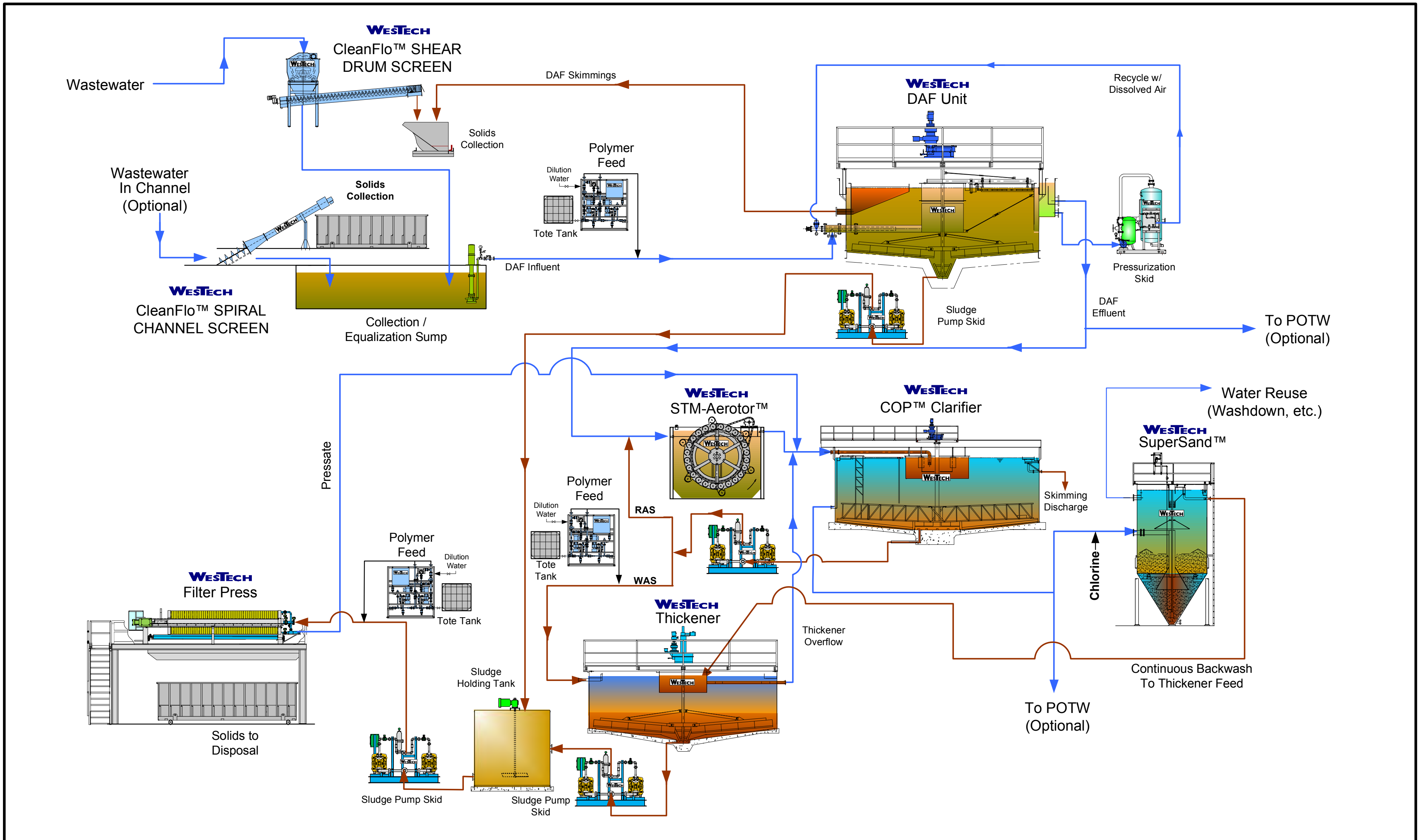
Carbonate Precipitation

To further facilitate removal of additional metals, carbonate co-precipitation is sometimes used. Carbonate precipitation takes place only if free carbonate ions (CO^{2-3}) are present and this occurs only if the pH is high. Some wastewaters, especially those with lead, cadmium, nickel, etc. which can form insoluble carbonates that can be used in carbonate precipitation, may already contain enough carbonates to allow precipitation to occur. Alternatively, inorganic carbonates such as soda ash (Na_2CO_3) can be added. High pH's also promote the precipitation of the metals as hydroxides. Hence, carbonate precipitation is often a co-precipitation. As mentioned above, carbonate precipitates settle and can be dewatered more easily than the corresponding hydroxide precipitates.

Note that pH values above 10 promote the formation of metal hydroxy complexes that can increase the metal solubility and reduce the precipitation effectiveness.

The treated water is then filtered by either pressure or gravity media filters depending on the logistics of the final disposal.

The sludge from this process typically goes to a conventional thickener and filter press for dewatering prior to disposal. Dewatering produces an average 20:1 reduction in sludge volumes. The water from the dewatering system is returned for processing. Variations of this process can be used to precipitate most heavy metals.



High Strength BOD Wastewater Treatment System

WesTech

DWN: **RCS** Date

WesTech ***CleanFlo™ Spiral Screens*** provide efficient, economical screening for plants with flows less than 10 MGD. Screening, conveying, and compaction are all performed by one drive motor. The stainless steel screen panel is automatically cleaned by long-wearing segmented brushes attached to a one-piece shaftless spiral auger. The shaftless spiral transports the screenings up the collection tube, where they are compacted and dewatered to 30-35% water content. These units are ideal for both municipal and industrial applications, especially in plants with smaller flow requirements.

High Strength BOD Wastewater

High strength BOD wastewater is produced in a number of industrial processes. These include petrochemical, chemical, food processing, and pulp and paper plants. Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by waterborne aerobic biological organisms to break down organic material. The BOD is a measure of organic water pollution. Biological oxidation has been used for decades to reduce BOD and remains the preferred treatment method.

Anaerobic treatment is economical when the organic load and temperature are high and the wastewater lacks essential nutrients. Anaerobic treatment converts biomass to energy-rich biogas (methane) which may be used as fuel. Effluent from anaerobic treatment has low BOD, with corresponding minimal environmental disruption. Anaerobic reactors harness biological reactions and are sensitive to temperature and pH. They also require significant time to start up and recover from upsets.

High Strength BOD Wastewater Steps

1. Primary Clarification
If influent levels of oil or solids are high, primary clarification may be required. This may be accomplished using either sedimentation or flotation prior to biological treatment. Evaluation of these processes is based on influent water quality, contaminant to be removed, and chemicals required for the biological process.

2. Anaerobic Pretreatment
Anaerobic pretreatment is typically indicated for BOD levels over 2,000 mg/L and temperatures over 25°C. Significant amounts of alkalinity may need to be added to maintain reactor pH. Biogas can be captured and used as an energy source to offset the operating cost of the plant. If biogas is not used as a fuel, treatment such as activated carbon may be necessary for odor removal. Control of pH is a critical component of any anaerobic process. Nutrients may need to be added.

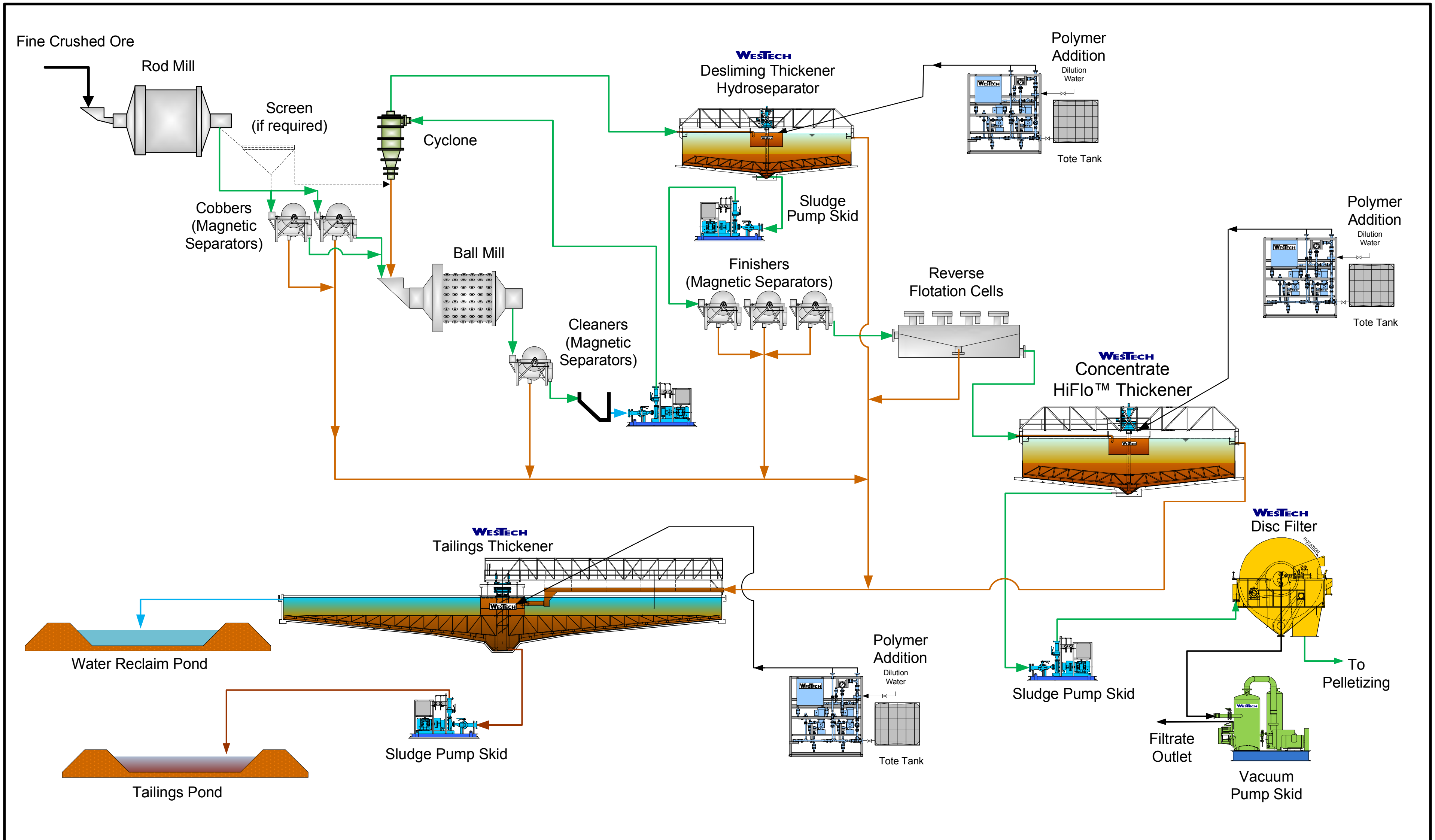
3. Activated Sludge
Industrial effluents often don't contain all the necessary nutrients for biological growth. Nitrogen, phosphorus, and other nutrients must frequently be added to ensure biomass growth and BOD removal.

Continuous flow, suspended growth aerobic systems (CFSGAS) are designed to handle continuous flow. They do not provide a bed for a bacterial film, but rely on waterborne bacteria. Suspension and aeration are typically provided by an air pump, which provides constant stirring in addition to oxygenation.

This typically produces better effluent quality (lower BOD) than attached growth or anaerobic treatment. A medium to promote fixed film bacterial growth may be added to handle high levels of wastewater biomass. Adding anoxic zones can discourage filamentous bacterial growth, promote nitrification, and produce better settling characteristics.

4. Effluent Polishing
The effluent quality desired may raise the need for total suspended solids (TSS) or fats, oil and grease (FOG) removal through media filtration. If there are non-biodegradable organic constituents present, chemical oxidation may be employed to reduce chemical oxygen demand (COD). Waterborne pathogens and viruses require disinfection using chlorine, ozone, or UV light.

5. Solids Dewatering
Dewatering using a thickener, belt press, filter press, centrifuge, or drying bed reduces waste disposal costs.



Iron Ore – Magnetite Benefication

WESTECH

DWN: **RCS** DATE:

The WesTech ***TitanTraction™ Thickener*** is specifically designed for large flow rates and high tonnages where center drive units become uneconomical. The TitanTraction™ Thickener is a column-supported unit with the rake arm driven by a tractor mounted on the rim of the thickener tank. WesTech employs unrivaled state-of-the art technology to address the complexity of these super-sized thickeners. Designs are verified by integrating the results from computational fluids analysis, finite element analysis, and mechanical event simulation. TitanTraction™ thickeners are selected when diameters exceed 100 meters, flow rates exceed 20,000 cubic meters per hour, and exceptionally high torques are required.

Iron Ore Concentration Process

Magnetite is mined in large chunks and is crushed into small particles by a series of crushers. After primary crushing with jaw crushers and secondary crushing with gyratory crushers and tertiary crushing with cone or high pressure grinding rolls (HPGR), the ore is screened on vibrating screens to size the particles. The portion of this process which is still too large is sent to a rod mill.

Magnetic Separators

From the rod mill the material proceeds to the cobber magnetic separators. Any non-magnetic material which has been released by the rod mill is separated and sent to the tailings thickener. Magnetite iron ore particles are separated by the magnetite separator from the gangue (waste material) minerals in the cobber magnetic separators. This material flows to the ball mill for further size reduction.

Material from the ball mill flows to the cleaner magnetic separators. Again non-magnetic material which has been released by the size reduction process is sent to the tailings thickener. The magnetic component is pumped to hydrocyclones for sizing.

The finer material in the hydrocyclone overflow is sent to the desliming hydroseparator, while the course material in the hydrocyclone underflow is returned to the ball mill for regrinding. Polymer is added to the desliming hydroseparator to aid in the settling and thickening of the solids.

The desliming prepares the ore for flotation, discarding the ultrafine particles. The underflow from the desliming thickener is sent to a series of finisher magnetic separators to further purify the solution. The overflow from this thickener reports to the tailings thickener.

Reverse Flotation Cells

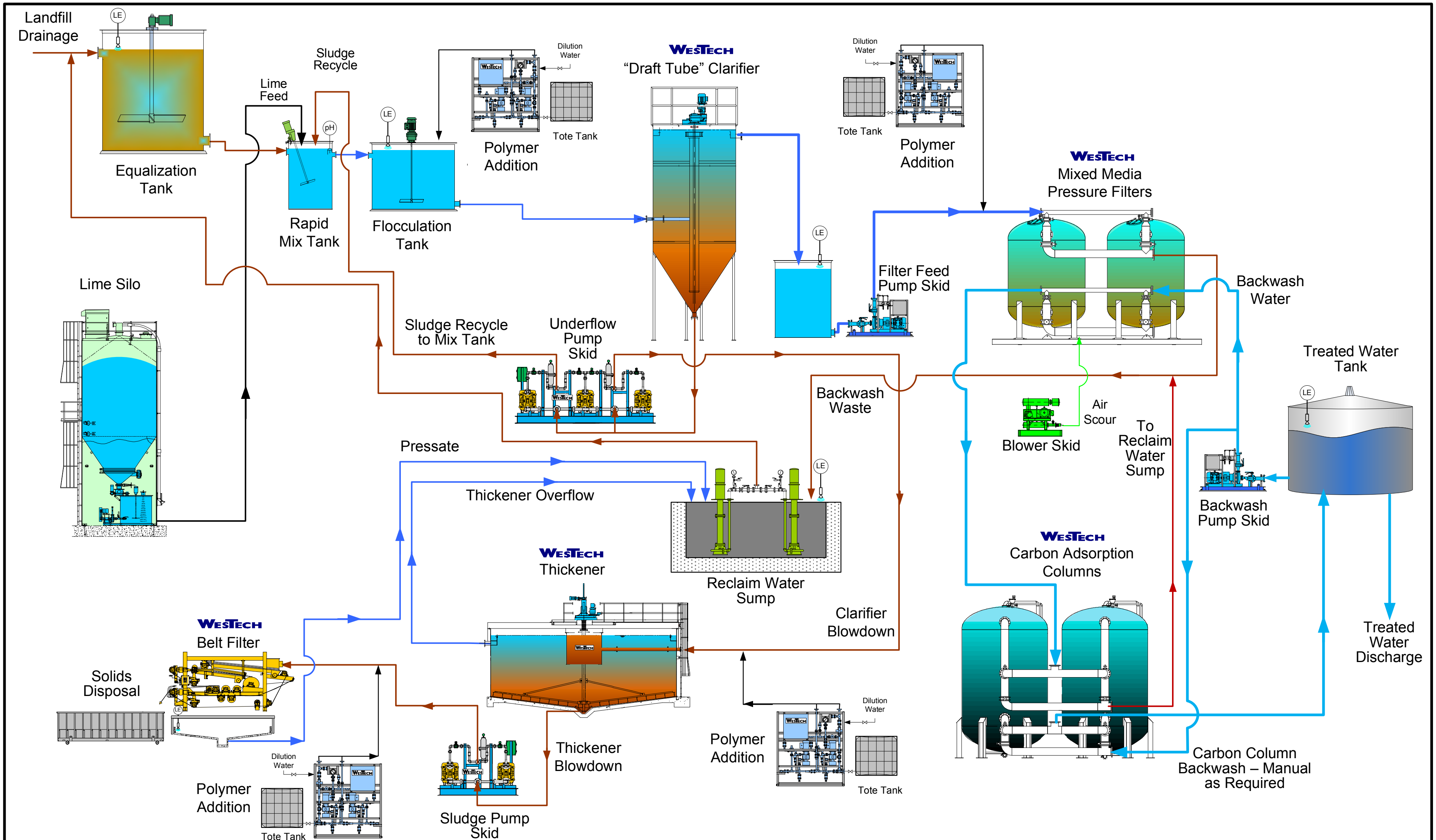
The separated magnetic material from the finisher separators is sent to reverse flotation cells for further separation. The flotation phases employ conventional large-size mechanical cells, in addition to flotation columns. This process uses starch (depressant) and amine (quartz collector) as reagents to promote the separation of the contaminant mineral (quartz) from the iron-bearing mineral.

The floated material from the flotation process is also sent to the tailings thickener. The underflow from the flotation process is sent to the concentrate thickener.

In the concentrate thickener, the purified slurry is thickened prior to being pumped to a disc filter. Again the addition of polymer aids in the separation and thickening process. The disc filter uses vacuum to dewater the magnetite iron ore concentrate and discharges a relatively dry cake which is sent for pelletizing. This process allows ore of very low magnetite content to be processed into a high quality product.

Tailings

The various reject streams are sent to a tailings thickener. In this unit the solids are allowed to settle and are then pumped to a tailings pond for further settling and water reclamation. The overflow from the tailings thickener is sent to the water reclaim pond and then recycled back into the process.



Landfill Leachate

WESTECH

DWN: **RCS** DATE:

WesTech ***Granular Activated Carbon (GAC)*** pressure filters are an effective means for removal of low-molecular-weight contaminants from aqueous solutions. They are especially suited for the removal of dissolved organic compounds responsible for poor taste and odor in drinking water, as well as removal of chlorine from industrial waters. When used as pretreatment equipment, these filters will prolong the life and efficiency of demineralizing ion exchange resins and reverse osmosis membranes.

Landfill Leachate

Landfills are categorized by regulations in three types: industrial, municipal, and hazardous. Individual landfills may be further differentiated by the types of waste which they accept.

All landfills are required to be capped, usually occurring at the end of each day. The cap is typically 6-8" of soil. The cap reduces odor and loss due to wind. At the closing of the landfill, a permanent cap consisting of a membrane and more soil is added.

Before the landfilling operation begins, an "impermeable" base is required. This usually consists of two layers of membranes separated by at least 12" of sand. A network of drain pipes is buried in the sand. These pipes transport the wastewater that must be treated.

Dissimilarity of Landfill Leachate

Rain or groundwater infiltrating through the buried waste can dissolve solids and heavy metal salts. The aqueous leachate may also contain organic and inorganic chemicals from the decomposition of waste inside the landfill. While landfills within the same categories may have similar leachates, each landfill has its own fingerprint when it comes to pollutants. Testing is required to determine leachate composition and the exact treatment required.

Some landfills produce a leachate with a high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) together with a nitrogen component. These leachates may require biological treatment to achieve acceptable discharge levels.

Some leachates contain heavy metals such has chrome, lead, and mercury. These require treatment for removal of these heavy metals. Sludge produced by this treatment will naturally contain heavy metals and will require hazardous waste disposal.

Treatment plant design considerations include site, landfilling techniques, cover and cap design, bottom isolation, collection design, landfill gas utilization, and onsite operation facilities.

General Treatment Steps

Depicted here is a basic system for the removal of suspended solids and organics. The system consists of clarification, filtration, and treatment by activated carbon.

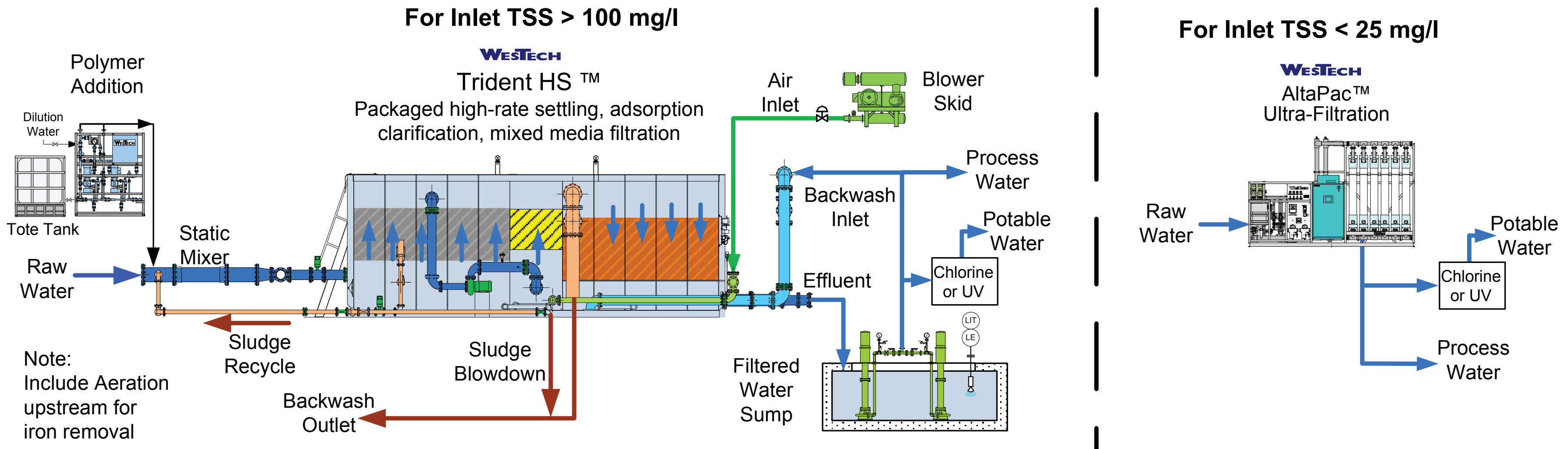
Clarification and filtration removes suspended solids and organics and acts as pretreatment for the activated carbon units. Clarifier underflow and backwash from the filters and activated carbon units flows to a thickener. The percent solids are increased in the final sludge stream which is sent to dewatering.

If biological treatment is required, it precedes the clarification step. A portion of the clarifier underflow cycles back to the biological treatment system, enriching the microbial population.

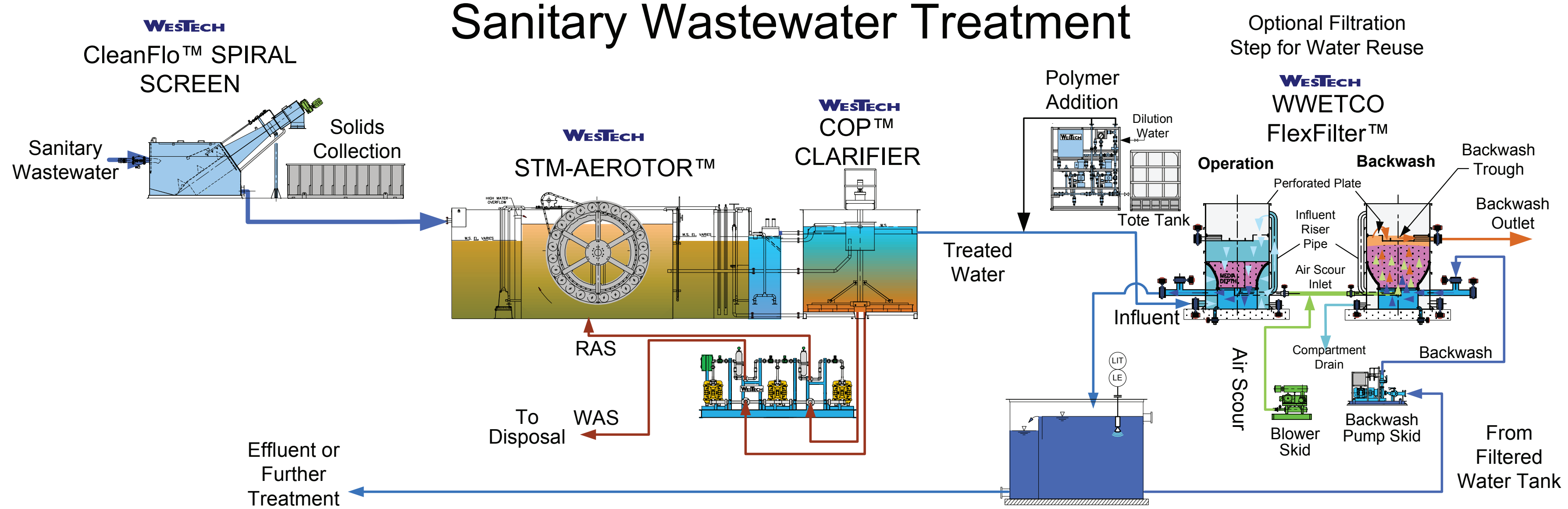
Heavy metals are removed downstream from the clarifier and upstream from the filter and activated carbon units. In this case, the filters and the activated carbon units become the polishing units to remove any trace solids and organics.

Landfill gases also must be treated. If the gases are vented to the atmosphere, hazardous and noxious substances must be removed. Usually contacted carbon is used for this purpose. The gases contain methane and may be used as fuel. This usually requires several treatment steps which produce another set of liquid wastes to be treated.

Process / Potable Water Treatment



Sanitary Wastewater Treatment



Package Plant – Water / Wastewater Treatment

WESTECH

DWN: **RCS** DATE:

The ***Trident® HS*** is a high-rate clarification system utilizing tube clarification enhanced by sludge recirculation. Internal sludge recirculation increases settling by increasing available surface area for flocculation. Periodic sludge blowdown maintains the optimum concentration of sludge in the clarifier. The Trident® HSR can be used to convert an existing Trident® installation to Trident® HS technology. By converting from Trident® to Trident® HS, it is possible to increase solids loading capacity, remove Cryptosporidium and Giardia, and increase total organic carbon removal by 40%.

Man Camps

Many times mining, oil and gas exploration, construction, and other activities take place in remote areas of the world. In these cases it is necessary to provide both potable water and treatment of sanitary wastes for the facility. In addition, many of these activities take place in temporary fashion as the sites will either be developed or abandoned at a future date.

Therefore, it is often necessary to provide treatment systems which will be able to produce and/or process the necessary volumes of water for the "crew" manning the site, but to also do so with packaged equipment which is easy to transport and set up at the site. Most often this type of treatment is skid-mounted or built within a standard container for easy shipping and installation.

Water Sources

Possible water sources for these sites typically consist of rivers, streams, or lakes. These sources may have high suspended solids levels and may also be contaminated with microbiological organisms. In addition, there may also be seasonal changes in the water quality, i.e., higher suspended solids in the springtime due to rain runoff.

Trident

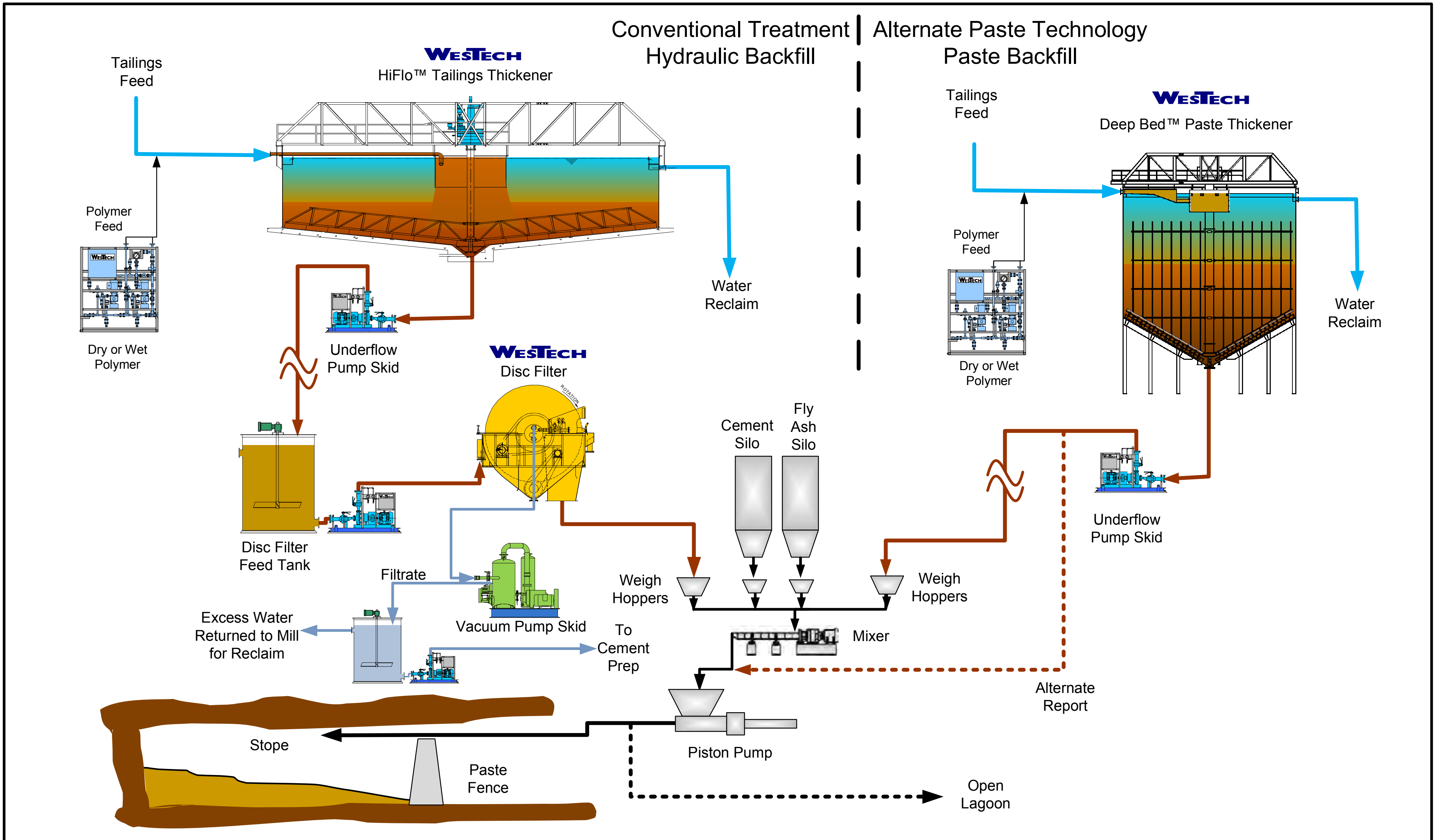
An effective way to deal with these sources of raw water is a packaged treatment plant consisting of a coarse up flow clarification followed by a plate-type separator and finally a multimedia filter. The WesTech Trident® system has proven itself in thousands of applications to be able to handle high and varying solids while producing a stable high-quality effluent. Effluent from the system is often of sufficient quality to be used for various process water applications at the site.

In order to make the water potable (safe for drinking), one of the most efficient and effective ways is to treat it through ultrafiltration membranes. These membranes have sufficiently small pore sizes to remove 99.99% of all microbes including Giardia cysts and Cryptosporidium. After treatment with ultrafiltration the water is typically treated with either chlorine or ultraviolet light to ensure it is safe.

STM-Aerotor™

The other half of the equation at these sites is to treat the sanitary waste generated. As with most "municipal" systems, these waste streams peak in both volume and contaminant levels at certain times of the day, in this case typically at shift change. A system which can handle these spikes in quantity and quality is therefore required. The system also needs to operate with little operator attention. Since power is normally at a premium on these remote sites, a system with low horsepower requirements is extremely desirable.

The STM-Aerotor™ meets all these requirements. It has the lowest ratio of horsepower per pound of dissolved oxygen of any commercial biological treatment. It uses conventional mixed liquor activated sludge technology in addition to fixed film biological growth to provide the maximum biological treatment in the minimum footprint. As with conventional activated sludge treatment, the STM-Aerotor™ employees a downstream clarifier to settle the biological solids.



Mine Backfill

WesTech

DWN: **RCS** DATE:

WesTech has successfully utilized the ***SuperDisc™ Disc Filter*** in a pilot study to treat the effluent water from the Massachusetts Clinton Wastewater Treatment Plant to less than 0.1 mg/L of total phosphorous. The plant effluent is discharged into the Nashua River where phosphorus inhibits aquatic life by reducing oxygen levels through eutrophication. With an average daily flow of three million gallons per day, Clinton removes phosphorus through a conventional activated sludge system followed by chemical coagulation.

Mine Backfill

Mine backfill is defined as the material used to fill the cavities (i.e., stopes) created by underground mining. Backfilling can be a means to dispose of sludge and/or tailings which may contain hazardous materials and to reduce surface environmental impacts by storing tailings underground.

Alternately, backfilling with nonhazardous materials can allow for mining productivity improvements. To these materials are added a variety of fillers such as fly ash, course sand, or gravels along with a binder, such as cement, which is added to provide structural strength.

Conventional Flow Sheet

A vacuum disc filter, preceded by a high-rate thickener to reduce the hydraulic loading, is typically used to produce the "sludge" portion of the mine backfill. The filter cake is discharged to a weigh hopper, then to a batch mixing hopper or a continuous mixer where a measured amount of binder and other materials are added.

The cemented paste is then pumped via high pressure piston pumps below ground or distributed by gravity, depending on the specific site. Most backfill projects in the world use this conventional flow sheet with a vacuum disc filter because there is less water in the filter cake and, therefore, less cement binder required, which is a major operating cost of a backfill operation

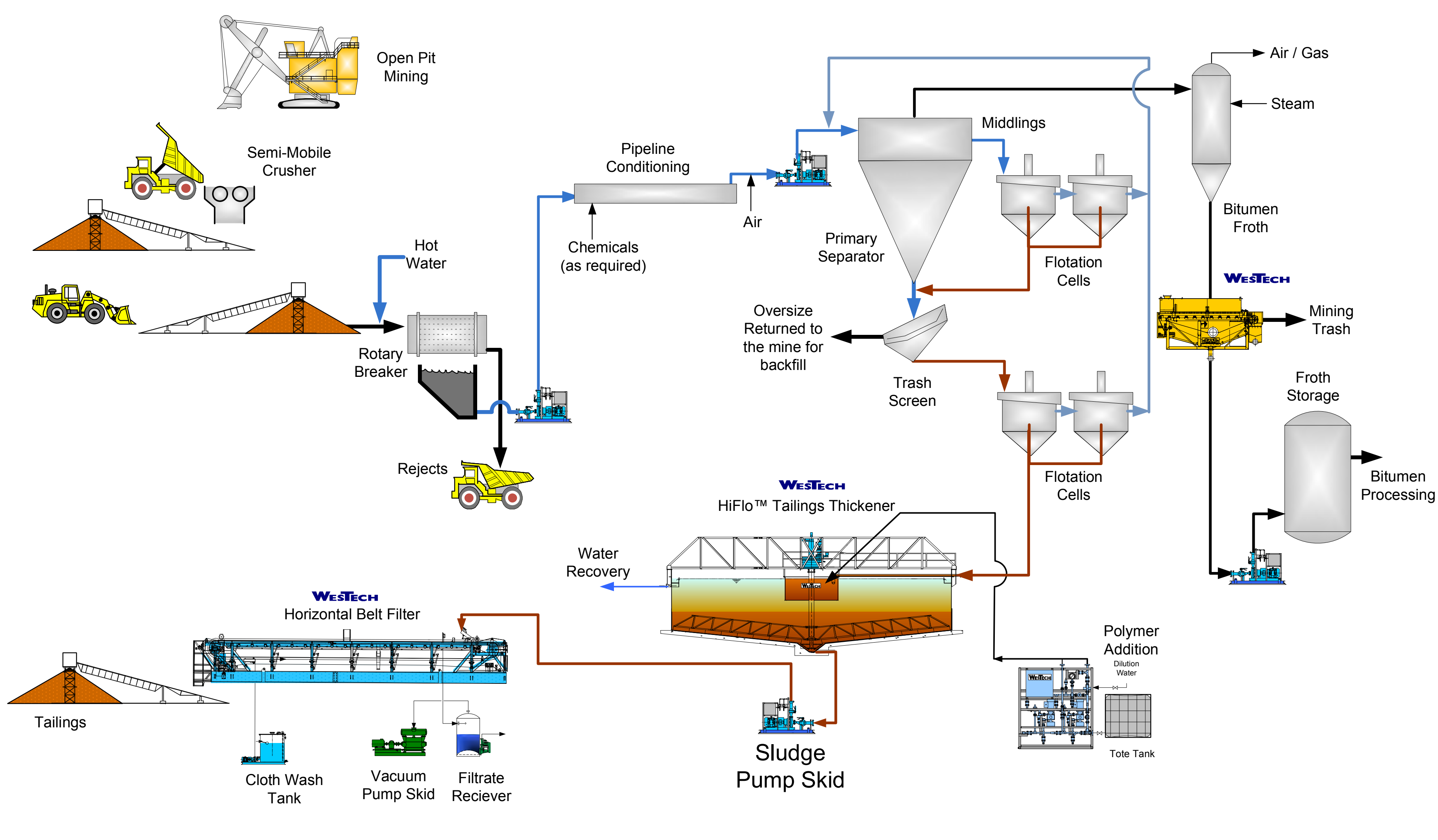
Paste Flow Sheet

In underground mining, the WesTech Deep Bed™ Paste Thickener is an emerging option to the conventional solution of high-rate thickener/vacuum filter for paste backfill applications. There can be a number of factors which make paste thickening an attractive alternative. There are some backfill operations with shallow mines and long distance runs, making the pumping costs of a high-yield stress paste more attractive.

Because a paste is non-settling, the coarse particles do not have to be removed prior to thickening. Paste thickeners can eliminate the need for vacuum filters, which can be expensive to operate, and may not be feasible for high elevation mine sites. This also significantly reduces operator attention.

Alternatively, it is possible to use a Deep Bed™ Paste Thickener to feed a vacuum filter. This can reduce the size of the vacuum filter as the feed to the filter is more concentrated than that from a high-rate thickener. Another option would be to use a Deep Bed™ Paste Thickener in parallel with a filter. This option allows for the blending of the paste underflow with the filter cake.

The underflow from the paste thickener would be split, sending a portion to the vacuum filter. The paste thickener underflow and the filter cake would then be combined to obtain the desired moisture content for the backfill.



Open Pit Oil Sands

WesTech

DWN: **RCS**

WesTech ***Drive Units*** are specifically engineered for the high torque requirements of minerals thickeners. They are designed with a direct in-line high efficiency speed reducer and motor stack as well as a durable precision bearing. State-of-the-art torque protection and rake lifting capability ensure an unrivaled customized design for each application.

Open Pit Oil Sands Mining

The term "oil sands" is actually a bit of a misnomer. The deposits are saturated with a tarlike substance known as bitumen. A great deal of processing is required to separate this bitumen from the associated soil and other debris. One of the two most common ways to recover bitumen from oilsands is through open pit mining of deposits which lie near the surface. Oil sands deposits which lie within 75 meters of the surface are typically recovered via mining. This process is much the same as strip mining for coal or any other mineral.

Mining shovels remove the oil sand and load it into large mining trucks. These trucks carry the oil sands to mobile crushers. The crushed material is stockpiled for the next step.

Slurry

The oil sands broken up in these crushers are then fed to rotary breakers with the addition of hot water to remove rocks and other debris. The resulting slurry is pumped through a pipeline and chemicals are added as required. The slurry reports to a primary separator where it is classified into three distinct cuts – the overflow, the middle means, and the underflow.

The middle means are sent to flotation units where the floating material is recovered and returned to the head of the primary separator. The underflow from the flotation units is combined with the primary separator underflow and sent to a trash screen. The oversized material from the screen is washed and and is returned to the mine via pipeline to fill in mined-out areas. The undersized material is sent to a further bank of flotation units. Floated material off the secondary flotation units is also recovered to the head of the primary separator while the underflow is sent to the tailings thickener.

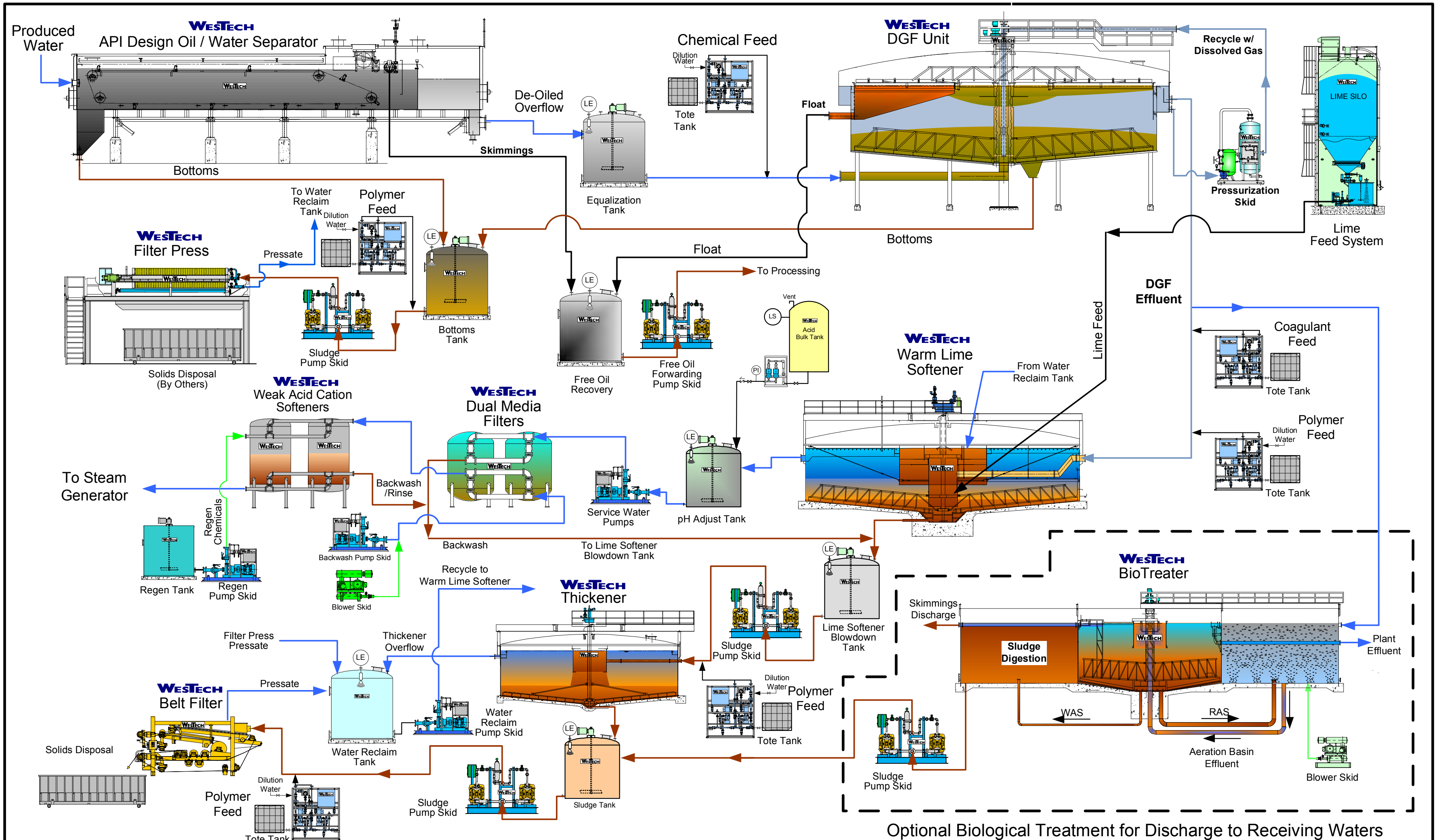
Bitumen

The overflow from the primary separator is sent for processing via steam heating of the bitumen. Bitumen is deficient in hydrogen. Bitumen must be upgraded to synthetic crude oil specification in order to be an acceptable feedstock for refineries. This is done by the addition of hydrogen or the rejection of carbon, or both. Upgrading uses natural gas as a source of heat and steam for processing and also as a source of hydrogen. Other hydrocarbons such as naphtha may also be used for upgrading.

In the tailings thickeners the suspended solids are settled to a sludge which is sent to a horizontal vacuum belt filter for dewatering. The filtrate from the horizontal belt filter is returned to the head thickener for reprocessing. The dried cake from the horizontal belt filter is sent to tailings piles or landfills for disposal.

Overflow

The overflow of the tailings thickener is water which is recovered for recycling back into the circuit. This is not solely due to restrictions on water usage. It is therefore critical that treatment processes involving water recovery in reuse are employed in this application. The combination of tailings thickener(s) and vacuum dewatering equipment results in maximum water recovery.



Oil Sands Produced Water Treatment

WESTECH

DWN: **RCS**

WesTech's ***Oil/Water Separators*** combine state-of-the-art separation, skimming, and sludge transport technologies into a highly efficient primary oil separation device. Removing the bulk of free oils and greases from plant process water streams yields valuable hydrocarbons. Further processing downstream yields recyclable water for plant operations. We provide new as well as retrofit equipment. We offer traditional rectangular units as well as maintenance friendly, high torque, circular units.

Steam Assisted Gravity Drainage (SAGD)

The term "oil sands" is a bit of a misnomer. The deposits are saturated with a tarlike substance known as bitumen. A great deal of processing is required to separate this bitumen from the associated soil and other debris. The most common way to recover bitumen from oil sands is through the use of steam to heat the bitumen. This reduces the viscosity so that it can be pumped to the surface in much the same way as crude oils. Oil sands deposits which lie deeper than 75 meters are recovered in this manner. This method is used to extract approximately 90% of the oil sands deposits in the major regions of Canada.

Steam Assisted Gravity Drainage

Steam assisted gravity drainage (SAGD) is a technique where two horizontal wells are drilled into the deposit. These horizontal wells may extend for miles in all directions. One well is directly above the other. In the upper horizontal well, steam is injected continuously to heat the bitumen. The lower of the two wells is used to pump the bitumen to the surface.

The bitumen produced via SAGD contains a significant amount of water from the steam condensate. Since the quality of the water required for discharge is high and the availability of raw water is limited, the choice is most often made to recycle this water.

Some of the major differences from conventional water treatment systems are the desire to preserve as much heat as possible and the need to reduce the high amounts of silica which are common in water at SAGD operations. Heat recovery saves energy in cold climates. In addition, silica reduction via warm lime softening requires temperatures of 140° F for best silica reduction.

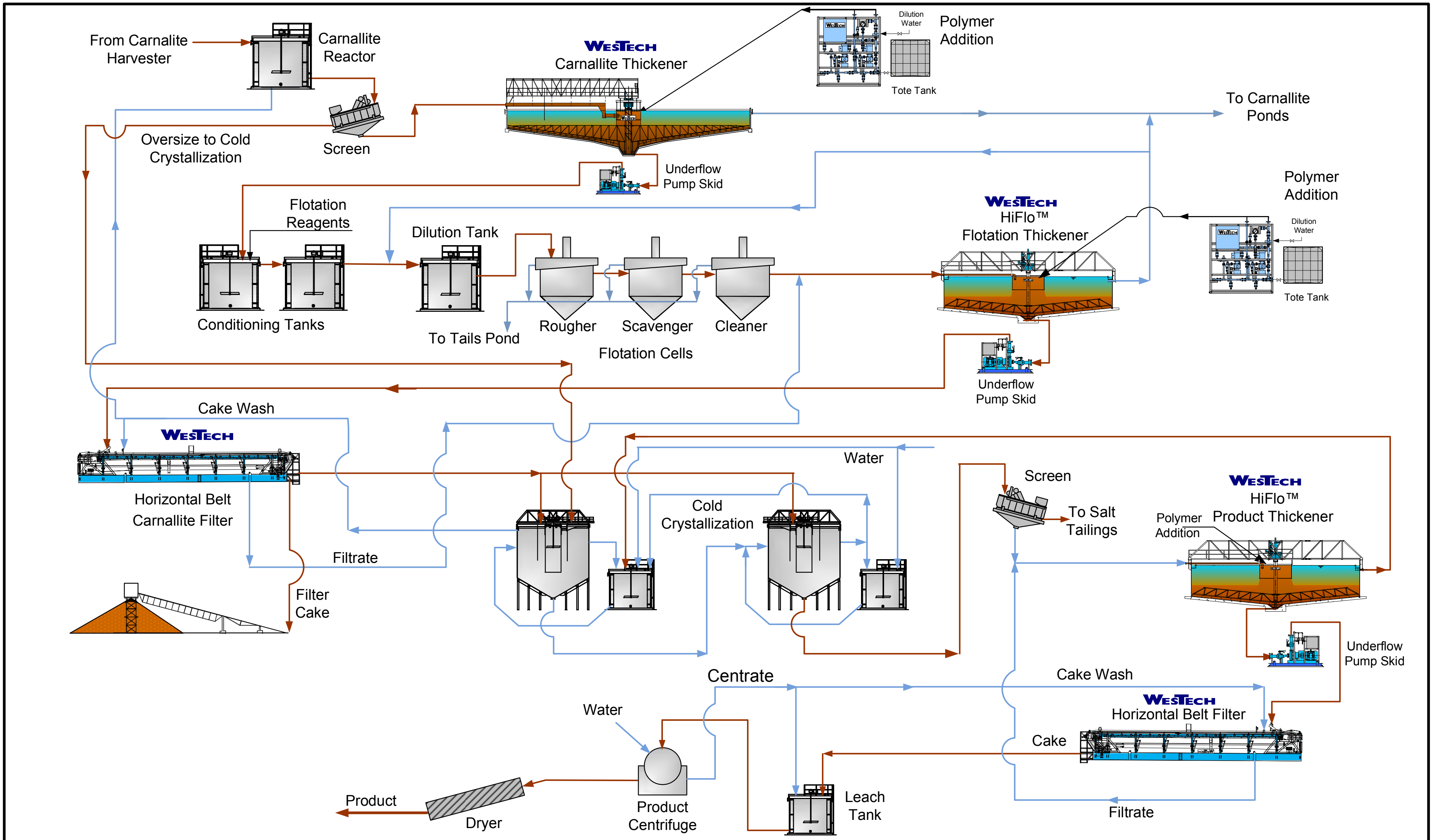
Oil/Water Separator

Water treatment begins with the separation of free oil. This can be done either in a conventional rectangular oil/water separator or in a circular oil/water separator as manufactured by WesTech. Once the free oil has been removed, the effluent flows to a dissolved gas flotation (DGF) unit where the dispersed oil is floated to the top by means of dissolved gas bubbles. Both these units are gas tight to prevent the release of volatile organic compounds (VOC's) and to preserve as much heat value as possible.

Warm Lime Softener

The effluent of the DGF unit is pumped to a warm lime softener. As the name implies, this unit employs traditional lime softening run at an elevated temperature of 140° F. At this elevated temperature the removal of silica is greatly enhanced. This removal rate can be as high as 80-90%.

In addition, the lime softening reduces any hardness and acts as a final oil removal step to ensure there is no oil contamination of downstream processing. From the warm lime softening, the water is pumped through dual media filters to remove any suspended solids in the lime softening effluent. This water then goes through weak acid cation units for further polishing prior to the steam generators.



Potash Cold Crystallization

WesTech

DWN: **RCS** DATE:

Potash is the common name for mined and manufactured salts that contain potassium in water-soluble form. The name derives from “pot ash”, which refers to plant ashes soaked in water in a pot, the primary means of manufacturing the product before the industrial era. Potassium derives its name from potash, and was first derived by electrolysis of caustic potash, in 1808. Today, potash is produced worldwide in amounts exceeding 30 million tons per year, mostly for use in fertilizers. Various types of fertilizer potash thus comprise the single largest global industrial use of the element potassium.

Potash Cold Crystallization

Potash is an important family of potassium-based industrial chemicals. It is used in glass production and soap making, but its most prevalent use is as an agricultural fertilizer. This flow sheet describes the production of potassium chloride from the decomposition of carnallite ($KCl{\bullet}MgCl{\bullet}6H_2O$ + NaCl) and the subsequent re-crystallization of KCl (Sylvite) under ambient or “cold” conditions.

Carnallite

Carnallite is a naturally occurring dual salt commonly found in the presence of other salt-type minerals such as halite. Under certain conditions, significant amounts of carnallite can be formed by means of solar evaporation in ponds filled with saturated brine solutions. Two major brine sources suitable for primary carnallite production are the Dead Sea in Israel and Jordan as well as brines found in the Qinghai province of China.

Thickener

Carnallite is harvested from evaporation ponds and delivered to a primary sizing screen where oversized material can be separated, resized, and processed. Screened material is delivered to the carnallite thickener where excess transportation brine is removed and the crystals are concentrated. The saturated overflow brine from this thickener is returned to the evaporation ponds.

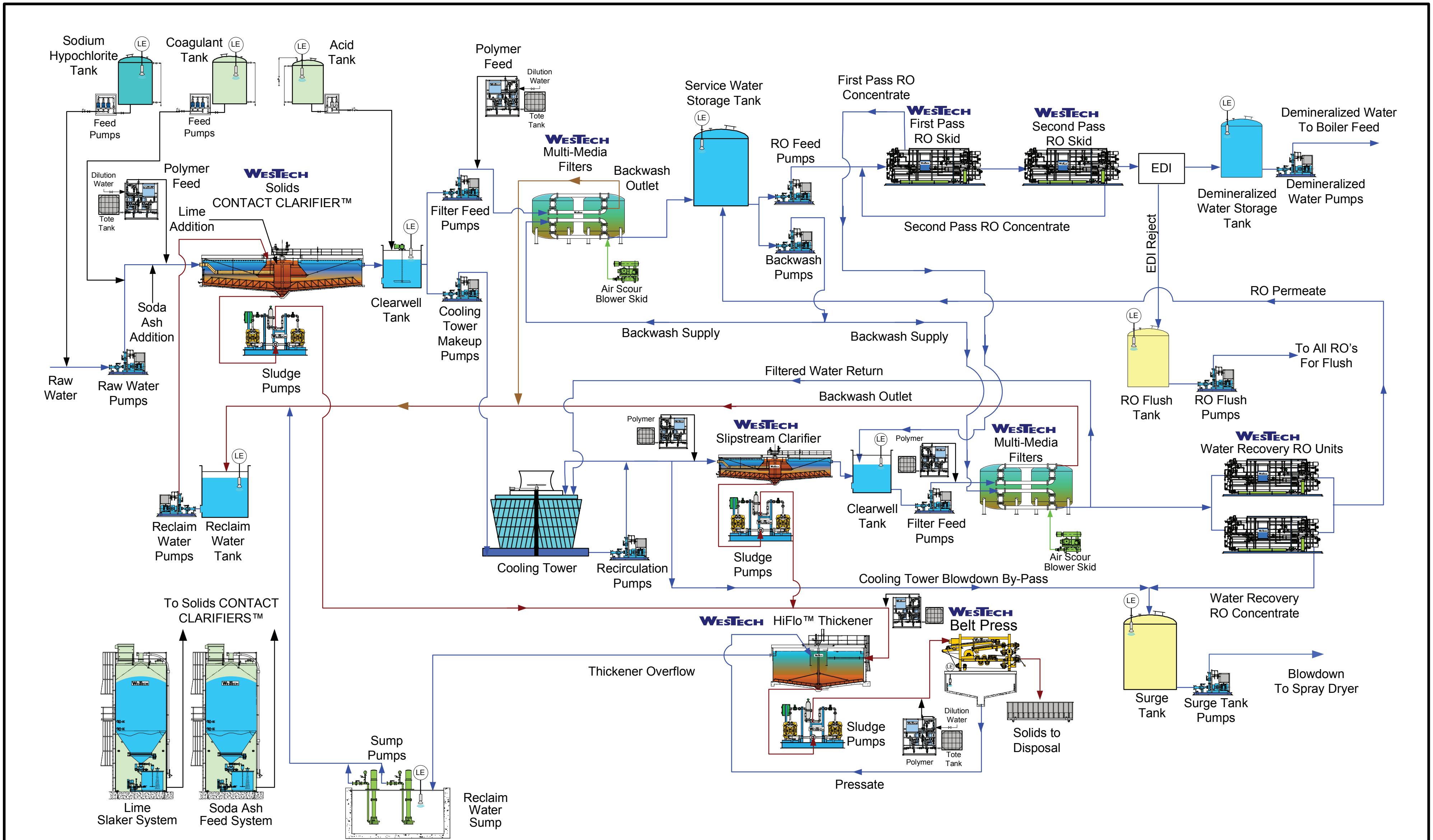
Flotation Circuit

Thickener underflow is sent to a selective flotation circuit where collector and frother chemicals are added and the gangue minerals and crystals are selectively separated. Concentrated carnallite from the flotation circuit is transferred to a flotation thickener where saturated flotation brine is removed and recycled to the flotation circuit or returned to the evaporation ponds.

Dewatering

Concentrated carnallite is then further “dewatered” on horizontal belt filters producing a low moisture crystal product suitable for the decomposition/recrystallization process. In cold crystallization, carnallite is decomposed into free ions and by carefully controlling the concentration at the appropriate ambient conditions, Sylvite (KCl) will recrystallize while the MgCl remains in solution. However, any halite remaining in the solution also recrystallizes at these concentrations and conditions.

The halite crystals are generally much larger than the Sylvite crystals and can be removed by screening prior to product thickening. The concentrated product Sylvite moves from the product thickener to product horizontal belt filters where the crystalline product can be countercurrent-washed and dewatered to remove wetting brine which contains MgCl. The filter cake is then leached for final cleaning in a centrifuge. Centrifuge cake is then dried, compacted, sized, and bagged for sale and use.



Power Generating Station – ZLD with Sidestream Softening

WesTech

DWN: RCS DATE:

WesTech's advanced line of equipment for industrial sedimentation applications includes a wide range of ***Clarifiers and Thickeners*** expressly designed for current and future process requirements. The equipment is precision engineered and manufactured to rigid standards providing high torque capacities, long life and reliability. WesTech manufactures our own thickener and clarifier ***Drive Units*** ensuring long drive life and the best fit for your process equipment.

Power Station

Power-generating stations, like other industrial wastewater producers, are facing stricter discharge requirements. This flow sheet combines many of the water treatment steps that might be encountered in converting a power station into a zero liquid discharge (ZLD) system. In this system, the final waste stream is sent to a spray dryer.

This flow sheet is a combination of several other flow sheets. The first section where the raw water enters is the service water pretreatment. The service water can be used for general water needs in the plant. The next section is demineralization for boiler feed water. The final section is the zero liquid discharge system that treats a slip stream from the cooling tower.

Not shown is water treatment necessary for drinking (potable) water and sewage (see man camps).

Service Water Pretreatment - Cold Lime Softening and Clarification

In the first stage of treatment the raw water is softened to reduce the calcium and magnesium hardness (for more information on softening see the Cold Lime Softening flow sheet). Some of the softened water is diverted to the cooling tower.

After recarbonation, the treated water is collected in the service water storage tank. Some of the service water is sent to the demineralizer system. The rest of the water is used for backwashing filters.

The softening system includes a sludge dewatering step that is common to the entire plant. The thickener overflow is sent to the clarifier. The belt press pressate and wash water are returned to the thickener.

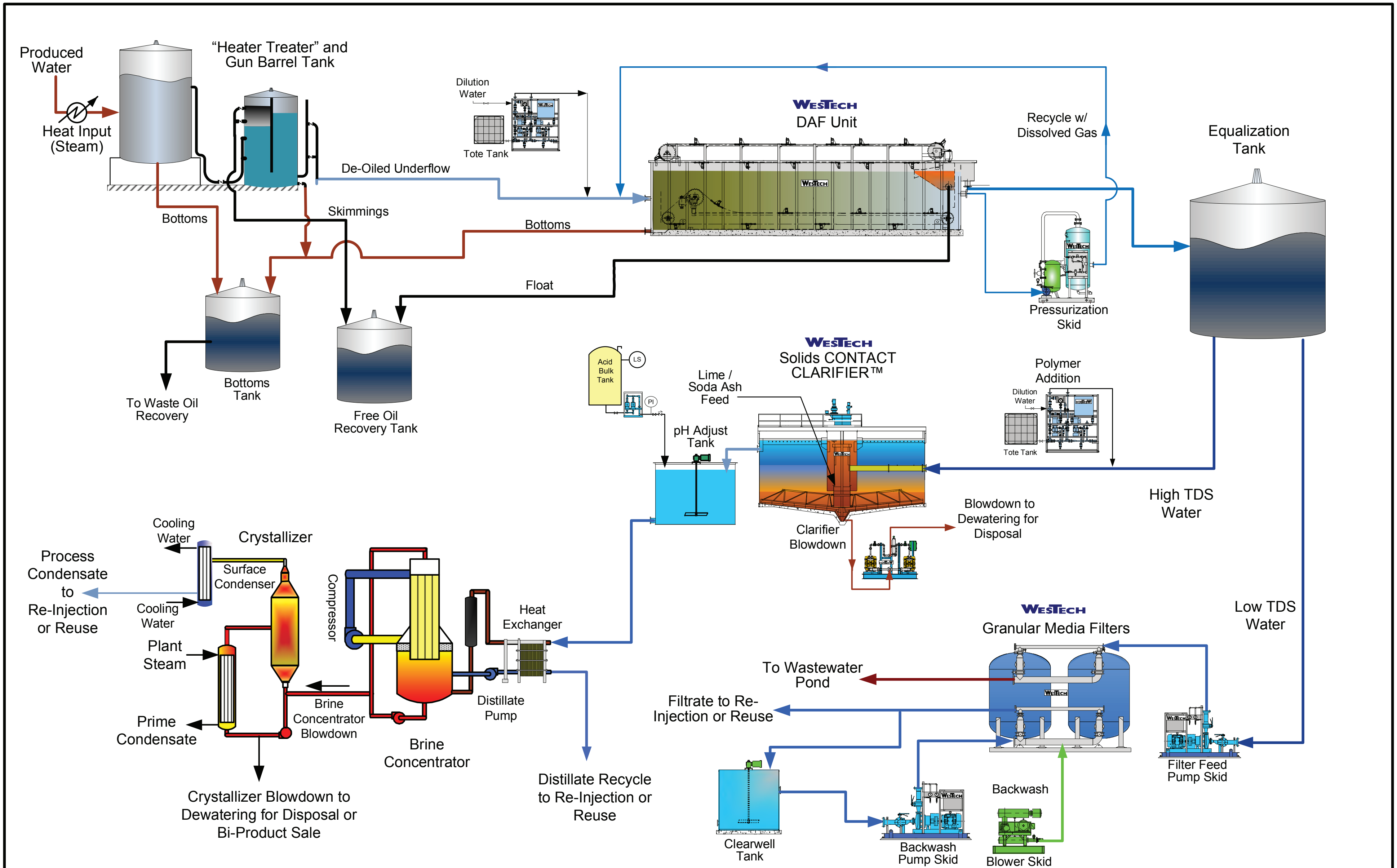
Boiler Feed Water - Demineralization

The softened water passes through two stages of reverse osmosis (RO) to remove the bulk of the minerals. The RO reject is sent to the ZLD system. The electrodeionization (EDI) system makes high purity water by polishing the trace contaminants left after reverse osmosis using electricity instead of chemicals.

Zero Liquid Discharge – Cooling Tower Slip Stream

The cooling tower slip stream treatment system is nearly identical to the ZLD flow sheet (a more detailed description of the process can be found on the Cold Lime Softening flow sheet). In this case, the clarifier is not used for cold lime softening, but it could be. The ZLD system shares the sludge dewatering facilities with the service water pretreatment system.

The water is clarified, filtered, and treated with reverse osmosis. The reject from the boiler feed water system may be added to the clarifier or sent to the drying system depending on the chemistry of the water. The reverse osmosis concentrate is treated with a spray dryer and the dry solids are sent to a landfill. If the concentrate stream is too large for a spray dryer, the wastewater may be sent to drying beds in areas where the evaporation rate is greater than nominal rainfall, or to an evaporator/crystallizer system.



Produced Water

WesTech

DWN: RCS DATE:

WesTech builds a complete line of ***Dissolved Air Flotation (DAF)*** and Dissolved Nitrogen Flotation (DNF) equipment for both municipal and industrial applications. Dissolved air and nitrogen flotation is used in applications where the specific gravity of the solids or contaminants is close to or less than 1.0. Dissolved air or nitrogen provides the driving force for separation. The gas is dissolved into a liquid under pressure in a specially designed saturation tank. The saturated liquid flows under pressure to the mechanism. The pressure is released by the back pressure control valve near the center of the unit. The sudden release of pressure causes the gas to come out of solution and form microscopic bubbles. These microscopic bubbles adhere to the incoming solids and form a buoyant blanket which rises to the surface for removal by mechanical means.

Produced Water Treatment

When oil or natural gas comes out of the ground, water flows with them. The drillers call this "produced water" because it is produced by the well. This water is naturally occurring and the chemistry is unique to each strata. The flow rate of produced water varies greatly. Dry gas wells may only produce 2-3 barrels (42 gallons) of water a day. Some oil wells produce 2-3 barrels of water for every barrel of oil produced.

The amount of water "produced" by a well is usually constant over 80% of the life of the well. Initial flows are no indication of long term flows and, at the end of the life of the well, water production usually goes up. Fortunately water quality does not vary after the first few weeks of production.

Deep Well Injection

Most produced water is deep well injected. The only treatment needed for deep well injection is usually filtration to remove solids that could plug the well. In some cases, partial softening is needed because the deep wells are often very hot, causing hardness to precipitate and plug the well screen or the formation.

Treatment Options

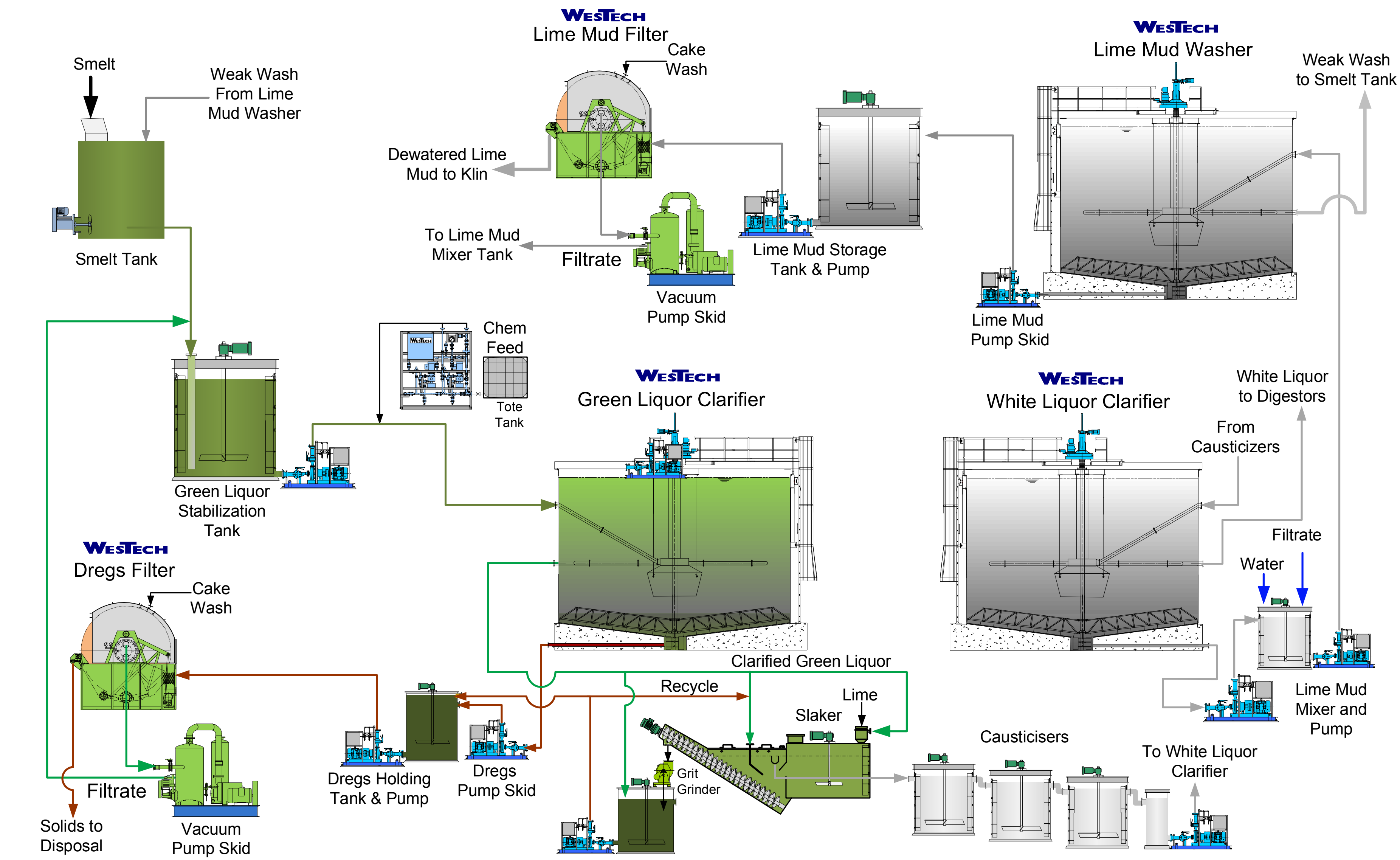
With the recent increase in well drilling, along with problems in permitting new deep wells, treatment options are being studied. The preferred option is to reuse the produced water. Some states allow the use of produced water as anti-icing solution or as dust control on the roads to the wells. However, these allowances are under review by the state and federal authorities and may not be allowed in the future.

Drilling, Finishing, or Hydraulic Fracturing

Another reuse option is to use the produced water as makeup for drilling, finishing, or hydraulic fracturing ("fracing") of wells. This option is especially attractive in areas where fresh water is difficult to obtain. Since the wastewater characteristics are unique and the makeup requirements vary with each usage, customized treatment systems are usually necessary. These treatment systems may include filtration, clarification, softening, and reverse osmosis.

To complicate the design, the system may be in the middle of "nowhere" with the only power available from diesel generators. The system will operate for about 30 days and then it must be moved to another site which may have different chemistry. All waste materials, solid and liquid, must be hauled off to a location that may be miles away.

When the TDS in the produced water exceeds 10,000, it can be difficult to reuse. Other options for disposal are deep well injection or zero liquid discharge (ZLD) by using evaporators and crystallizers. Some of the dry waste has been used for road salt but most has to be encased and buried.



Pulp and Paper – Green Liquor / White Liquor Circuit

WesTech

DWN: **RCS** DATE:

WesTech's ***Continuous Rotary Drum Filters*** provide a wide range of liquid-solids separation for many types of industrial processing flow sheets. They offer the operating flexibility to handle dewatering, washing, and filtration applications. Working with the customer, WesTech provides laboratory test data to assess process optimization, design, and sizing of the equipment supplied. WesTech Drum Filters are available up to 13.5 feet in diameter and 36 feet in length and are built for ease of operation as well as to meet demanding customer specifications.

Pulp and Paper

The most common process for making paper is called the Kraft or Kraft Mill process. In this process, wood chips are "cooked" at 150 - 165º C, under pressure in a liquid solution containing caustic (NaOH) and sodium sulphide (Na_2S) to pulp the wood.

White Liquor

The solution of caustic and sodium sulfide is referred to as "white liquor". These chemicals, along with heat and pressure, release the lignin from the fibers in the wood. The resulting "pulp" is washed, screened, and sent on to bleaching and becomes the feed stock for the paper-making process.

Black Liquor

The waste from the pulping washing step (residual chemicals, lignin, organics, etc.) are removed and become what is known as "black liquor." This black liquor is sent to multiple effect evaporators to be concentrated. From there it is burned in the recovery boiler.

The black liquor is burned in an oxygen-deficient atmosphere. This process forms a molten product consisting mostly of Na_2S and sodium carbonate (Na_2CO_3).

Green Liquor

This molten material is referred to as "smelt"It is sent to a tank where water is added. The resulting liquid is known as "green liquor." From the smelt tank the stream is sent to the green liquor stabilization tank.

The green liquor also contains small amounts of suspended solids, called "dregs." The dregs are hazardous and must be removed. This is typically done in the green liquor clarifier.

Dregs

The dregs from the green liquor clarifier are sent to a rotary vacuum filter called the "dregs filter." Here the dregs are washed to remove residual chemicals and are dewatered prior to disposal. The liquids are recycled to the green liquor stabilization tank.

Slaker

The clarified green liquor is fed to a "slaker" where NaOH is formed. The grit and unreacted lime settle to the bottom where they are removed by means of a screw conveyor.

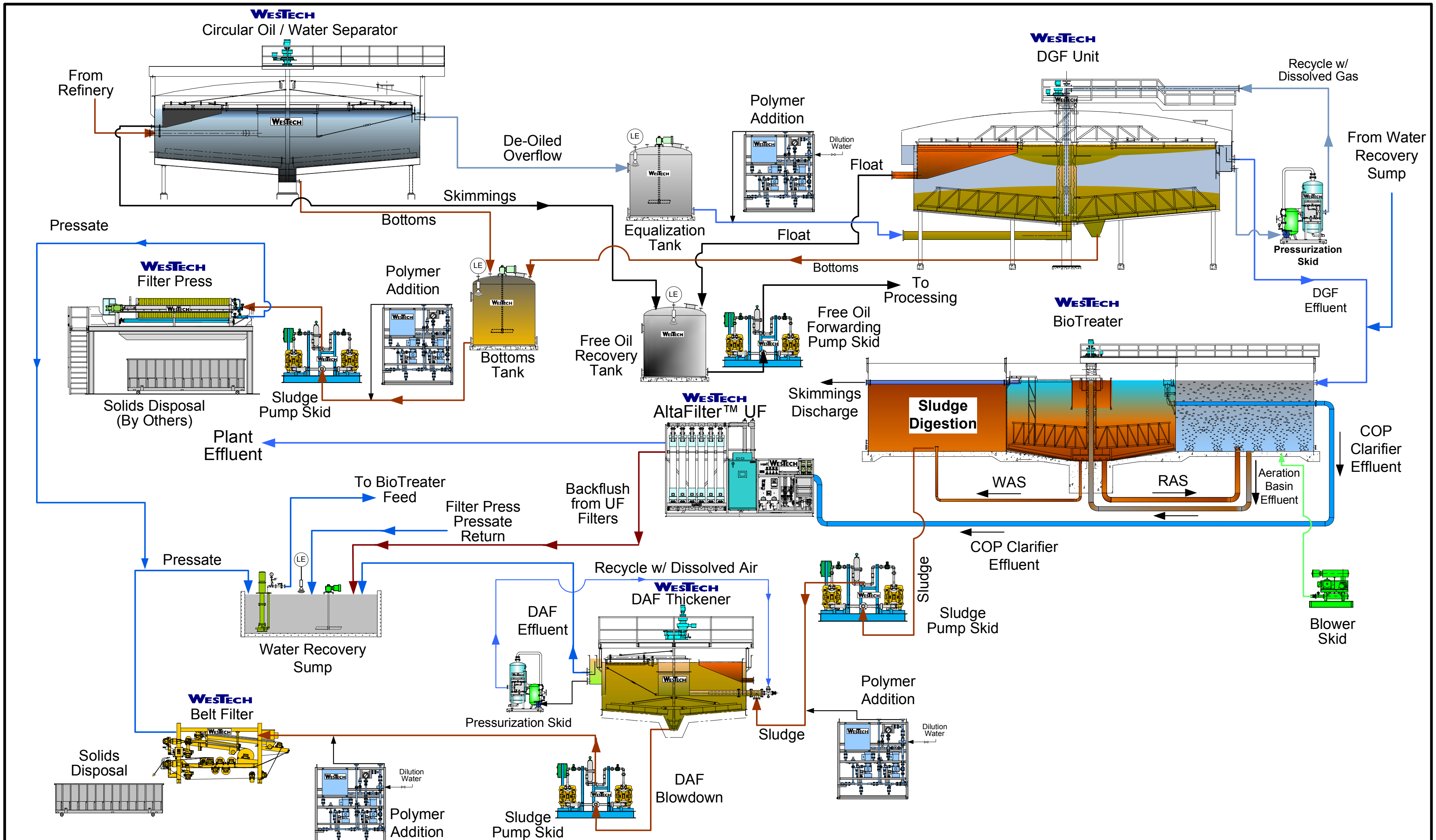
The slurry flows through a series of agitated tanks in a process known as causticising. The main products of this process are calcium carbonate ($CaCO_3$) and NaOH. The effluent of this process is now referred to as "white liquor" and is pumped to the white liquor clarifier.

The overflow from this clarifier is returned to the pulp digestion process. The settled $CaCO_3$ precipitate is known as lime mud. This slurry is "washed" with a combination of fresh and recycled water.

Lime Mud Washer

This wash water is sent to the "lime mud washer." The overflow from this unit is sent back to the smelt tank. The underflow is dewatered on a rotary vacuum filter known as the "lime mud filter." The dewatered solids ($CaCO_3$) are sent to the lime kiln to be converted to burnt lime (CaO). The filtrate from these filters is returned to the lime mud mixer tank.

In this way, a very high percentage of all the chemicals used are recycled and there is much less impact on the environment from waste disposal.



Refinery Effluent Treatment

WESTECH

DWN: **RCS** DATE:

The ***BioTreater™ Biological Treatment and Clarification System*** combines a biological treatment system with clarification in a compact design utilizing common wall construction. The biological treatment is located at the periphery in a ring-shaped area while the clarification stage is in the central region. The treatment system is fully expandable for complete biological nutrient removal. The system can also be designed to incorporate aerobic sludge holding, flow equalization, post aeration and chlorine contact chamber.

Oil/Water Separators

The American Petroleum Industry (API) developed design guidelines for oil/water separators in the early twentieth century. These rectangular design guidelines have remained remarkably constant since that time, and oil/water separators have become standard equipment worldwide.

The design goal of these separators is to create a quiescent zone in which oil droplets can float and coalesce on the surface for skimming and removal. Settled solids are transported to a collection sump for disposal.

Factors governing the separation of fats, oil and grease (FOG) from wastewater include: viscosity of the fluids, temperature of the waste stream, particle size, specific gravity of the FOG, the apparent specific gravity of solids coated with oil, retention time, and turbulence created in the oil / water separator. These factors are **not** affected by separator geometry.

Rectangular Separators

Traditional separators have been rectangular. While small units have the advantage of shop assembly, all rectangular units require submerged bearing, chain and flight skimmers. With many submerged moving parts, these older units are notoriously maintenance intensive. The units are difficult to seal to prevent the escape of volatile organic carbons (VOC).

This was not an issue when the units were first put into service, but had become a matter of regulation by the EPA, causing rectangular units to require retrofit, replacement, or abandonment. Sealing difficulties lie in the many sections of the covers required for long tanks, numerous access openings in the covers required for maintenance and inspection, difficulty in sealing chain drive shaft penetrations, and retrofit difficulties with old concrete or steel tanks.

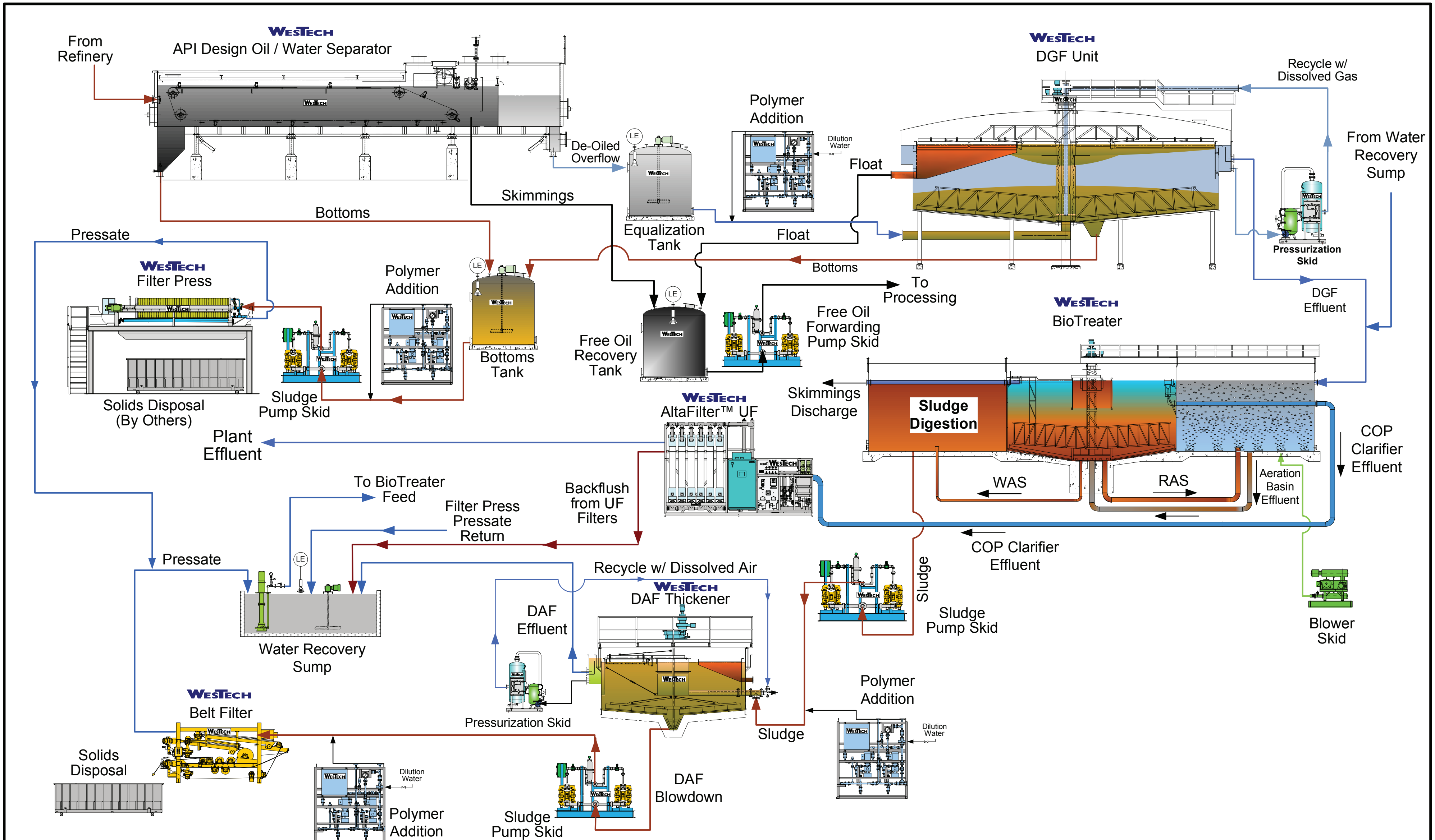
Weaknesses with rectangular separators include chain deterioration and oily sludge removal. As sludge builds up to the rakes, the submerged bearings and chain-driven rakes fail because they cannot push the viscous sludge. If the rakes fail, the separator must be shut down and emptied for repair. Repair is hindered by vapor control covers that must be removed. Operators avoid frequent equipment failures by pumping out overly dilute sludge to maintain a low sludge layer.

Circular Units

The rakes in circular units are designed to transport dense sludge loads. Circular clarifiers are commonly used for heavy oily sludge thickening in refineries. Circular units can concentrate sludges up to 5%, so no additional thickening is required before treatment. Circular unit maintenance is simplified with fewer moving parts, and the motor and gearbox are located above the domed VOC containment roof. Circular units may also be installed in existing, yet vacant, tanks at significant cost savings.

Maximum flow through rectangular units is limited by the length-to-width ratio and available real estate. Circular units easily function at diameters over 100 feet and offer much higher flow capacity.

As with other instances of technology reapplication, performance track records are short. Nevertheless, the potential increases in efficiency coupled with the decreases in maintenance costs means consideration of circular separators should be given for new installations as well as existing plants.



Refinery Effluent Treatment – API Type Separator

WESTECH

DWN: **RCS** DATE:

The WesTech ***BioTreater™ Biological Treatment and Clarification System*** combines a biological treatment system with clarification in a compact design utilizing common wall construction. The biological treatment is located at the periphery in a ring-shaped area while the clarification stage is in the central region. The treatment system is fully expandable for complete biological nutrient removal. The system can also be designed to incorporate aerobic sludge holding, flow equalization, post aeration and chlorine contact chamber.

Refinery Effluent Treatment

Oil refineries create large amounts of oily wastewater. The wastewater usually contains flammable material, so all equipment is covered and sealed. The air above the wastewater is displaced by nitrogen (nitrogen blanketed) so that fires or explosions cannot take place. The wastewater also may contain heavy metals such as cobalt, iron, copper, etc.

Oil/Water Separator

The first step in refinery wastewater treatment is an American Petroleum Institute (API) design oil/water separator. API requires a long and shallow rectangular concrete basin with width set by flow rate. WesTech has developed and sold circular oil/water separators built to API standards.

The oil/water separator creates a laminar flow that allows oil to rise to the top and solids to drop to the bottom. The solids are collected through various means and sent to a bottoms tank. The contents of the bottoms tank are then pumped to a filter press where free water and oil are removed. Polymer is usually added to the material flowing to the press to improve filtration.

The free oil is skimmed from the oil/water separator and flows over a weir to an oil recovery tank. The recovered oil is then pumped back to the process.

Dissolved Gas Flotation

The wastewater flows from the oil/water separator to an equalization tank. Polymer is added to the wastewater as it is pumped to a dissolved gas flotation (DGF) unit. Some of the effluent from the DGF flows through a pressurization skid where a gas is dissolved in the water under pressure.

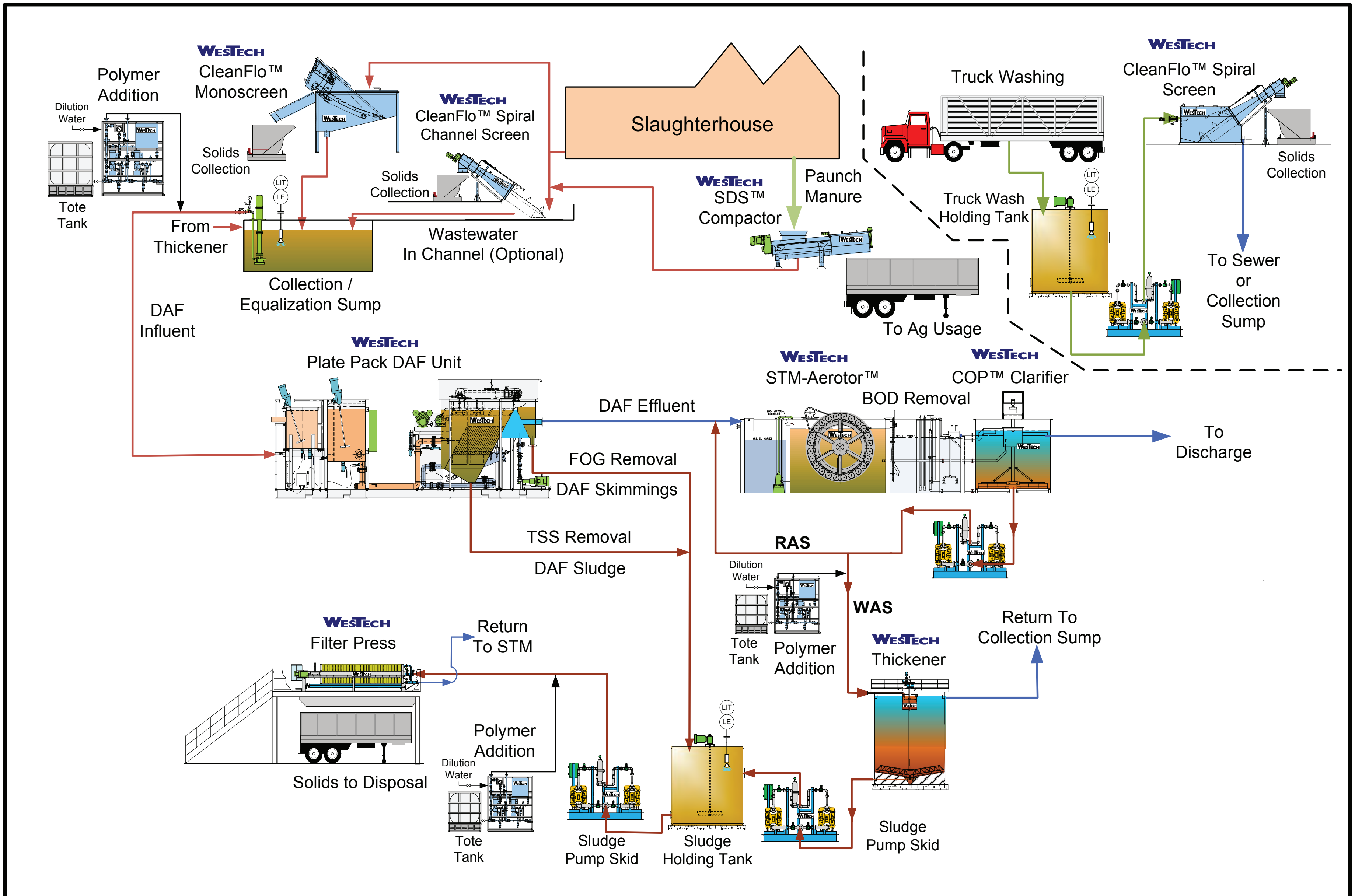
The water with dissolved gas is recycled back to the DGF. The DGF is not pressurized, so the recycle flow releases most of the dissolved gas which creates bubbles. The bubbles flow up through the wastewater and collect any oil that is present. The gas and oil floats to the top of the water where the bubbles burst and the oil is released to float. This "float" is skimmed and flows to the oil recovery tank.

Biotreater

The wastewater then flows to a biotreater where bacteria consume the bulk of the remaining hydrocarbons. Sludge is created as the bacteria grow and must be removed from the system. Part of the sludge is recycled back to the front of the system (recycled activated sludge) and the rest is sent to sludge digestion (waste activated sludge).

Dissolved Air Flotation

Effluent from the sludge digester is pumped to a dissolved air flotation (DAF) unit. Some of the effluent from the DAF flows through a pressurization skid where a gas is dissolved in the water under pressure. This water with dissolved air is recycled back to the DAF. Bubbles are formed that then float the sludge to the top of the DAF. The sludge is skimmed and pumped to a belt filter for drying and disposal. Treated wastewater flows to a sump where it is recycled back to the plant processes.



Slaughterhouse Wastewater Treatment

WesTech

DWN: **RCS** DATE:

Historically, slaughterhouses were located along rivers to facilitate waste removal. Prior to the US Clean Water Act of 1972, untreated slaughterhouse waste damaged waterways because of its high biochemical oxygen demand (BOD). Slaughterhouse waste is high in calorie rich fats and protein. Dumping this in waterways provides aquatic microorganisms a cornucopia of food that results in their logarithmic reproduction. Treating slaughterhouse wastewater is important for prevention of high organic loading to municipal wastewater treatment plants. The most common methods used for treating slaughterhouse wastewaters include fine screening, sedimentation, coagulation, flocculation, and filtration.

Slaughterhouse Wastewater Treatment

In a slaughterhouse, wastewater can be generated from a variety of sources: washing carcasses, processing offal, cleaning equipment, stockyards, any rendering process, chillers, vehicle wash facilities, etc. There also a number of noncontact sources: storm water, cooling water (vacuum pumps, air conditioners, compressors), steam condensate, etc. The amount of wastewater generated depends on the age of the plant (new plants tend to be designed for less water use) and the plant practices (i.e. wet vs. dry cleaning practices).

The amount of wastewater generated can range from several hundred to several thousand gallons per head of cattle processed.

Screening

Screening is the preferred pretreatment for almost every waste stream. Removal of large solids not only produces a source of renderable materials with monetary value, but also reduces the solids, biochemical oxygen demand (BOD), oils and grease levels requiring treatment by downstream processes. Screens accomplish this without the addition of chemicals and with minimum energy input.

However, proper screen selection is vital to having a treatment system which is highly efficient and easy to operate and maintain. Screens must be designed to operate with a minimum amount of cleaning. WesTech offers a complete line of screens designed for each waste stream.

Striking a Balance

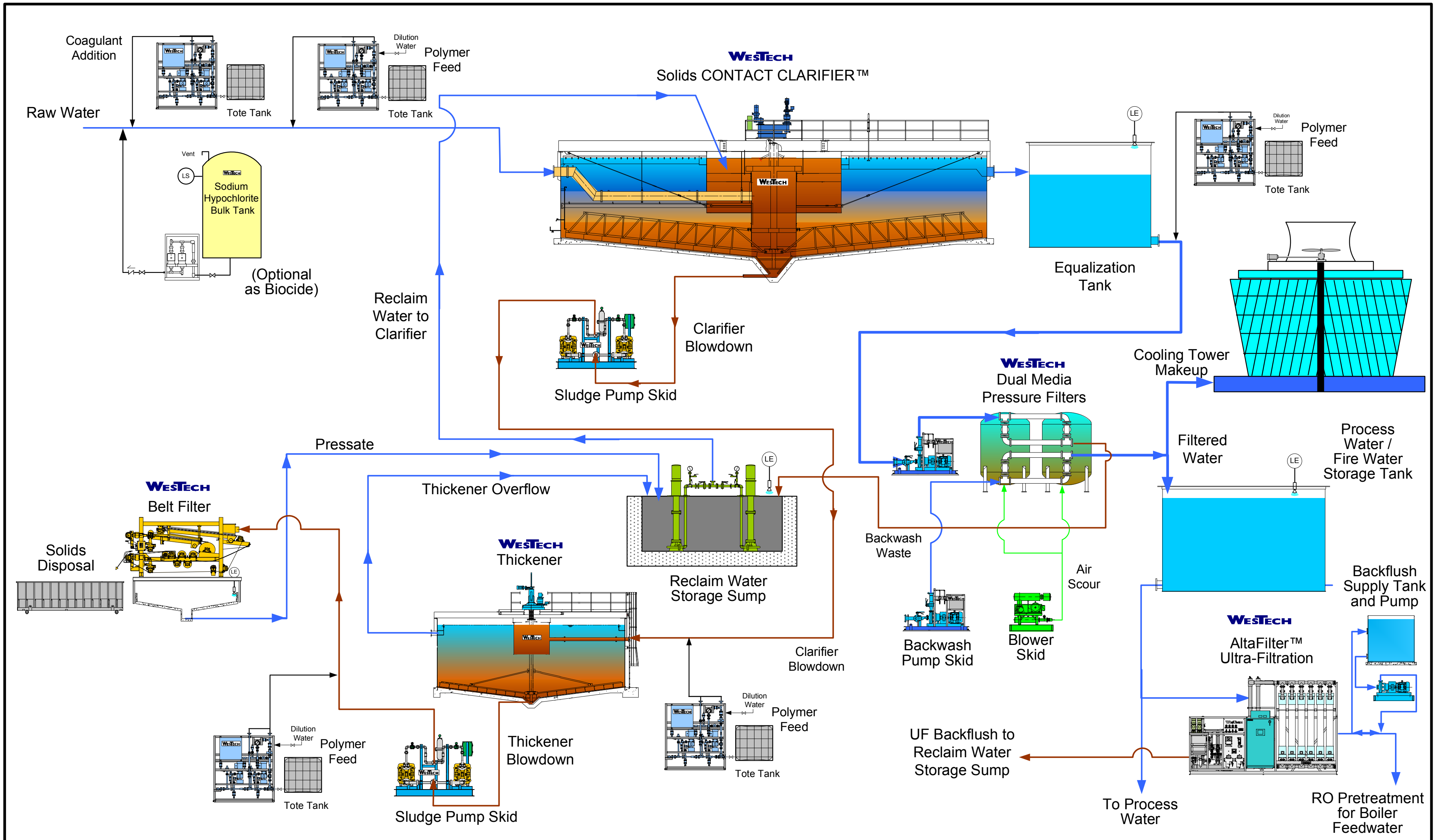
A well-designed wastewater treatment system strikes a balance between streams which are best kept segregated, either due to recoverable byproducts or because of the difficulty and/or cost of treatment (i.e. blood, manure, etc.), and streams which can be combined for the equalization of flow rates and levels of contaminants. Any wastewater treatment process performs best when treating a stream which is constant in its levels of constituents (either high or low). This is especially true with biological treatment. The number and type of microorganisms adapt to the amount and type of nutrients available.

After screening and equalization, the majority of the wastewater is sent to a dissolved air flotation (DAF) unit where fats, oil and grease (FOG) are floated to the surface and skimmed off to a sludge holding tank. Heavier solids settle and are also sent to this same tank. These materials may have value as renderable materials. The water from the DAF is sent to biological treatment for BOD removal.

WesTech STM-Aerotor™

The WesTech STM-Aerotor™ employs a combination of activated sludge and fixed film to consume the biological material. This allows the unit to better handle swings in contaminant levels associated with daily cleaning cycles and to survive weekend periods of low BOD levels. The effluent from the STM-Aerotor is processed the same as conventional activated sludge in a WesTech COP™ clarifier.

From the COP clarifier, a portion of the sludge becomes recycled activated sludge (RAS) which is recycled back to the STM-Aerotor to maintain a high microorganism population. The remainder of the sludge becomes waste activated sludge (WAS) which is sent to a thickener. This unit thickens the sludge and discharges it to the sludge holding tank. It should be noted that the skimmings and sludge from the DAF are not sent to the thickener as they are already in a thickened state from the DAF and would not benefit from further settling time. Sludge from this tank is pumped to a filter press for dewatering.



Surface Water Pretreatment

WesTech

DWN: RCS DATE:

The ***AltaFilter™ Ultrafiltration System*** is supplied as a pre-engineered system with integrated piping, valves and controls, and has been successfully applied in potable water treatment, municipal wastewater filtration and industrial applications. Custom-engineered systems are available to meet unique needs.

Surface Water Pretreatment

Surface water pretreatment prepares water for use in any type of treatment plant and is needed when the source of water comes from a raw/contaminated source (usually river water) where the total suspended solids (TSS) could range from 50 mg/L – 200 mg/L.* This treatment consists of four steps: chemical pretreatment, clarification, filtration, and sludge treatment

Chemical Pretreatment

Sodium hypochlorite (bleach) is added to kill any living organisms that may be in the raw water. Coagulant helps particles come together to improve clarity and settling. Polymer turns individual particles into larger clusters. The larger particles settle faster and form a more concentrated sludge.

Clarification

After the chemical pretreatment, the water flows into the Solids CONTACT CLARIFIER™. The Solids CONTACT CLARIFER™ is used when there are not enough solids in the feed water source to flocculate on their own. Settled solids from the bottom of the clarifier are mixed with the feed water. The particles interact and form larger, faster settling particles. The clarified water flows out the top and the solids (sludge) are scraped to the center and removed for dewatering. The overflow typically has less than 10 mg/L of suspended solids.

Filtration

If necessary, the overflow can be treated by filtration. The water starts by going into an equalization tank that allows for a constant flow into the dual media filter. As the water flows from the equalization tank to the dual media filter, polymer may be added to improve filtration. The resulting water TSS is now less than 1mg/L. It may be directly sent to a cooling tower or it can be further filtered depending on the intended use.

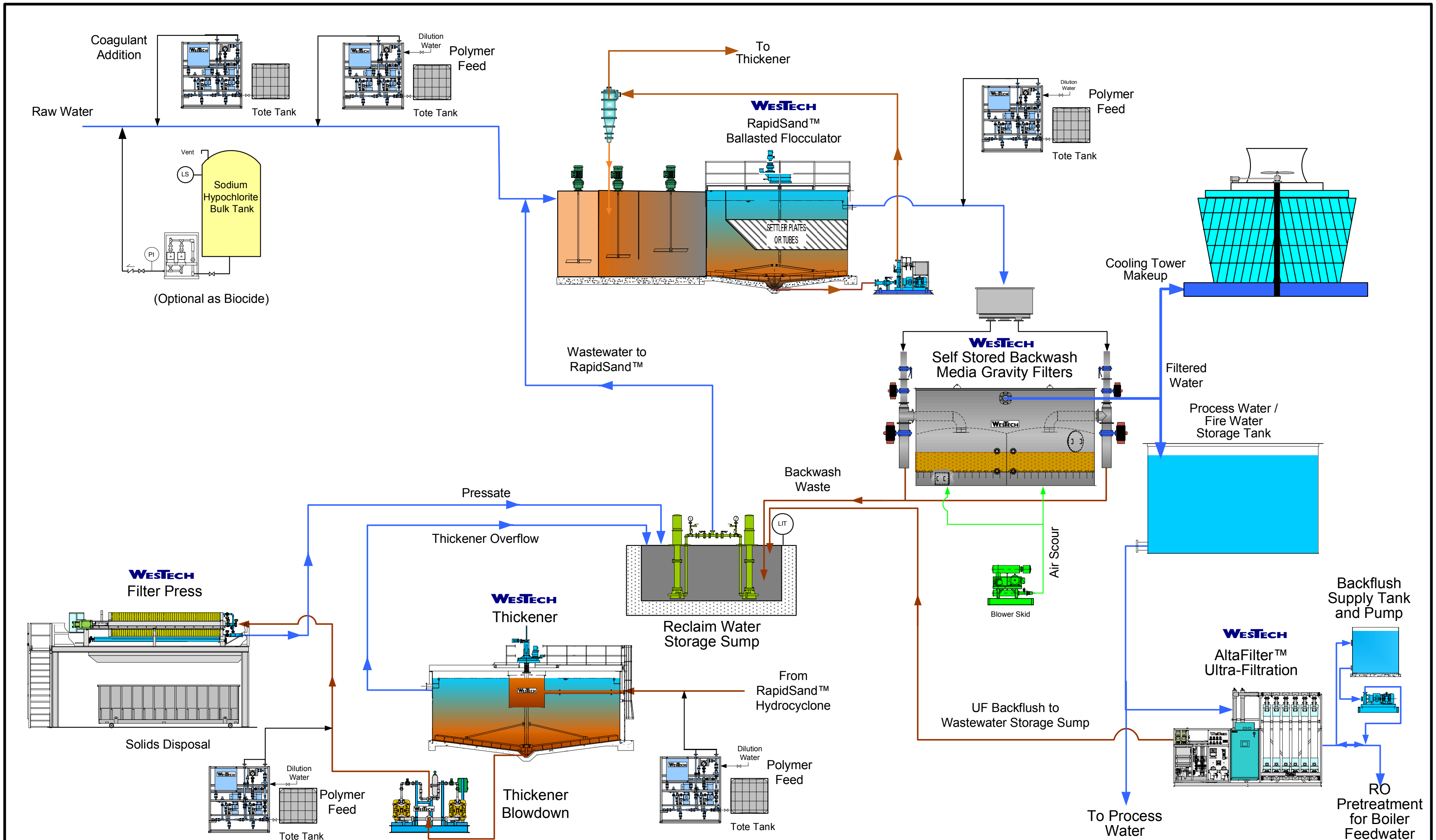
If the water is being used for a boiler then it may need to go through reverse osmosis. The AltaFilter™ Ultrafiltration System is a low pressure membrane filtration system that removes small suspended solids from the water to improve the efficiency of the reverse osmosis system.

Sludge Treatment

The underflow of the Solids CONTACT CLARIFIER™ is pumped into a thickener. Polymer is added to improve settling and clarity. The thickened underflow is sent to a belt press or other type of vacuum or pressure dewatering filter. The belt press places the solids between two belts and squeezes the water out through a series of rolls.

The belt press requires additional polymer to function properly. The cake is then hauled off for disposal and the pressure and wash water is recirculated for further use. The pressate and cloth wash water get pumped to the reclaim water storage sump with the backwash from the filtration systems and then it is recycled back into the Solids CONTACT CLARIFIER™.

* If total suspended solids are <50 mg/L then water should go straight to a filter. If >500 mg/L, the water might go to a standard clarifier. Cold lime softening might be considered for water hardness above 150 mg/L as $CaCO_3$.



Surface Water PreTreatment - RapidSand™

WesTech

DWN: **RCS** DATE:

The WesTech ***RapiSand™ Ballasted Flocculation System*** is a high rate clarification process combining rapid mixing and multi-stage flocculation, followed by sedimentation. RapiSand™ sedimentation is extremely fast and can be applied in a wide variety of suspended solids removal applications. Typical advantages of the RapiSand™ include expanding plant capacity, minimizing plant footprint, providing fast startup capabilities, as well as providing great performance characteristics. RapiSand™ may be the answer to your suspended solids process needs.

Surface Water Pretreatment

Surface water pretreatment prepares water for use in any type of treatment plant (i.e., power, chemical, petrochemical, etc.) and is needed when the source of water comes from a raw/contaminated source (usually river water) where the total suspended solids (TSS) can range from 50 mg/L – 200 mg/L. This treatment consists of four steps: chemical pretreatment, clarification, filtration, and sludge treatment.

Chemical Pretreatment

Sodium hypochlorite (bleach) is added to kill any living organisms that may be in the raw water. Coagulant helps particles come together to improve clarity and settling. Polymer turns individual particles into larger clusters. The larger particles settle faster and form a more concentrated sludge.

Clarification

RapiSand™ Ballasted Flocculation is a high-rate water clarifying system utilizing both chemical and physical treatments to remove suspended solids and unwanted particles. The process uses the proven flocculation technique of adding a dense ballast sand, allowing for much higher settling rates. Raw water is mixed with a coagulation agent to destabilize and neutralize particles in the water. During the next step of flocculation, sand and polymer are combined with the coagulated flow. The flocculation mixer provides the particles with enough energy to stay suspended and grow in size.

In the sedimentation area, developed floc particles (coagulant, polymer, sand, and solids) are allowed to settle to the bottom. Clarified water may pass through tube settlers or inclined plate settlers before it is drawn off the top of the sedimentation basin.

The settled solids are gathered and pumped from the sedimentation area through a hydrocyclone where the sand is separated for reuse and the solids are processed further.

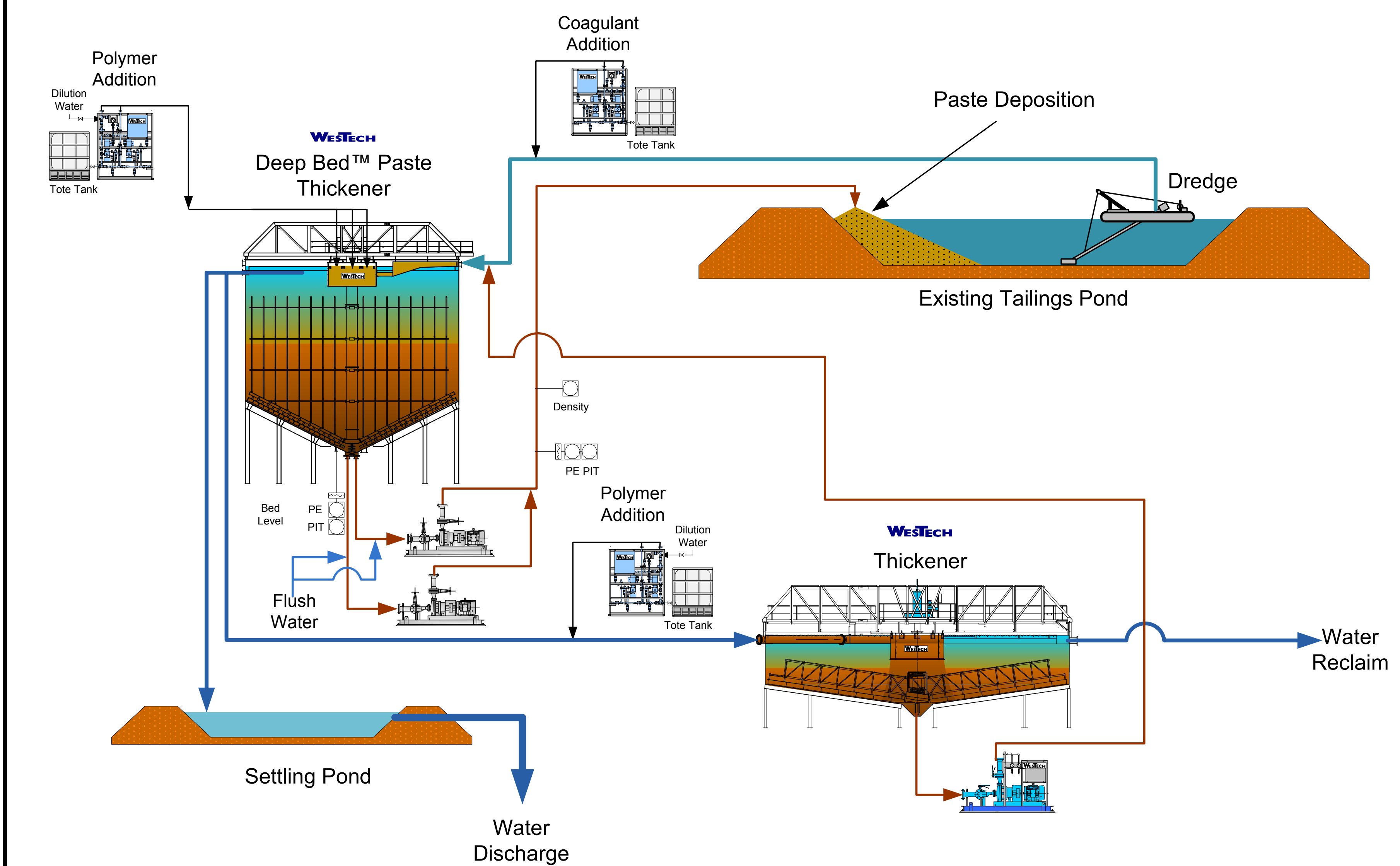
Filtration

If necessary, the overflow can be treated by filtration. The process starts in an equalization tank that allows for a constant flow into the dual media filters. As the water flows from the RapiSand™ to the dual media filter, polymer may be added to improve filtration. The resulting water is now less than 1mg/L TSS. It may be directly sent to a cooling tower or it can be further filtered depending on the intended use.

If the water is being used for a boiler then it may need to go through reverse osmosis. The AltaFilter™ is a low pressure membrane filtration system that removes small suspended solids from the water to improve the efficiency of the reverse osmosis system.

Sludge Treatment

The underflow of the RapiSand™ is pumped into a thickener. Polymer is added to improve settling and clarity. The thickened underflow is sent to a filter press or other type of vacuum or pressure dewatering filter. The slurry is pumped into the filter press under pressure to force the moisture out. The filter press may require additional polymer to function properly. The cake is then hauled off for disposal and the pressate and wash water is recirculated for further use. The pressate and cloth wash water get pumped to the reclaim water storage sump with the backwash from the filtration systems.



Tailings - Paste Thickening

WESTECH

DWN: **RCS** DATE:

The WesTech ***Deep Bed™ Paste Thickener*** produces non-settling and non-segregating underflow with the maximum rheology (density) possible. WesTech is a leader in paste technology with diverse application experience and a large installation base. Our Deep Bed™ paste thickeners maximize water recovery, enable surface stacking, reduce tailings impoundment size, improve CCD circuit product recovery, all while reducing environmental impact.

Tailings Paste Thickening

The advantages of paste thickeners in tailings circuits have been well-established for most minerals. The type of paste thickener underflow generally used for surface stacking of tailings is called "thickened tailings." Thickened tailings are a suspension of solids which are relatively non-settling and non-segregating and which have a higher concentration and viscosity than that of conventional tailings.

Common applications include a thickener with underflow pumps that are typically centrifugal and transfer pumps that can be either centrifugal or positive displacement.

Paste vs. Conventional

Paste thickeners thicken tailings to higher underflow solids concentrations than conventional and high-rate thickeners. For example, a tailings stream in an iron ore application could be thickened to 45–50% solids Newtonian slurry in conventional or high-rate thickeners. Conversely, the same tailings stream could be thickened to 65–70% solids non-Newtonian suspension using a paste thickener.

Water Recovery

Increased water recovery is important to many countries throughout the world due to the scarcity of fresh water. The more water that can be recovered from a tailing stream and, in turn, used again upstream in the plant reduces the amount of fresh water a mine needs. The cost of water is frequently one of the primary drivers for implementing a thickened or paste tailings disposal system.

Stacking

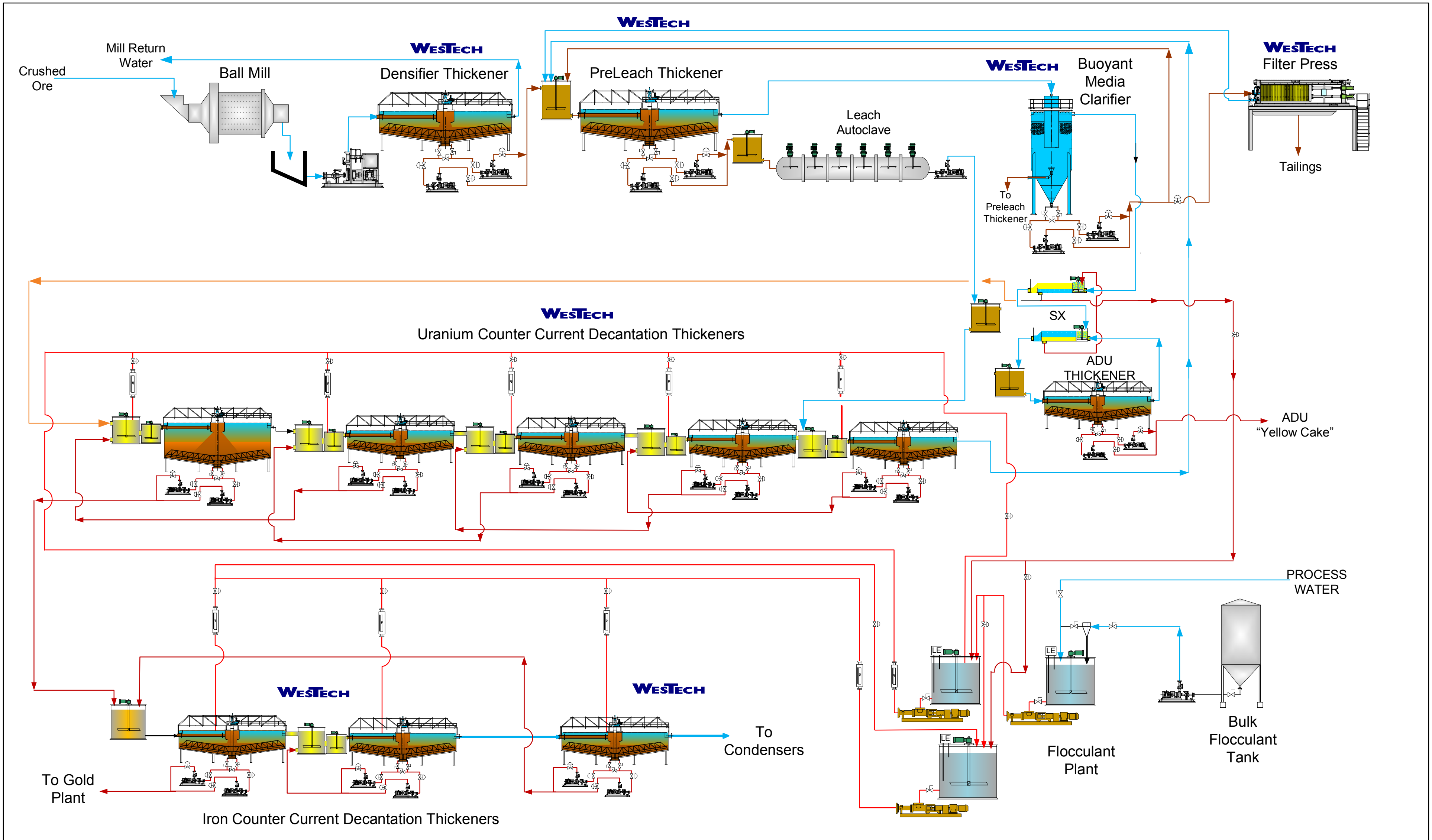
Surface stacking is the disposal of tailings on the surface of the ground. As a non-settling, non-segregating suspension of solids, minimal water is released into the impoundment and the stacked tailings dries significantly faster than conventional ponds where fines (slimes) segregate and can seal the surface of the deposit, preventing drying.

Stacking as a method of tailings disposal offers significant advantages over ponding. These advantages include: smaller impoundment area, less water in the pond, improved water or chemical recovery, a lower risk of containment breach, less groundwater contamination, and easier final reclamation of the site.

Extend Pond Life

When tailings ponds reach their capacities, the construction of a new dam is usually the solution for the deposition problem. This solution is very expensive and is not always an option if there are environmental, licensing and space constraints.

By utilizing a paste thickener, the thickened tailings stream is deposited into the existing pond, increasing the life of the impoundment. The existing free water in the pond will be displaced and available for recovery and the higher concentration and drying properties of the paste will take up less space, extending the life of the pond.



Uranium Leaching Circuit

WESTECH

DWN: RCS DATE:

The geometry of the ***TOP™ Thickener*** dewatering chamber provides additional solids residence time and larger inventory for compacted solids. Inclined scrapers are used for further dewatering within the chamber. WesTech's approach to elevated tank design is unique. An algorithm has been developed to simultaneously analyze parameters such as beam size, beam quantity, leg size, and leg location. Designs are verified using structural analysis software. Flow distribution patterns can be analyzed using computational fluid dynamics (CFD). WesTech uses CFD technology as a tool to optimize the feed distribution system design.

Uranium Ores

Uranium ores are generally classified as acidic, alkaline, or phosphate rock based. In all cases, the ore is milled and classified prior to leaching. Since the final milling is done in a ball or rod mill as a slurry, it is necessary to concentrate the milled ore slurry in a pre-leach thickener prior to the leaching process in order to reduce dilution. Acidic and phosphate ores are leached with acid while alkaline ores are generally leached with sodium carbonate and/or sodium bicarbonate.

Solvent Extraction

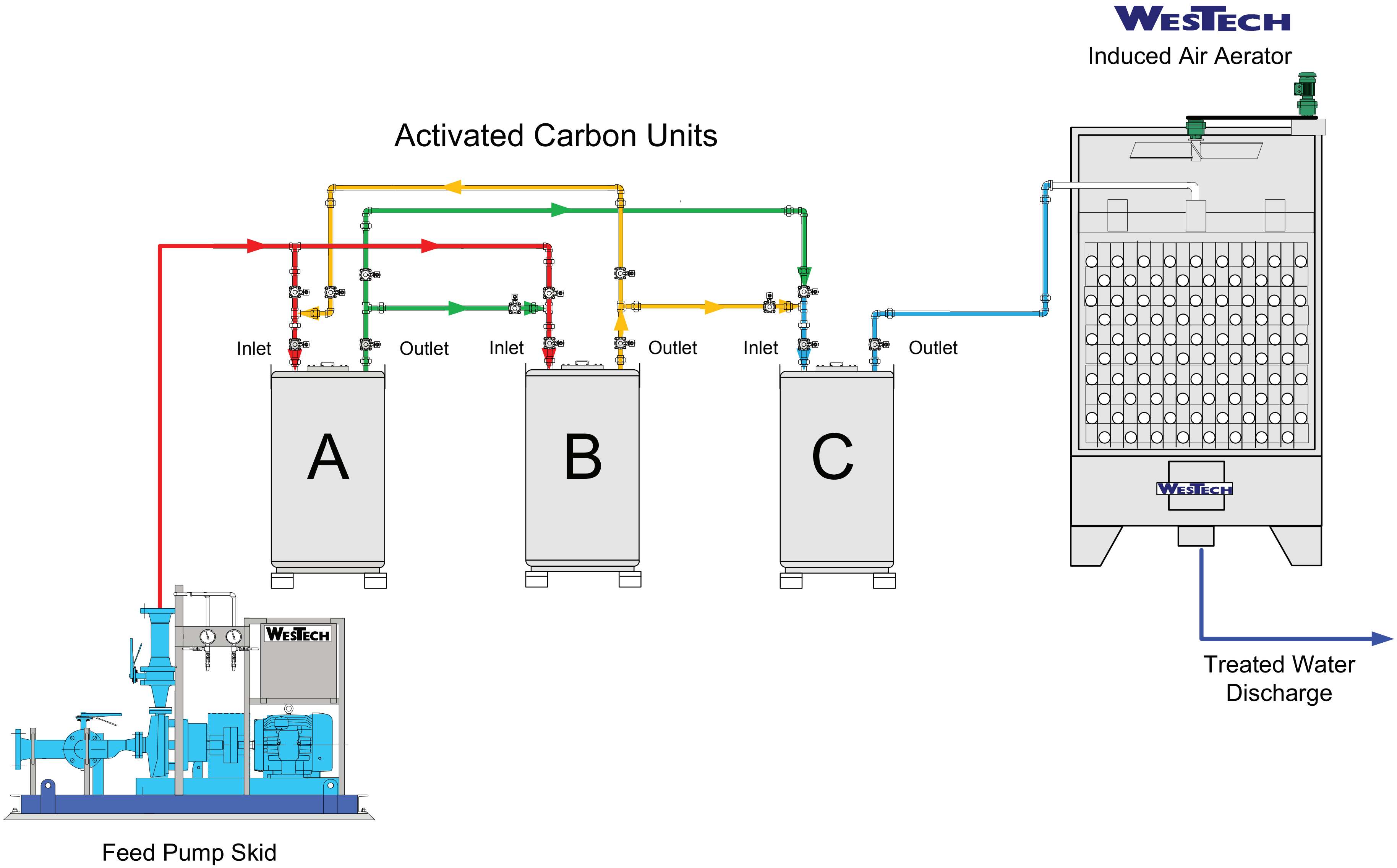
Once leached, the ore slurry is washed in a countercurrent decantation circuit where the valuable dissolved uranium-bearing materials are separated and washed from the gangue ore. This pregnant solution is then passed through a buoyant media clarifier where any finely divided gangue material can be further separated, and the valuable pregnant solution is polished.

This separation is important to minimize the development of "crud" in the subsequent solvent extraction process. The solvent extraction process allows for ion exchange of uranium ions between two aqueous phases. It is also common to use conventional direct resin-based ion exchange in lieu of solvent extraction.

Yellow Cake

Following ion exchange or solvent extraction, a precipitation reaction produces finely divided "yellow cake" particles. This "yellow cake" material is thickened and then filtered to produce a solid cake material suitable for further conversion into UO_2 or UO_3.

WesTech specializes in liquid/solids separations which are critical in the production of the uranium intermediate product called "yellow cake." These processes include: sedimentation for concentrating ore slurry, counter current decantation for washing and recovery of pregnant solution from leached ore slurry, polishing of pregnant solution prior to solvent extraction as well as final concentration and filter dewatering of "yellow cake" product.



Volatile Organic Carbon (VOC) Removal

WesTech

DWN: **RCS** DATE:

Multiple types of equipment are used for mechanical oxidation and ***Volatile Organic Carbon (VOC)*** removal. The most common and efficient is positive draft aeration. Counter-current flow of air and water is created in cylindrical or rectangular vessels. Loose fill of special shaped media increase contact surface area and exposure time. Water flows evenly over the unit cross section before dropping into the media filled aeration zone. The media allows for the air to move up through the finely dispersed water droplets.

Volatile Organic Carbon (VOC) Removal

Volatile organic carbon (VOC) are regulated organic compounds that are either hazardous to breathe or flammable. Usually these chemicals are removed by means of activated carbon usually followed by air stripping. This method has been shown to remove 95%+ of these compounds.

Activated Carbon Units

For small flows, the system consists of three (3) activated carbon units followed by a forced draft aerator. The activated carbon units are run in series in order to obtain maximum effectiveness. Unit A begins as the lead unit with Unit B as the lag unit. To simplify the piping and reduce the number of valves, Unit C is always the polishing unit.

The units are 5′ diameter by 72″ bed depth and contain 3,000 lbs. of activated carbon. These units are designed to be regenerated offsite and should have a capacity of at least 30 days.

When Unit A exhausts, it is replaced by a freshly regenerated unit. At this time, Unit B becomes the lead unit and Unit A becomes the lag unit. In this way, the lag unit always has the greatest capacity. The units are piped and valved such that they can be isolated, removed, and the order of operation changed while the system is online. Unit C is always the polishing unit and should be changed every six months whether it needs it or not. This will prevent problems with bed compaction, biological growth, etc.

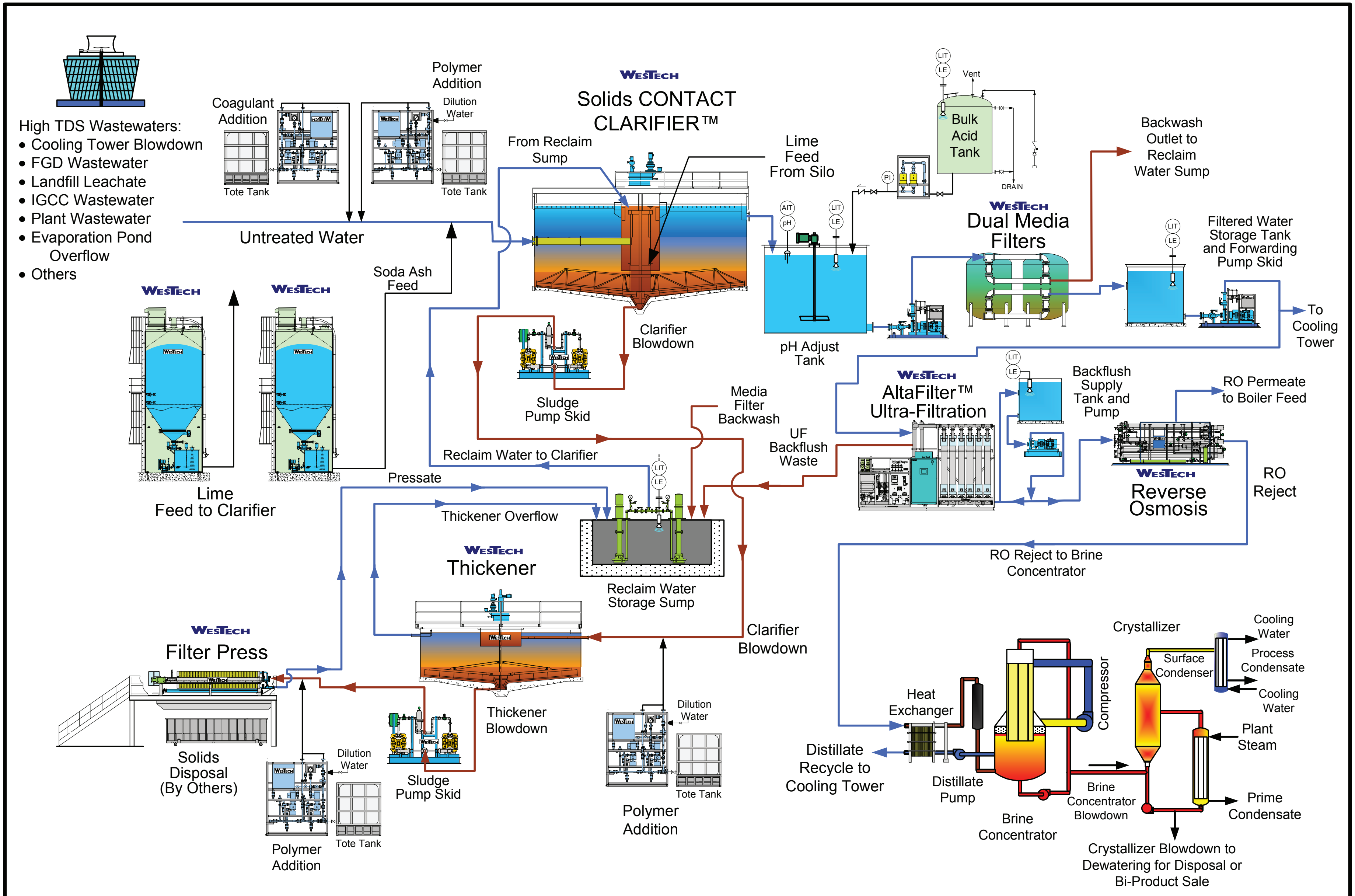
As stated above, the units are regenerated offsite. Spare units may be stored onsite for use when inline units become exhausted.

Forced Draft Aerators

After the removal of the majority of VOC's via the activated carbon, the stream is fed to a forced draft aerator for stripping of the last remnant of the VOC's. This minimizes the amount of VOC's discharged to the atmosphere. Following this step, the stream is discharged to the receiving waters.

If the concentration of VOC's is too high in the deaerator effluent air, activated carbon can be used again or the VOC's may be destroyed by several means, such as burning. One of the advantages of this system is that it would be a fairly straightforward task to pilot the treatment effectiveness.

For plants with a flare, all vapors are usually gathered and sent to the flare. Natural gas is added to the vent stream and then all organics are burned in the flare. This system removes >99.9% of all organics.



Zero Liquid Discharge

WesTech

DWN: **RCS** DATE:

The WesTech ***Solids CONTACT CLARIFIER™*** combines mixing, internal solids recirculation, gentle flocculation and gravity sedimentation in a single unit. The low shear impeller provides high volume recirculation and low floc shear, while expending less horsepower when compared to a conventional unit. Superior clarification provided by the Solids CONTACT CLARIFIER™ extends the life of the ultrafiltration membranes and reduces the amount of cleaning cycles, giving WesTech the most value from their membrane ultrafiltration system.

Zero Liquid Discharge: Crystallizer Pretreatment

Discharge requirements for industrial wastewater are becoming stricter. Many companies are moving to zero liquid discharge (ZLD) systems. In this example, water with high total dissolved solids (TDS) is treated before it is sent to a crystallizer. Crystallization is an evaporation process that creates a pure water distillate that can be sent back to the process. The remaining dissolved solids form crystals that can be removed and sent for disposal or used for something like road salt. The pretreatment process protects the crystallizer and the reverse osmosis filtration system by removing material that could harm them. The pretreatment includes three major steps: cold lime softening, filtration, and sludge treatment.

Cold Lime Softening and Clarification

Softening is the removal of elements in the water like calcium, magnesium, and silica that could cause fouling or scaling of reverse osmosis or crystallizer equipment. Softening begins with chemical addition. Coagulant and polymer improve the clarification process by encouraging individual particles to form fast settling clusters of particles. The Solids CONTACT CLARIFIER™ Softener provides a reaction zone for the removal of hardness. Lime and soda ash are added in the reaction zone just before the feed water.

- **Coagulant (when necessary) allows particles to come together.**
- **Polymer helps individual particles form large fast settling clusters.**
- **Lime is added to increase the pH to remove calcium and magnesium hardness.**
- **Soda ash is added (when necessary) to remove calcium hardness.**

Internally recirculated solids react with lime and soda ash and form heavy faster settling particles. The sludge is scraped to the center and removed for dewatering.

Acid is added to the softened water to stop the softening reaction. The pH is lowered to less than 8. Usually hydrochloric acid is used because it doesn't add sulfates that could form gypsum scale in the reverse osmosis and crystallization processes.

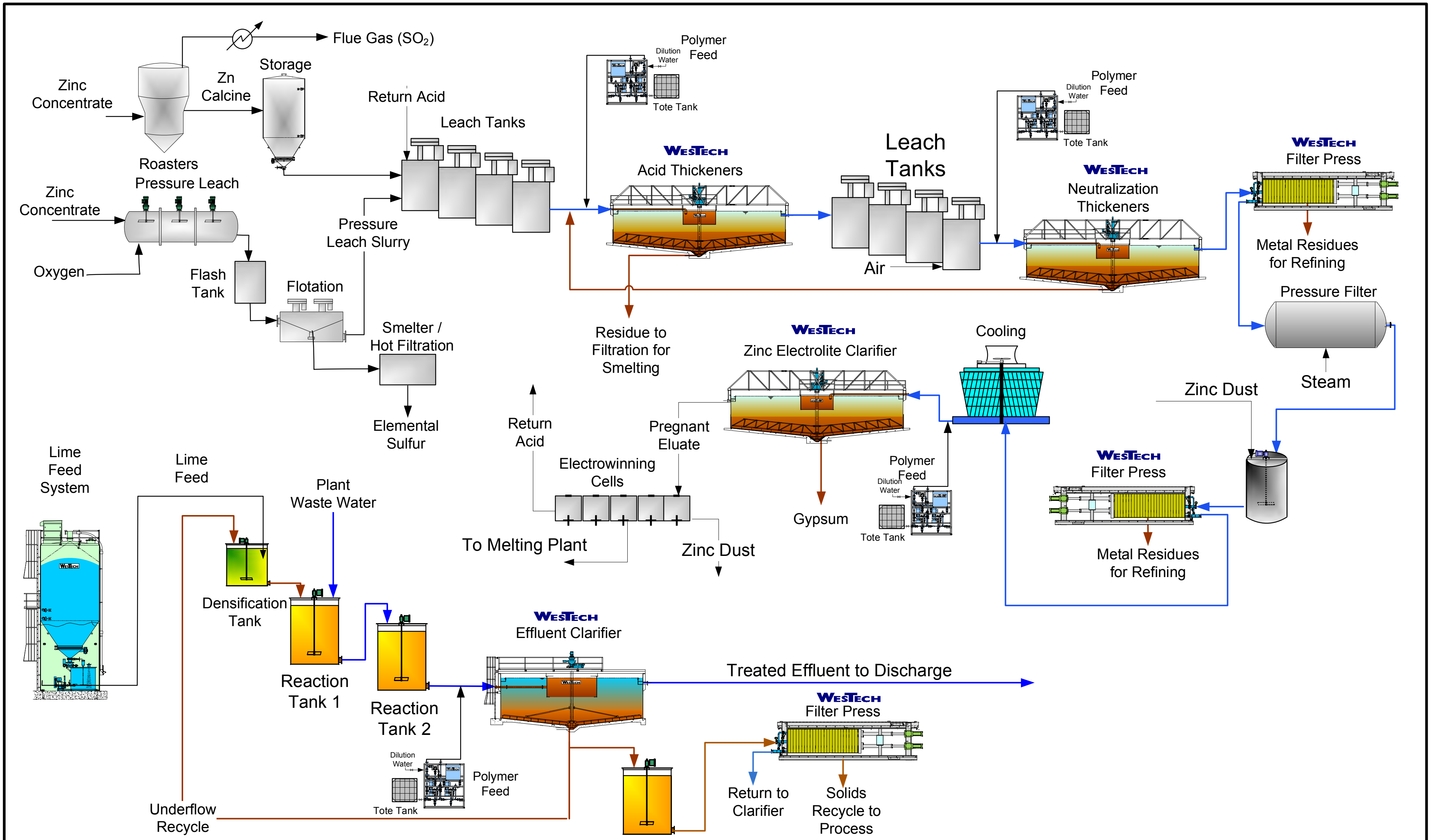
Filtration

Three stages of filtration are used; each provides pretreatment to the next. The dual media filters and the AltaFilter™ Ultrafiltration System remove any remaining solid particles. The backwash water is recycled back to the clarifier. Reverse osmosis removes the dissolved solids from the water. The treated water is sent back to the process. The concentrated dissolved solids stream is sent to the crystallizer.

Sludge Treatment

The underflow of the Solids CONTACT CLARIFIER™ is pumped into a thickener. Polymer may be added to improve settling and clarity. The thickener increases the concentration of the sludge. The overflow is sent back to the clarifier. The thickened underflow is sent to a filter press or other type of vacuum or pressure dewatering filter.

In the filter press the water is forced out of the sludge under pressure. It may require additional polymer to function properly. The cake is then hauled off for disposal. The pressate and any wash water get pumped to the reclaim water storage sump with the backwash from the filtration systems and then it is recycled back into the clarifier.



Zinc Processing (Refining)

WesTech

DWN: **RCS** DATE:

WesTech's ***AirLift™ Dilution System*** uses an airlift pump to draw clarified water evenly from the thickener surface into the feedwell. An even draw from multiple points prevents flow disturbances in the quiescent settling zone while ensuring proper dilution and feed mixing inside the feedwell. Dilution flow can be regulated with precision by operator adjustment of the airflow to the system.

Zinc Processing

Zinc (Zn) is the fourth-most widely used metal, following iron, aluminum and copper. It is mined mostly in Canada, the former USSR, Australia, Peru, Mexico and the US. The US is the world's largest consumer of zinc.

Zinc is a metallic element that has only moderate hardness and can be made ductile and easily worked at moderate temperatures. Its most important use, as a protective coating for iron known as galvanizing, derives from two of its outstanding characteristics: it is highly resistant to corrosion, and, in contact with iron, it provides sacrificial protection by corroding in place of the iron.

Most zinc is used in the galvanizing steel process. Other uses include the automotive, construction, electrical, and machinery industries. Zinc compounds include agricultural chemicals, paints, pharmaceuticals, and rubber.

Refining

Zinc concentration is usually done at the mine site, prior to reaching the zinc processing plant (refinery). The concentration includes crushing, flotation, and thickening. The most common process in the refining is electrowinning, which uses an electrolytic cell to reduce the zinc. An electric current is run from a lead-silver anode through a zinc solution. The zinc deposits on an aluminum cathode and is harvested. The zinc is then melted and cast into ingots.

In a typical refinery flowsheet, zinc concentrate is converted to zinc calcine (ZnO) by burning the concentrate in fluid bed roasters. Zinc calcine is the soluble zinc form which is the primary feed for the leaching plant. After leaching, the acid leach slurry is thickened and dewatered to recover residues which go to the lead smelter for further processing. After neutralization, clear zinc sulfate solution flows from thickeners to the zinc dust purification circuit.

Removing Impurities

Trace impurities are removed from the solution by adding slurried zinc dust through three purification stages. The solution is filtered in the first two stages with filter presses. In the third stage, the solution is cooled and then directed to a gypsum clarifier. The purified clarifier effluent is then pumped to the electrolytic plant.

Other by-products produced in this process can include fertilizers, lead, cadmium, indium, germanium, and elemental sulfides. Wastewater from the lead and zinc operations is treated by liming in the effluent treatment plant. Heavy metals are precipitated in reaction tanks and separated from the clean water by thickening and dewatering. The solids are recycled back to the plant and the clean water is discharged to the river.

SECTION TWO – PROCESS EQUIPMENT

FORCED / INDUCED DRAFT AERATOR

Forced / Induced Draft Aerator Overview:

A variety of aeration equipment types are used for effective mechanical oxidation and gas removal. The most common, and most efficient, is positive draft aeration. This is accomplished in cylindrical or rectangular vessels where a counter-current flow of air and water is created.

To increase contact surface area and exposure time, media is used in the form of loose fill of special shapes, easily cleaned PVC slats, or wood trays. Water is discharged into a tray at the top of the aerator that evenly distributes flow over the unit cross section with orifices or nozzles. It then drops into the aeration zone that contains the appropriate media and provides space for the air to move up through the finely dispersed water droplets.

Induced Draft Aerator

The air countercurrent is produced by electric operated blowers by either of two methods. The most commonly used air movement method is by **induced draft**, which employs a suction blower located at the top of the unit. The blower induces flow through screened air inlet baffles near the bottom of the vessel, up through the media/water mix of the aeration section, through air stacks located in the distributor tray to ensure even collection, and finally through a vane style moisture separator and the blower itself.

Forced Draft Aerator

A **forced draft** unit accomplishes the same flow pattern, but forces the air in the inlet baffle, and exhausts it through the screened hood located at the unit top.

Features:

- Few moving parts
- Aluminum or stainless steel construction

Benefits:

- Minimal maintenance required
- Low cost

Applications:

- Iron oxidation
- Hydrogen sulfide removal
- Methane removal
- VOC removal
- CO_2 removal

CASCADE AERATOR

Cascade Aerator Overview:

Cascade Aerators induct air into a water flow in order to oxidize iron and reduce dissolved gases.

How it Works:

With Cascade Aerators, aeration is accomplished by natural draft units that mix cascading water with air that is naturally inducted into the water flow. Cascade water is pumped to the top of the aerator, and cascades over a series of trays. Air is naturally inducted into the water flow to accomplish iron oxidation and some reduction in dissolved gasses. WesTech’s Cascade Aerators are of non-corroding, all aluminum or stainless construction and have no moving parts, making them maintenance free and inexpensive to buy and operate.

Features:

- No moving parts
- All aluminum or stainless construction

Benefits:

- Low cost
- No maintenance

Applications:

- Oxygenation
- Iron Oxidation

APPLICATION SUMMARY
AERATOR SYSTEM

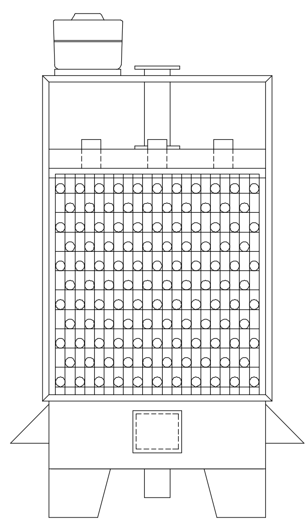
Aeration of water is used to accomplish two different processes. The first is the addition of atmospheric oxygen to the water as a method of oxidizing dissolved metals such as ferrous iron, manganous manganese and silver. This first process involves a certain time lapse (detention) after aeration to allow the introduced oxygen to oxidized the dissolved metals to a filterable (insoluble) form. Required detention times can be influenced by the addition of pH modifiers in the case of ferrous iron, or the addition of potassium permanganate in the case of manganese. Both of these are best added after the aeration is accomplished.

Aeration is also used as a method of removing gases dissolved or entrained in water to be treated. This second process (often referred to as gas stripping) is used to remove carbon dioxide, hydrogen sulfide, methane, volatile organic compounds such as trihalomethame, and radon from water. Removal of free CO_2 in the water reduces the subsequent lime treatment requirements and plant operating costs.

A variety of aeration equipment types are used to bring air into close contact with the water to be treated in order to expedite the transfer of gas between the two phases. The most common, and most efficient, is **positive draft aeration**. This is accomplished in cylindrical or rectangular vessels where a counter-current flow of air and water is created. To increase contact surface area and exposure time, media is used in the form of loose fill of special shapes, easily cleaned PVC slats, or wood trays. Water is discharged into a tray at the top of the aerator that evenly distributes flow over the unit cross section with orifices or nozzles. It then drops into the aeration zone, that contains the appropriate media and provides space for the air to move up through the finely dispersed water droplets.

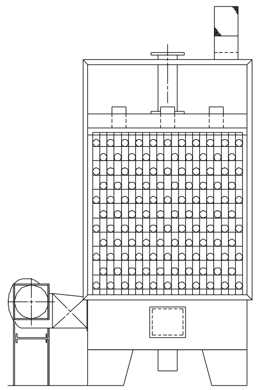
INDUCED DRAFT AERATOR

The air counter current is produced by electric operated blowers by either of two methods. The most often used air movement method is by an **induced draft**, which employs a suction blower located at the top of the unit. The blower induces flow through screened air inlet baffles near the bottom of the vessel, up through the media/water mix of aeration section, through air stacks located in the distributor tray to insure even collection, and finally through a vane style moisture separator and the blower itself.



INDUCED DRAFT AERATOR AIR FLOW

APPLICATION SUMMARY
AERATOR SYSTEM



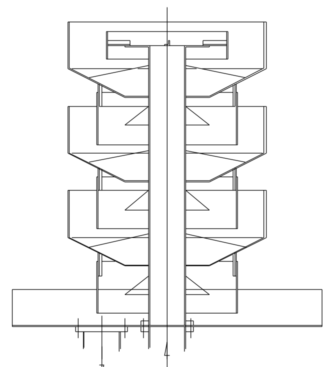
FORCED DRAFT AERATOR
AIR FLOW

FORCED DRAFT AERATOR

A **forced draft** unit accomplishes the same flow pattern, but forces the air in the inlet baffle, and exhausts it through a screened hood located at the unit top.

CASCADE AERATORS

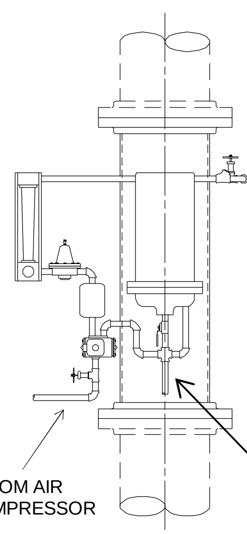
A more cost effective method, where efficiency is required, is accomplished by natural draft units that mix cascading water with air naturally inducted into the water flow to accomplish iron oxidation and some reduction of dissolved gases. WesTech=s **cascade aerators** are of non-corroding, all aluminum construction and have no moving parts, making them maintenance free and inexpensive to buy and operate.



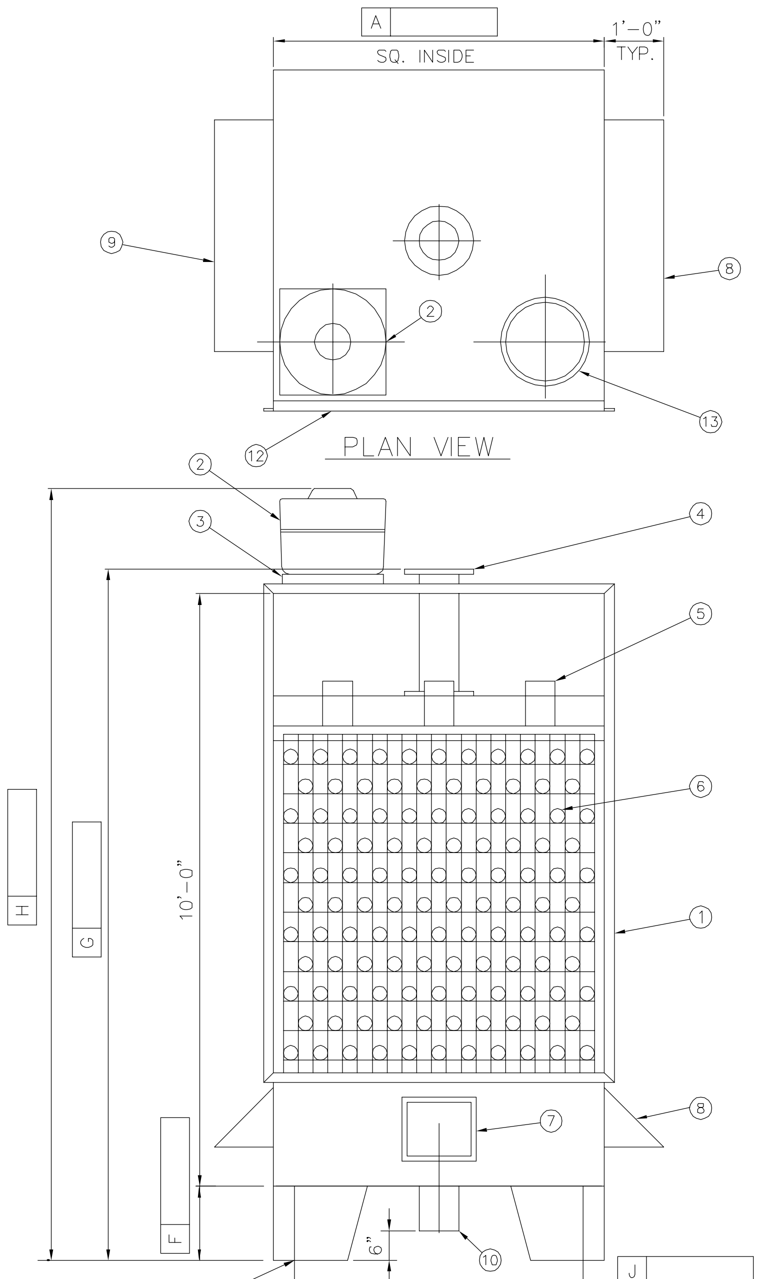
CASCADE AERATOR
SECTION SHOWING COLLECTOR PAN

PRESSURE AERATOR

A specialty type of this equipment is the **pressure aerator**, which is often used to oxidize ferrous iron from ground water in situations where filtration can be used without other treatment regimes. Compressed air is diffused and mixed into the pressurized filter influent line in the form of a fine bubble cloud. This intimate mixture of air and water is carried to the top of the pressure filter(s) where an automatic air release valve releases any excess air that leaves solution. In this manner, the need to provide another set of pumps (with their capital and operating expense) in the plant is avoided. *[If the pH of the water is above 7.1 and hydrogen sulphide, carbon dioxide, and organic iron are not a problem, oxidation of ferrous iron can be effectively accomplished by this process. Reduction of dissolved gases by this method is very small.]*



PRESSURE AERATOR



ELEVATION

EQUIPMENT LIST

ITEM NO.	DESCRIPTION
1	ALUMINUM AND STAINLESS STEEL HOUSING AND STRUCTURAL INTERNALS DESIGNED FOR [B] GPM
2	UPBLAST BLOWER WITH A.C.M.A. SEAL & U.L. LISTED TO PROVIDE [C] CFM AIRFLOW AT 3/8" S.P.
3	VANE STYLE MOISTURE SEPARATOR
4	[D] " DIA. FLANGED INLET CONNECTION
5	DISTRIBUTOR BOX WITH AIR STACKS
6	ROUND PVC SLATS (NSF APPROVED MAT'L) ON 6" VERTICAL CENTERS, SUPPORTED BY STAINLESS STEEL GRID CURTAINS
7	13" x 15" INSPECTION PORT
8	AIR INLET WITH #24 MESH SCREEN AND INTERNAL BAFFLES
9	SECOND AIR INLET UTILIZED ON UNITS LARGER THAN 72"
10	[E] " DIA. OUTLET CONNECTION PLAIN END FOR MECH. COUPLING (BY OTHERS)
11	ANCHOR HOLES (4) FOR [ ] " DIA. BOLTS (BY OTHERS) TO RESIST 100 MPH WIND BY U.B.C. DESIGN
12	BOLTED REMOVABLE SIDE (HINGE OPTIONAL)
12	INSPECTION/ACCESS PORT

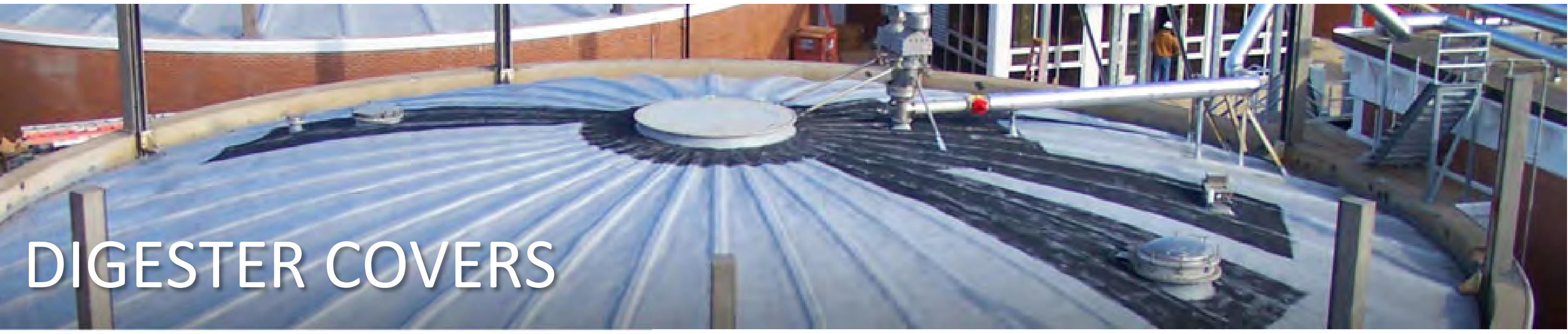
NOTES:

1. INLET CONNECTION IS NOT DESIGNED TO SUPPORT THE WEIGHT OF INFLUENT SUPPLY PIPING
2. MOTOR STARTER (NOT BY WESTECH)
3. EST. SHIPPING WEIGHT [M] LBS.
4. EXPECTED OPERATING WEIGHT [N] LBS.

REVISION	BY	CHKD	DATE	LTR
ADDED MODEL NO. IN TILTLE BLOCK	RSc	JLN	4-2-98	A

DESCRIPTION	INDUCED DRAFT AERATOR – IRON OXIDATION							
MODEL	AWI41X				SIZE	LEG MOUNTED (48" AND LARGER)	AWI41X01	0.0833 x 12.0000
DATE	11/97	STD. BY	CRG	STD.CHKD.	JLN	STD.APPVD	GM	SCALE: NONE
DATE		PROJ. BY		PROJ.CHKD.		PROJ.APPVD		
DRAWING NUMBER	AWI41X01	PROJECT NUMBER		REV.	A			

WESTECH



DIGESTER COVERS

Digester Covers Overview:

WesTech provides innovative designs for custom digester covers using the latest structural standards while integrating ease of erection and economical value. WesTech offers three major structural designs: Steel Truss, Radial Beam, and DuoSphere™. Our Steel Truss and Radial Beam structures can be configured to fixed or buoyant configurations. Our DuoSphere Membrane Digester Cover is the most versatile cover available. The tank mount design provides an innovative and cost-effective solution for new and replacement covers.

Structural Designs:

Steel Truss Structure

Truss covers include steel plates welded to both the top and bottom of the trusses to form an attic space, which protects the structural members from corrosion and provides insulation for the sludge.

Radial Beam Structure

With no ceiling plates and 50% less field weld length than a truss cover, beam covers are a very economical choice for anaerobic digester covers.

DuoSphere™

The DuoSphere™ membrane digester cover is the most versatile cover available. The tank mount design provides an innovative and cost-effective solution for new and replacement covers.

Digester Cover Types:

Fixed Covers

Innovative designs incorporating a water launder or more advanced seal materials can overcome liquid level variation limitations. A conventional annular seal design relies on the sidesheets being submerged in the sludge to achieve a pressure seal and prevent odors from escaping.

Buoyant Covers

Buoyant floating covers are in contact with the sludge, which reduces the exposed liquid surface area and prevents a large scum blanket.

Gasholder Covers

Gasholder covers can be constructed using radial beams, trusses, or engineered textiles as in the case of the DuoSphere™ dual membrane covers.

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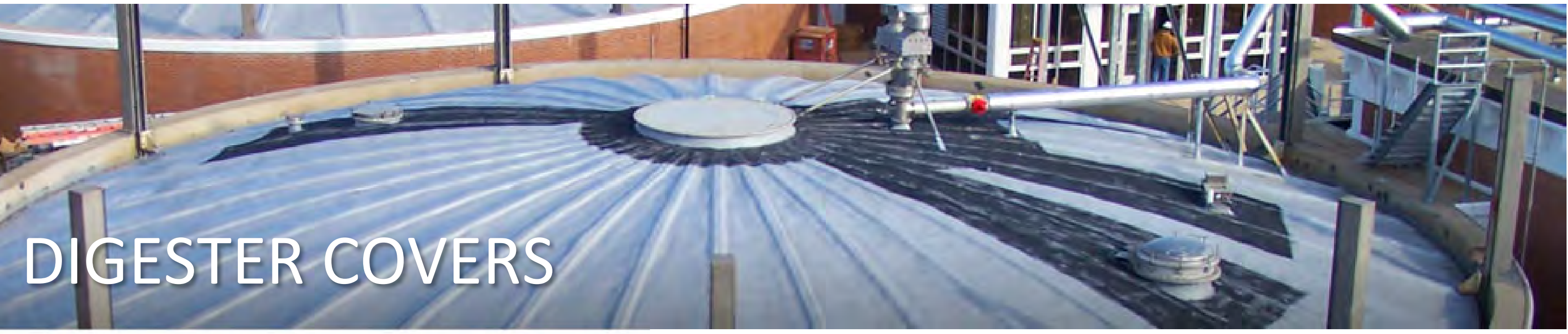


DIGESTER COVERS

STRUCTURAL DESIGNS

Steel Truss and Radial Beam Covers

Features:

- Several options available for various process requirements.
- Available sizes range from 20 ft. to 125 ft. in diameter.

Benefits:

- Prefabricated roof sections for faster field installation.
- Custom-designed for wide latitude of application.
- Beam covers cost less than other options.
- Biogas and odor containment.

DuoSphere™ Digester Covers

Features:

- Variable liquid level capabilities.
- Significant gas storage volume.

Benefits:

- Lowest installed cost.
- Absolute odor containment.

DIGESTER COVER TYPES

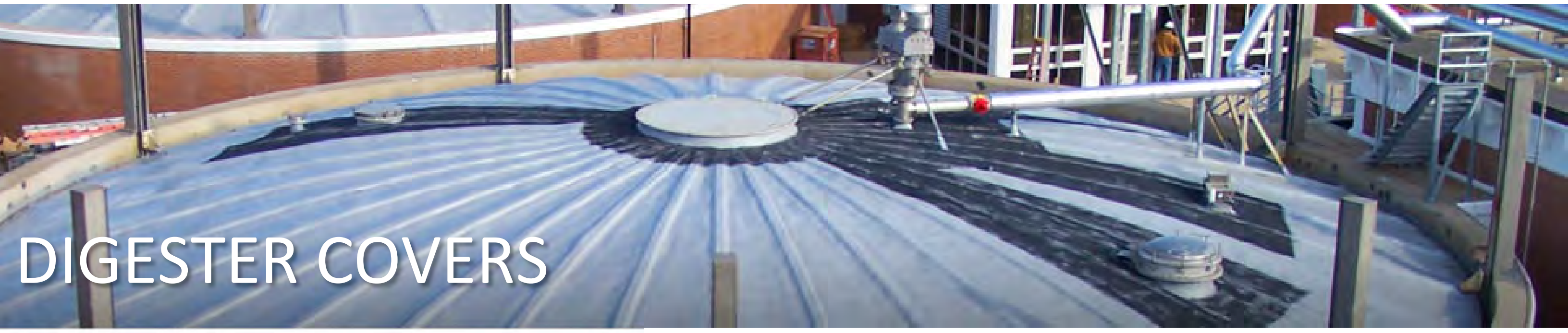
Fixed Covers

Features:

- Prefabricated beam roof sections.
- Designed for tank diameters that range from 20 to 125 feet.

Benefits:

- Complete gas and odor containment.
- Most economical steel cover option.
- Faster installation.
- Best option for small liquid level variations.



DIGESTER COVERS

Buoyant Covers

Features:

- Innovative truss design.
- Attic space.

Benefits:

- Best option for high liquid level variability.
- Increases stability of cover.
- Provides natural thermal insulation.

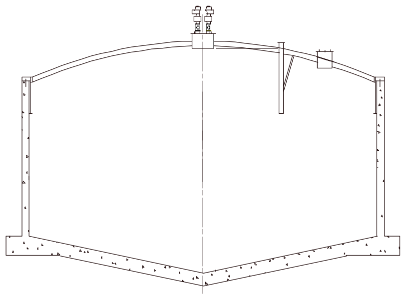
Gasholder Covers

Features:

- Cover travel makes liquid level variation possible.
- Slide guides allow the cover to travel above the tank wall, thus increasing gas storage at high liquid levels.

Benefits:

- Side sheet height can be designed to optimize gas storage.
- Stored biogas can be used as a fuel source.

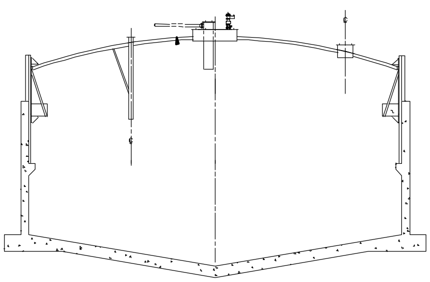


Model DCB1

Fixed Beam Cover - Model DCB1

Most economical of all covers. Designed for use as a primary digester when sludge levels remain fairly consistent. Can also be used as a secondary digester when sufficient gas storage space is allowed through other means.

Disadvantages - Has limited gas storage capacity.

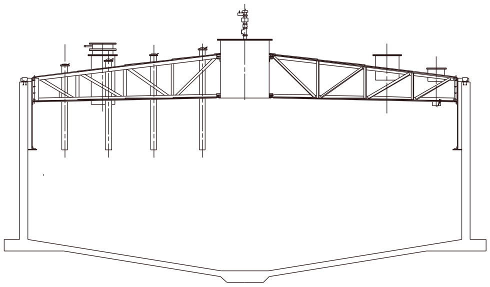


Model DCB34

Beam Type Gasholder Cover - Model DCB34

Designed to store varying volumes of digester gas within a narrow low-pressure range. Can be used with primary or secondary digesters. Normally does not require insulation as cover is separated from sludge by several feet of gas. Vertical guides simplify piping and electrical connections. Beam to membrane construction provide easier access to all parts of the cover when applying paint and coatings. The single membrane cover also allows installation of viewports to visibly observe mixing, scum, and foam conditions in the digester.

Disadvantages - Certain mixing systems are not compatible with gasholder covers. Requires more ballast than a comparable truss supported cover.

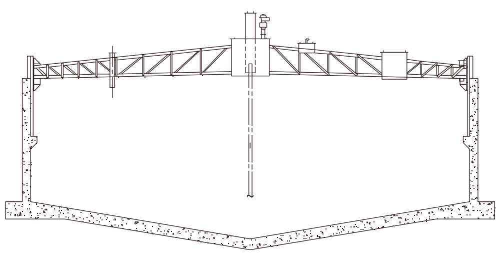


Model DCT1

Fixed Truss Supported Cover - Model DCT1

Designed for use as a primary digester when sludge levels remain fairly consistent. Can be used as a secondary digester when sufficient gas storage space is provided through other means. Inherent attic space provides insulation to temperature-sensitive sludge.

Disadvantages - More expensive than comparable beam cover. Difficult to assure adequate surface preparation and coating in attic space because of limited access and maneuverability. Attic space will collect condensate which must be pumped out periodically.

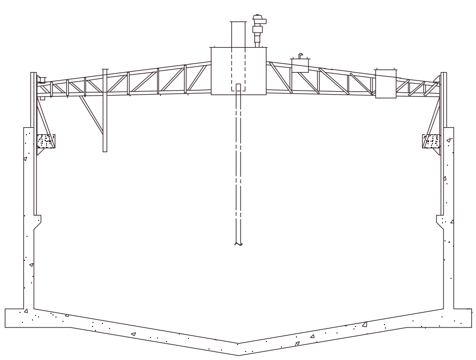


Model DCT24

Buoyant Floating Truss-Supported Cover Model DCT24

Designed for use as a primary digester when either severe scum or foaming problems exist, or where sludge levels vary significantly. Cover floats directly on sludge contents as a means of suppressing scum or foam accumulation. Provides a more complete scum submergence than a comparable beam buoyant cover. Inherent attic space provides insulation to temperature-sensitive sludge.

Disadvantages - More expensive than comparable beam cover. Difficult to assure adequate surface preparation and coating in attic space because of limited access and maneuverability. Attic space will collect condensate which must be pumped out periodically.

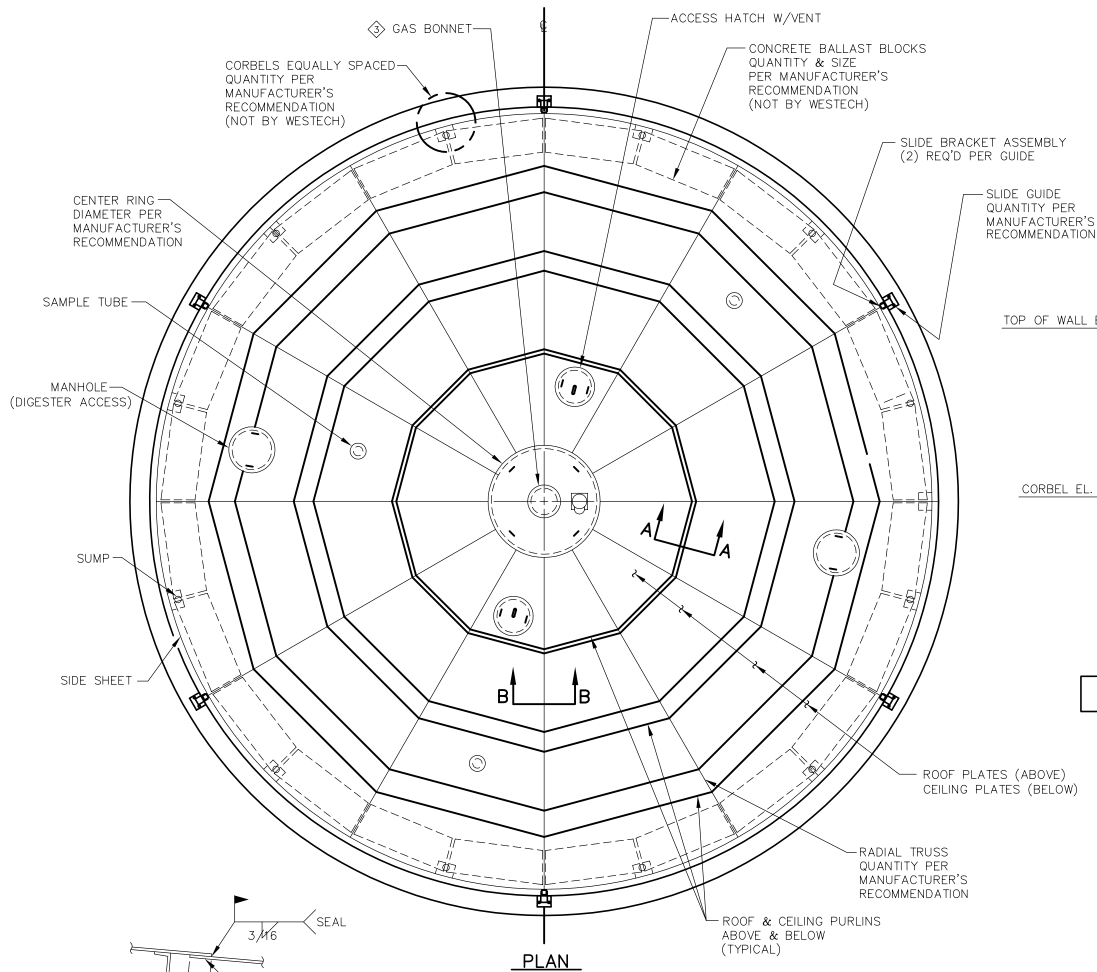


Model DCT34

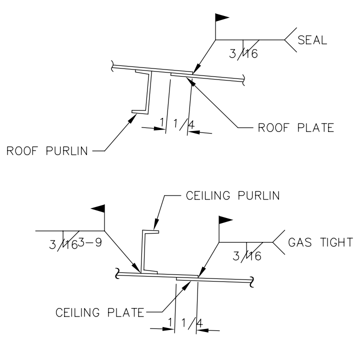
Truss-Supported Gasholder Cover Model DCT34

Designed to store varying volumes of digester gas within a narrow low-pressure range. Can be used with primary or secondary digesters. Vertical guides simplify piping and electrical connections. Requires less ballast than comparable beam cover.

Disadvantages - Certain mixing systems not suited for large fluctuations in cover levels. More expensive than comparable beam cover. Difficult to assure adequate surface preparation and coating in attic space because of limited access and maneuverability. Attic space will collect condensate which must be pumped out periodically.

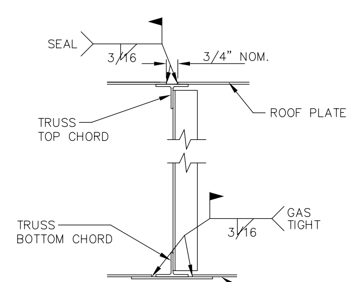


PLAN

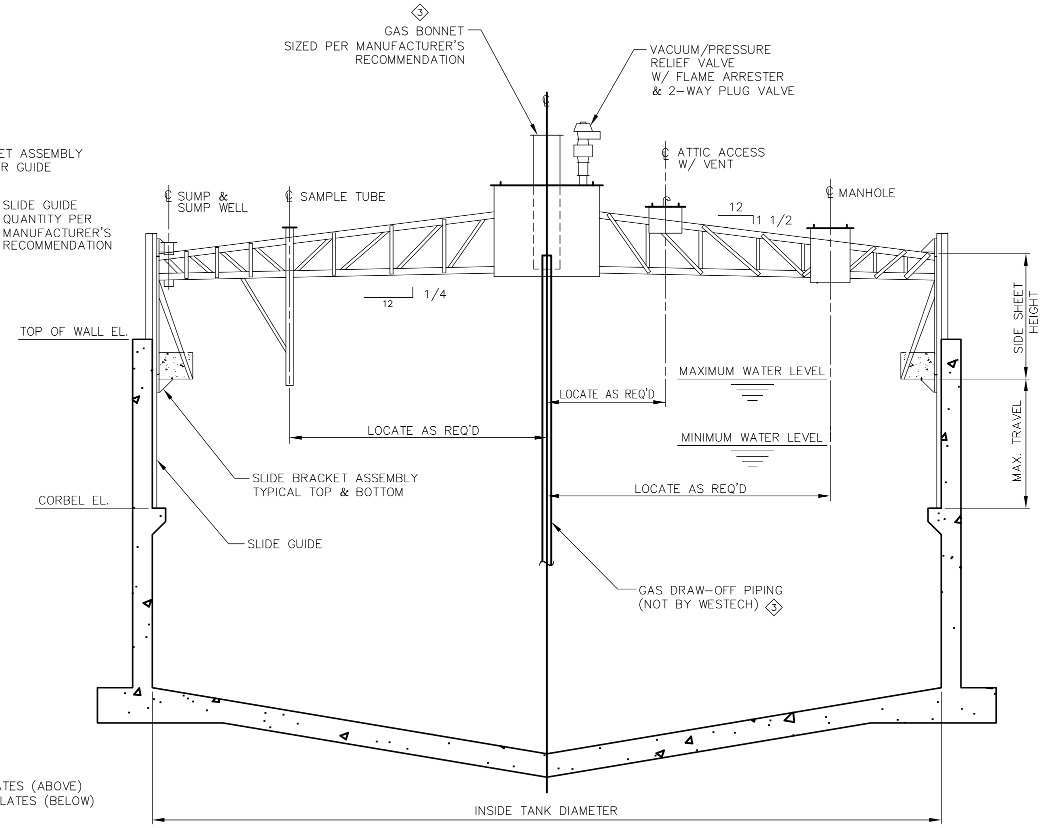


SECTION A–A

(THRU ROOF & CEILING PLATES)



SECTION B–B



ILLUSTRATIVE SECTION

DESIGN TABLE

INSIDE TANK DIAMETER:		RELIEF VALVE PRESSURE:	
WALL THICKNESS:		MANHOLE QUANTITY:	
TOP OF WALL ELEVATION:		MANHOLE SIZE:	
CORBEL ELEVATION:		RADIUS TO MANHOLE:	
MAXIMUM LIQUID LEVEL:		SAMPLE TUBE QUANTITY:	
MINIMUM LIQUID LEVEL:		SAMPLE TUBE SIZE:	
SIDE SHEET HEIGHT OR GAS STORAGE REQUIRED:		RADIUS TO SAMPLE TUBE:	
PRESSURE/VACUUM RELIEF VALVE SIZE:		GAS DRAW-OFF PIPE SIZE:	
OPERATING PRESSURE:			

GENERAL NOTES:

1. OWNER/ENGINEER TO PROVIDE INFORMATION LISTED IN THE DESIGN TABLE.
2. CONTACT WESTECH FOR ADDITIONAL PROJECT SPECIFIC INFORMATION.
3. CONTACT WESTECH FOR ALTERNATE GAS DRAW-OFF PIPING ARRANGEMENTS.
4. AUTOCAD DRAWINGS AVAILABLE UPON REQUEST.
5. WORK THIS DRAWING WITH DRAWINGS DCT34-CAT2 & DCT34-CAT3.

GENERAL ARRANGEMENT

DESCRIPTION

TRUSS GASHOLDER COVER-DCT34

MODEL				SIZE				.0169 x 59
01/06	JSG	AD	RS	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

LTR	REVISION	BY	CHKD	DATE

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
DCT34-CAT1		0

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BIOTREATER™ BIOLOGICAL TREATMENT

BioTreater™ Biological Treatment and Clarification System Overview:

The BioTreater™ Biological Treatment and Clarification System combines the biological treatment system and clarification into a compact design utilizing common wall construction. The biological treatment is located at the periphery in a ring-shaped area while the clarification stage is in the central region. The treatment system is fully expandable for complete biological nutrient removal. The system can also be designed to incorporate aerobic sludge holding, flow equalization, post aeration and chlorine contact chamber.

The treatment system will be complete with mixers for the anaerobic and anoxic zones (if applicable), fine or coarse bubble aeration for the biological portion, coarse bubble aeration for the aerobic holding tank, piping, valves, pumps and blowers. The system will incorporate a WesTech COP™ clarifier with spiral blades for rapid solids removal. The controls will provide a single point for operation of the equipment and incorporate dissolved oxygen probes and TSS probes for automating operation of the system. The clarifier includes scum removal and scum removal pumps. The digester is designed for a fill and decant cycle. A decant pump is included to return the supernatant back to the plant for treatment.

The BioTreater Biological Treatment and Clarification System can be installed in concrete tanks, or field-erected steel tanks. WesTech offers field erection services for the tanks and mechanisms.

Features:

- Compact layout
- Common wall construction
- Customized biological designs
- Erection Services for steel components
- Includes the WesTech COP Clarifier

Benefits:

- WesTech Unit Responsibility
- Saves space
- A stable and excellent effluent quality

BioTreaters are applicable to a wide range of municipal and industrial applications and can be designed to the meet the most stringent of effluent requirements. For re-use quality effluent, the BioTreater will be coupled with a WesTech Tertiary Filter.

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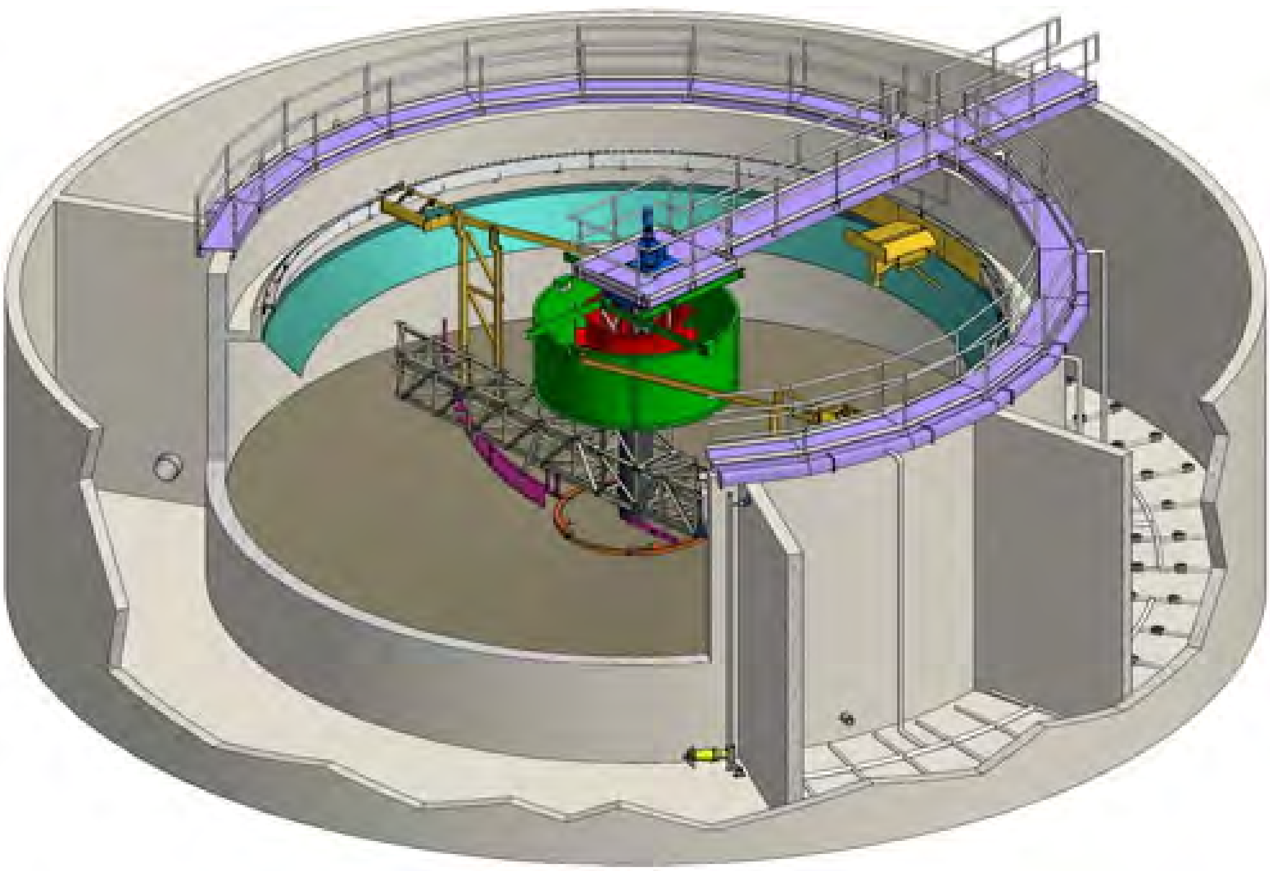
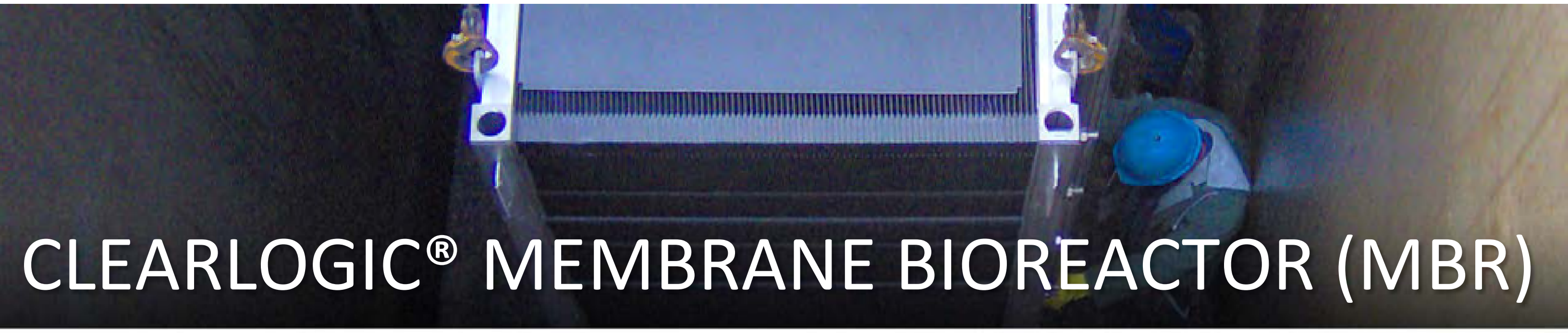
BIOTREATER™ BIOLOGICAL TREATMENT

BioTreaters are applicable to a wide range of municipal and industrial applications and can be designed to the meet the most stringent of effluent requirements. For re-use quality effluent, the BioTreater will be coupled with a WesTech Tertiary Filter.





CLEARLOGIC® MEMBRANE BIOREACTOR (MBR)

ClearLogic® Membrane Bioreactor (MBR) Overview:

The WesTech ClearLogic® Membrane Bioreactor (MBR) featuring the new Alfa Laval Hollow Sheet™ Membrane Technology offers clear advantages to the MBR process. Advantages of the ClearLogic® MBR include ultra-low transmembrane pressure, even flux distribution across the membrane and full chemical circulation during clean-in-place (CIP) operation.

During CIP, the membrane not only receives even chemical distribution, but also can be back-flushed. The results of these benefits include simple operation, fewer components, decreased maintenance, fewer cleaning cycles and longer life.

WesTech brings extensive biological wastewater treatment experience and offers a complete MBR system from turnkey plants to existing plant retrofits.

Features:

- Full circulation of mixed liquor across membrane plates
- Even flux - even utilization of full membrane surface
- Compact, robust, fully stackable design
- 316 SS frame, PVDF membrane
- Multiple cleaning methods
- Gravity-operated MBR

Benefits:

- Better utilization of air scour
- Significantly lower TMP than Hollow Fiber and Flat Sheet

STM-AEROTOR™ BIOLOGICAL NUTRIENT REMOVAL

STM-Aerotor™ Biological Nutrient Removal (BNR) System Overview:

The STM-Aerotor™ Biological Nutrient Removal (BNR) System uses Integrated Fixed Film and Activated Sludge (IFAS) technology as part of a process that provides biological nutrient removal for municipal and industrial wastewater treatment.

How it Works:

With every rotation, the STM-Aerotor captures atmospheric air, draws it down into mixed liquor in a steel or concrete basin, and slowly releases it as course bubble aeration. During the rotation, additional cascade aeration elevates the dissolved oxygen in the upper layer of the basin. The combination of the slow rotation of the STM-Aerotor, intense air release, and the addition of a peripheral mixing paddle ensure a thoroughly mixed system.

In addition, The STM-Aerotor includes a large surface area for fixed film growth. The interior and exterior of the special polypropylene discs provide the perfect environment for a variety of attached growth organisms. These organisms will react quickly to an increased food source, or shock load, to eliminate discharge violations during peak or diurnal fluctuations.

The amount of aeration can be controlled using a variable speed drive connected to the rotor, causing it to rotate faster or slower based on the actual oxygen demand.

The STM-Aerotor combines activated sludge and fixed film in a compact biological treatment system that requires a low power input. The unique media of the STM-Aerotor provides both the fixed film surface area and the vehicle for coarse bubble aeration. The STM-Aerotor design allows for efficient aeration without the need for diffusers, air piping, control valves, diffused aeration blowers, or supplementary mixers.

IFAS process systems have been employed for wastewater treatment because they have many distinct advantages. First, the IFAS process can accomplish more treatment than conventional activated sludge in an existing footprint. Second, complete nitrification occurs at much lower sludge ages than conventional activated sludge plants. Finally, the improvement in sludge settling makes operation of an IFAS plant much easier. Most IFAS systems use a free-floating or structurally supported media in a diffused aeration basin, but the STM-Aerotor does not. The STM-Aerotor has all the advantages of the IFAS process without the need for energy intensive diffused aeration or mixing equipment.

The STM-Aerotor has been used in different applications throughout the world. The compact nature of this system works well for small package plants in new communities, resorts, campgrounds, and truck stops. The ability to handle variable loading rates works well for industrial plants such as wineries, food processing, refineries, and dairies. The modular design works well for small treatment plants (less than 5 mgd) that may expand or require nutrient removal in the future.

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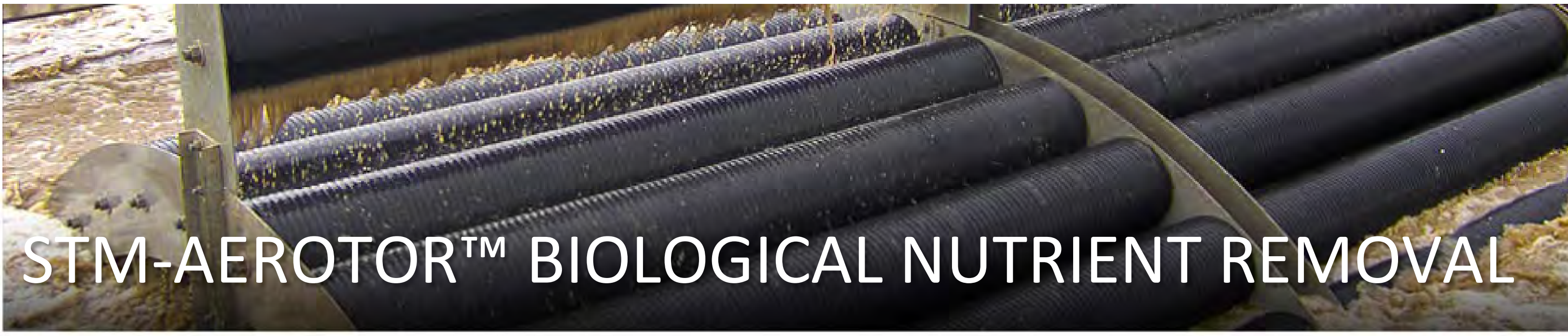


STM-AEROTOR™ BIOLOGICAL NUTRIENT REMOVAL

Features:

- Special polypropylene discs provide perfect environment for fixed film growth
- No blowers, aeration piping, or diffusers
- Low HP drives
- Compact design
- Stable process
- Wheels controlled with VFD’s and DO probes
- Peripheral mixing paddle

Benefits:

- No odors
- No noise
- Low energy requirement
- Small footprint
- Improved sludge settling
- Minimized operator attention
- Can accommodate seasonal fluctuations in flow rate

Applications:

- School Facilities
- Remote Job Sites
- Prison Facilities
- Truck Stops
- Housing Developments
- Shopping Malls
- Campgrounds
- Restaurants

Introduction

This STM-Aerotor summary describes a unique biological treatment process now available for municipal and industrial applications. The STM-Aerotor combines both activated sludge and fixed film treatment into one simple process. When compared to other treatment systems, the STM-Aerotor requires significantly less land area and dramatically reduces power requirements. This system offers several additional benefits such as: superior settling sludge, biological nutrient removal in the same basin, and lack of odors, noise, or splashing.

History

The concept behind the STM-Aerotor was invented in 1964 by Mr. Theo Stähler of Hadamar, Germany. A fish farmer, Mr. Stähler was looking for a method to treat and recycle water to his large fish raising operation. Since fish tolerate only very low levels of ammonia, the system had to not only remove the organic contaminants from the recycled water, but also eliminate virtually 100 percent of the ammonia. Mr. Stähler soon recognized that the STM-Aerotor system he had developed for his fish growing operation could readily be adapted to treat domestic and industrial wastewaters as well. After continued development of the process and equipment over the next 9 years, the first full scale domestic waste treatment plant was installed in 1973. Since then the system has been treating both domestic and industrial wastewaters in over 40 countries at over 900 installations.

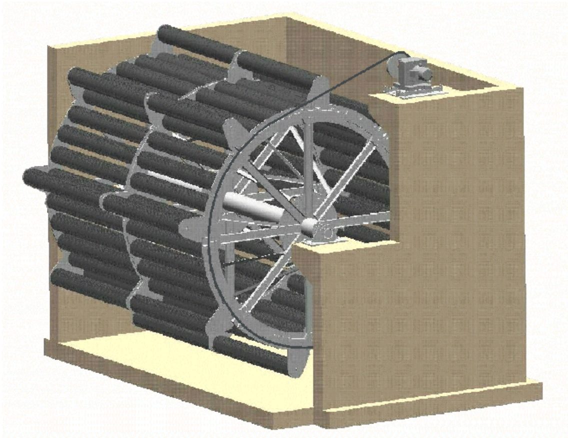


Figure 1

General Description

Figures 1 and 2 show illustrative views of the STM-Aerotor. The mechanism is designed to be 75 to 80 percent submerged in the wastewater. The STM-Aerotor consists of a slowly rotating central shaft and steel cage structure which supports specially designed polypropylene media bundles. The media bundles (Figure 3) form hollow chambers which capture surface air and carry it down into the mixed liquor, where it is compressed and then released as small bubbles. No blowers or diffusers are required. This extremely simple but effective aeration method is one of the keys to the STM-Aerotor=s efficiency.

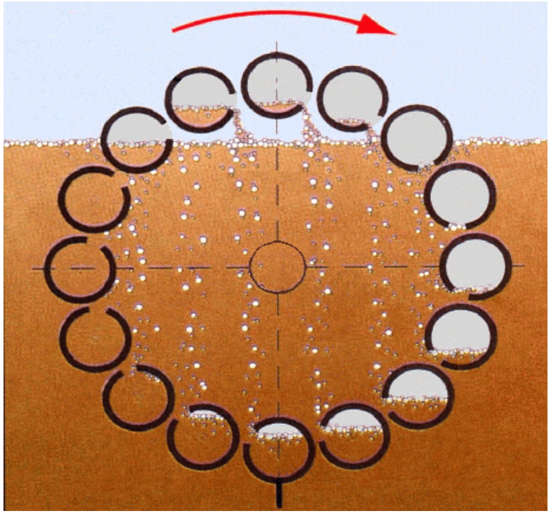


Figure 2

Another key to efficiency is that the amount of oxygen supplied to the mixed liquor is directly proportional to the speed of the slowly rotating mechanism. So during periods of high loading, more oxygen can be supplied by simply increasing the speed of rotation. The drive unit of the STM-Aerotor is provided with a variable speed control which can be directly coupled to an oxygen sensor in the basin. This system will provide a constant and efficient oxygen supply to the process.

In addition to aerating the mixed liquor, the polypropylene media provides a large surface area for fixed film microorganism growth. This fixed film produces considerable additional biomass and an overall longer sludge age for the process. Air trapped and compressed in the hollow media chambers provides a high oxygen transfer to the fixed film microorganisms.

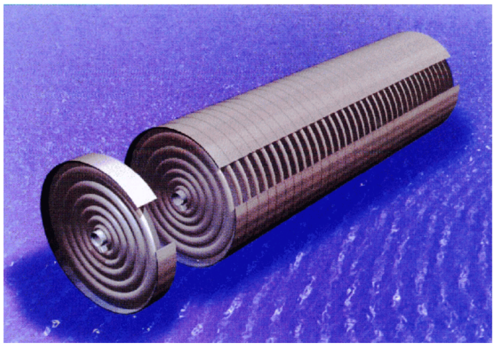


Figure 3

As wastewater flows into and out of the media chambers with every revolution of the STM-Aerotor, the fixed film constantly sloughs off old material and remains thin and optimally reactive. In combination with the suspended microorganisms, this sloughed material creates a dense, well-defined floc which improves settling in the final clarifiers and allows the STM-Aerotor to operate with mixed liquor concentrations as high as 6,000 to 8,000 mg/L, thus improving process efficiency even further.

The combination of a highly concentrated activated sludge and a fixed film biomass, coupled with a controlled and consistent oxygen concentration, produces an extremely stable but flexible process. Effluent clarity of the STM-Aerotor process is comparable to the best activated sludge processes.

BIOLOGICAL NUTRIENT REMOVAL

In addition to efficient BOD removal and nitrification, the STM-Aerotor process can be designed for simultaneous denitrification and the luxury uptake of phosphorus, all in a single basin. This patented method involves designing the STM-Aerotor and basin so that anoxic and/or anaerobic zones form underneath and adjacent to the rotating mechanism. Figure 4 illustrates this concept.

Through the gentle mixing action of the STM-Aerotor, mixed liquor continuously cycles through these different environments. These zones act as biological selectors, encouraging the growth of organisms which can denitrify the waste stream and/or absorb phosphorus. The resulting process can consistently produce an effluent with total nitrogen lower than 8 mg/L and phosphorus below 2 mg/L.

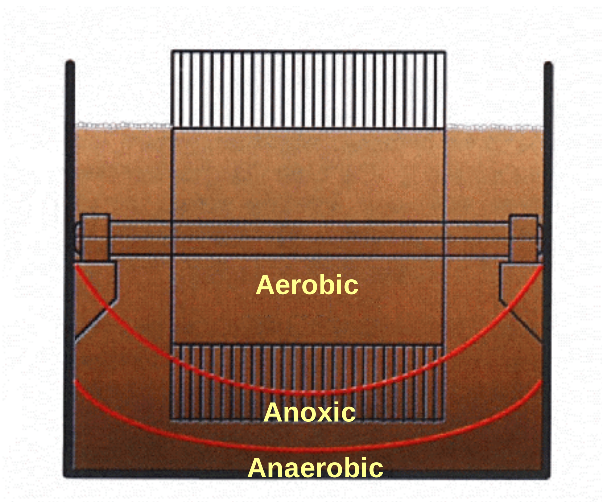
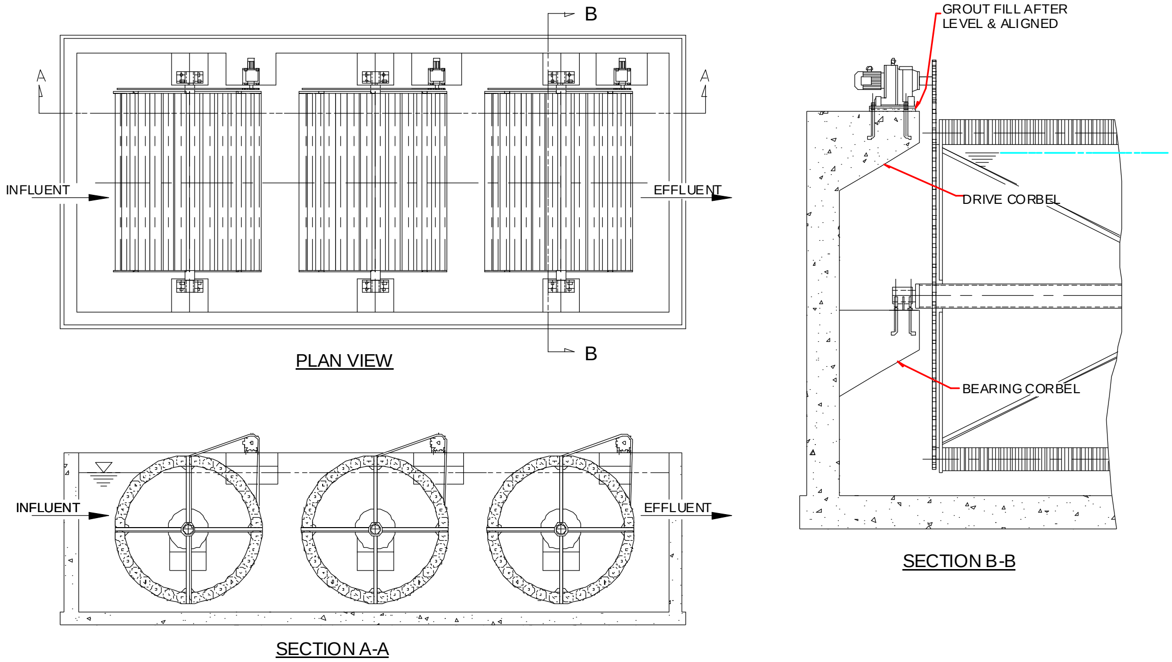


Figure 4

SUMMARY

The STM-Aerotor successfully combines the advantages of the activated sludge and fixed film processes in a single system. Low capital and operating expenses are combined with excellent effluent quality in an exceptionally stable but flexible process. Effective biological nutrient removal can be accomplished in a single basin.

STM-AEROTOR BASIN



Models: STM12

The STM-Aerotor wheels can be supplied in 5 different diameters and all widths up to 20'.

The STM-Aerotor is used in a wide variety of applications including:

S Secondary wastewater treatment, aerobic digestion, meat processing, food processing, septage, landfill leachate, refineries, breweries, wineries, and anywhere biological treatment can be used.

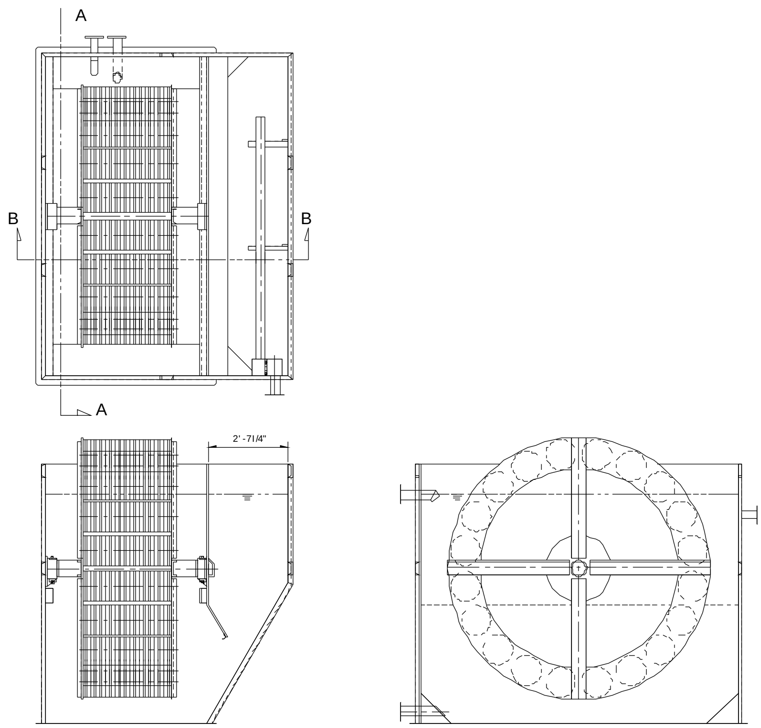
Advantages of the STM-Aerotor

S Small footprint
S Low power requirement
S Lack of noise, odors, and splashing
S Simple modular design for expansion
S Superior settling sludge
S Stable process with both activated sludge and fixed film components

Disadvantages for the STM-Aerotor:

S Limited to plants around 3 MGD and lower because of too many wheels
S May need to be approved by your State Water Quality Board

STM-AEROTOR CONTAINER



SECTION B-B SECTION A-A

Models: STM5

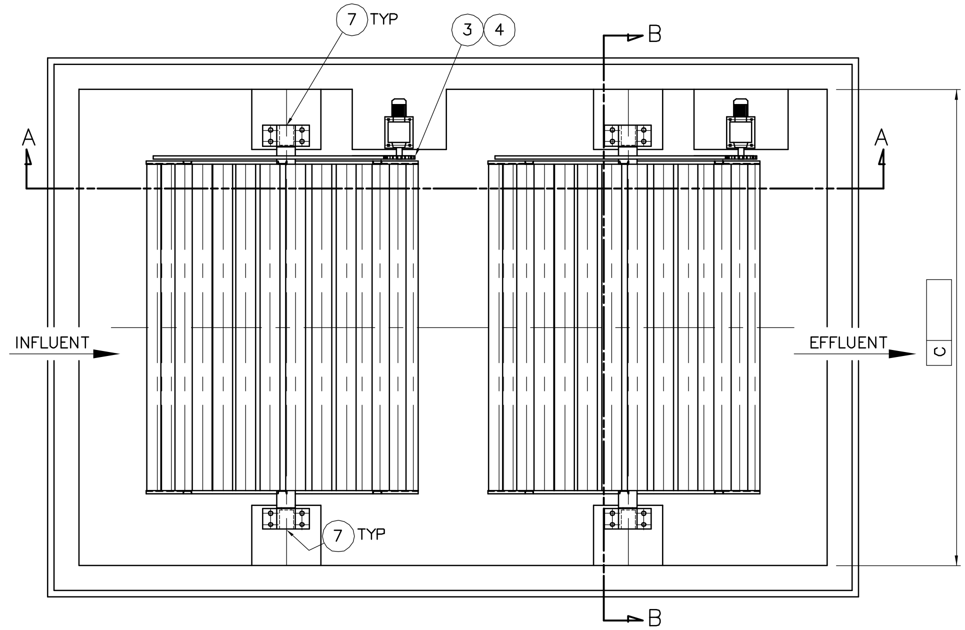
Description: The STM-Aerotor can be used as a package treatment plant. There are several available options for the plant: automatic RAS or pumped RAS, EQ basin, pumps, integral clarifier, digester, solids holding tank, chlorine contact chamber, chlorine tablet feeders, and tertiary filters.

Advantages:

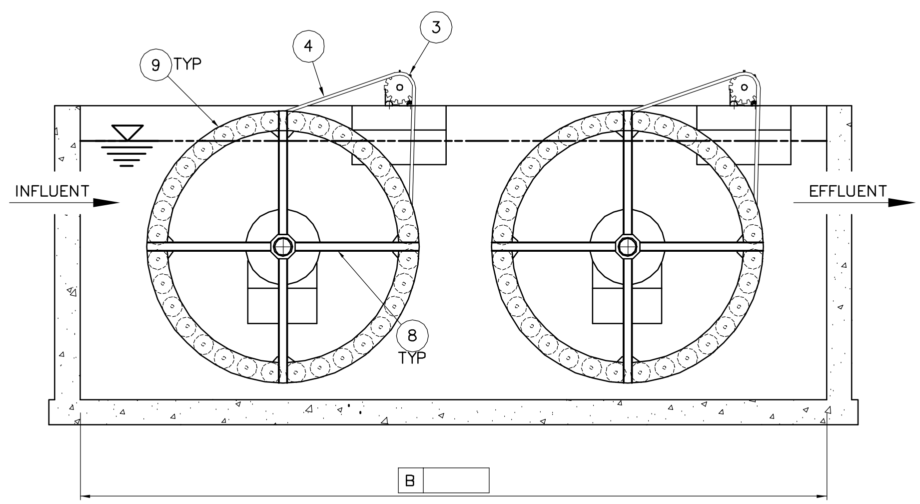
- Compact design
- Lack of odors, noise, or splashing
- Simple control logic

Disadvantages:

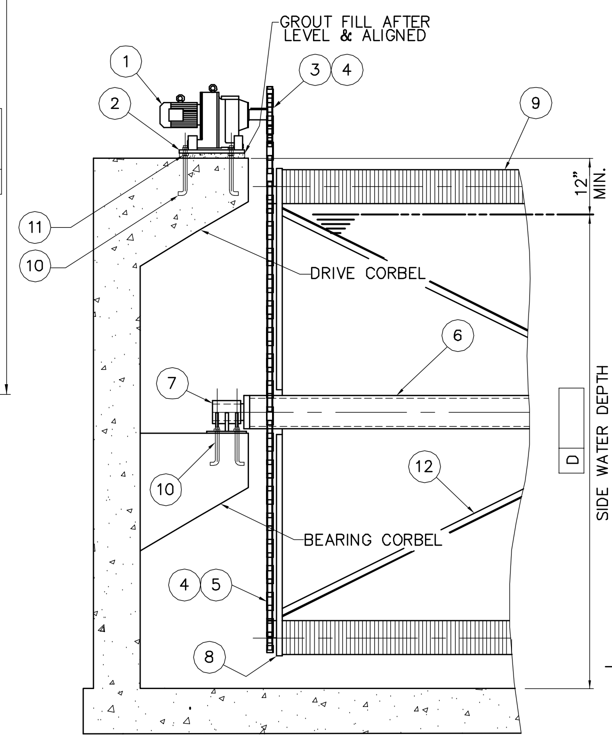
- May need to be approved by your State Water Quality Board



PLAN VIEW



SECTION A–A



SECTION B–B

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DRIVE UNIT E H.P.
2	DRIVE MOUNTING ASSEMBLY W/ CHAIN ADJUSTMENT SYSTEM
3	DRIVE SPROCKET (HDG STL)
4	DRIVE CHAIN (STL)
5	ROTOR SPROCKET (HDG STL)
6	ROTOR CENTER SHAFT (STL)
7	BEARING ASSEMBLY WATER LUBRICATED (UHMW)
8	ROTOR SUPPORT FRAME (STL)
9	STM–AEROTOR DISC BUNDLES (POLYPROPYLENE)
10	ANCHOR BOLTS
11	LEVELING NUTS
12	FRAME STIFFENERS

NOTES:

1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT FOLLOWING PROPER PROCESS DESIGN CRITERIA.
2. CONCRETE SIZES AND REINFORCING SHOULD BE SIZED BASED ON THE EQUIPMENT OPERATING FORCES.
3. CONSULT WESTECH FOR FINAL DIMENSIONS AND EQUIPMENT.

PREPARED FOR: ____________________

ENGINEER: ____________________

GENERAL ARRANGEMENT – STM AEROTOR™
DESCRIPTION

STM1X
MODEL

01–01	CH	JTR	RCW	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

SIZE

REVISION	BY	CHKD	DATE	LTR

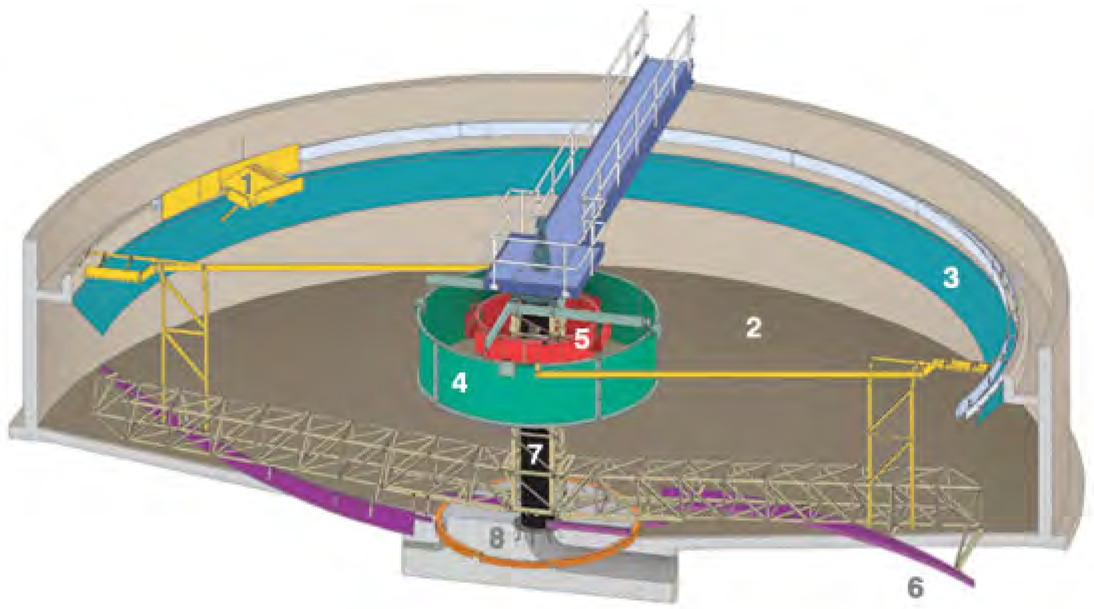
WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
STM1X02		0

COP™ SPIRAL BLADE CLARIFIER

COP™ Spiral Blade Clarifier Overview:

The WesTech COP™ Spiral Blade Clarifier is the result of research and design focus on building a better clarifier. Each COP Spiral Blade Clarifier is designed for the specific process requirements of each plant. Proprietary algorithmic computer programs are utilized and further refined to result in a clarifier that provides high performance, and is of benefit to plant operations overall. An acronym for Clarifier Optimization Package, this highly efficient clarifier design utilizes nine key design parameters to optimize the physical forces and limitations occurring in any clarifier to achieve superior performance:



1. **Scum Removal:** Removes scum buildup from within the feedwell and from the clarifier surface.

2. **Basin Configuration:** Uses deeper side water depth (SWD) and proper floor slope design for maximum capacity and highest effluent quality for the least cost.

3. **Density Current Baffle:** Eliminates wall currents and prevents short-circuiting. The wall-mounted baffle is low in cost and requires no maintenance.

4. **Flocculating Feedwell:** Promotes hydraulic flocculation in the inlet area and is designed to eliminate scouring of the sludge blanket.

COP™ SPIRAL BLADE CLARIFIER

5. **Energy Dissipating Inlet (EDI):** Converts the high energy feed from the center column into a lower velocity flow that is gently mixed in an impinged or tangential flow into the flocculating feedwell to maximize flocculation.

6. **Spiral Rake Blades:** Increase sludge transport capacity, providing rapid solids removal and lower sludge blankets. Eliminate septicity and denitrification.

7. **Center Column:** Minimizes floc shearing and reduces influent energy.

8. **Sludge Withdrawal Ring:** Reduces sludge inventory and blanket depth while maintaining high concentration. Provides rapid solids removal in conjuction with spiral rake blades.

9. **Effluent Launder Covers:** Eliminate algae growth and minimize maintenance time.

Features:

- Moves sludge inventory from the outer portions of the tank to the center
- Simplicity of design
- Wide range of operational applications

Benefits:

- Reduces denitrification flotation
- No clogging problems often associated with other rapid sludge removal clarifiers
- Performance is not affected by location of settled sludge
- Reduces rat-holing
- Results in lower solids over the weir and lower torques
- Results in greater solids thickening
- Increased sludge transportation

Applications:

- Primary clarification
- Secondary clarification

COP™ SUCTION HEADER CLARIFIER

COP™ Suction Header Clarifier Overview:

The WesTech COP™ Clarifier is the result of research and design focus on building a better clarifier. Each COP is designed for the specific process requirements of each plant. Proprietary algorithmic computer programs are utilized and further refined to result in a clarifier that provides high performance, and is of benefit to plant operations overall. An acronym for Clarifier Optimization Package, this highly efficient clarifier design utilizes key design parameters to optimize the physical forces and limitations occurring in any clarifier to achieve superior performance.

1. Scum Removal: Efficiently removes scum buildup from within the feedwell and from clarifier surface.
2. Basin Configuration: Uses deeper side water depth (SWD) and proper floor slope design for maximum capacity and highest effluent quality for the least cost.
3. Density Current Baffle: Eliminates wall currents and prevents short-circuiting. The wall-mounted baffle is low in cost and requires no maintenance.
4. Flocculating Feedwell: Promotes hydraulic flocculation in the inlet area and is designed to eliminate scouring of the sludge blanket.
5. Energy Dissipating Inlet (EDI): Converts the high energy feed from the center column into a lower velocity flow that is gently mixed in an impinged or tangential flow into the flocculating feedwell to maximize flocculation.
6. Center Column: Sized and designed to support the mechanism while preventing shear of floc and reducing influent energy.

Largely used as activated sludge clarifiers, the WesTech line of COP Suction Header Clarifiers offers a good value in sludge removal. Settled solids are removed through a rotating suction arm or header located at the bottom of the clarifier. The suction header is a sealed tube with orifices sized and spaced to ensure even solids removal over the entire clarifier bottom.

WesTech suction headers provide full radius, rapid sludge removal plus the added advantages of the COP Clarifier Optimization Package. Our suction header clarifiers provide high quality effluent with full floor sludge removal in every rotation.

COP™ SUCTION HEADER CLARIFIER

Features:

- Wide ranges of operational applications
- Simplicity of design and operation

Benefits:

- Low capital costs
- Rapid removal of settled solids
- Reduces denitrification in the sludge blanket
- Lowest disruption to clarification zone
- Uniform sludge removal across tank floor
- Reduces phosphorus release in BNR plants

Applications:

- Primary clarification
- Secondary clarification

Clarifiers

In the following pages, several different styles and models of clarifiers are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate clarifier model within this design catalog.

Each type of clarifier can have different features. Some of these features are outlined on the clarifier model number sheet. These features include:

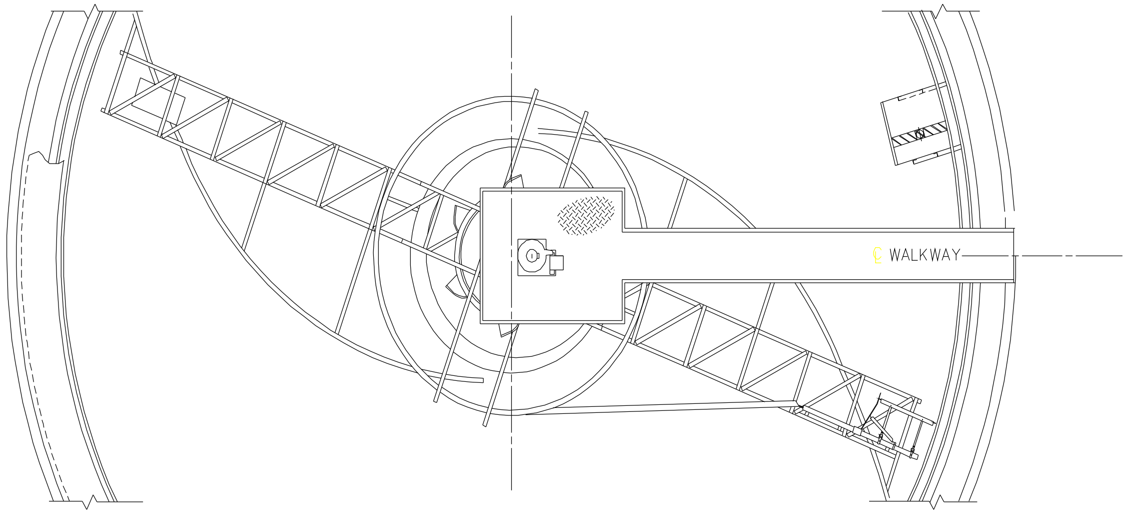
- Drive type (cage, shaft, rim, etc.)
- Feed type (center, peripheral, side, etc.)
- Arm type (segmented plow, spiral, suction, etc.)

Options are also offered and can be combined with certain types of clarifiers. These options include:

- Launder type (internal, external, inboard, crossflow, radial, etc.)
- Skimmer (standard, ducking, brushes)
- Lifting device
- Corner Sweeps (for square or rectangular tanks)
- Flocculating mixers
- Feed distribution (feedwells, flocculation wells, energy dissipating inlets (EDI))
- Launder covers
- Sludge withdrawal ring
- In tank baffles

These options and features are combined into standard model clarifiers as shown in the catalog. Other features and options can be combined for retrofit applications.

COP™ Clarifiers



Models: COPC1, COPS4

Description: An acronym for Clarifier Optimization Package (COP™), this clarifier utilizes nine key design parameters to optimize the physical forces and limitations occurring in any clarifier to achieve superior performance.

Advantages:

- Optimizes the clarification process
- Results in higher settled solids concentrations in the underflow and lower solids concentrations in the effluent
- Improves performance of downstream processes
- Sludge inventory is maintained near the center of the clarifier, not under the weir, resulting in lower torques and less effluent suspended solids
- Eliminates Rat-holing
- Rapid sludge removal
- Sludge transport and feed flow velocities are integrated
- Reduces denitrification flotation
- No clogging problems associated with other rapid sludge removal types
- Wide rages of operational applications
- Simplicity of design and operation
- Not affected by location of settle sludge

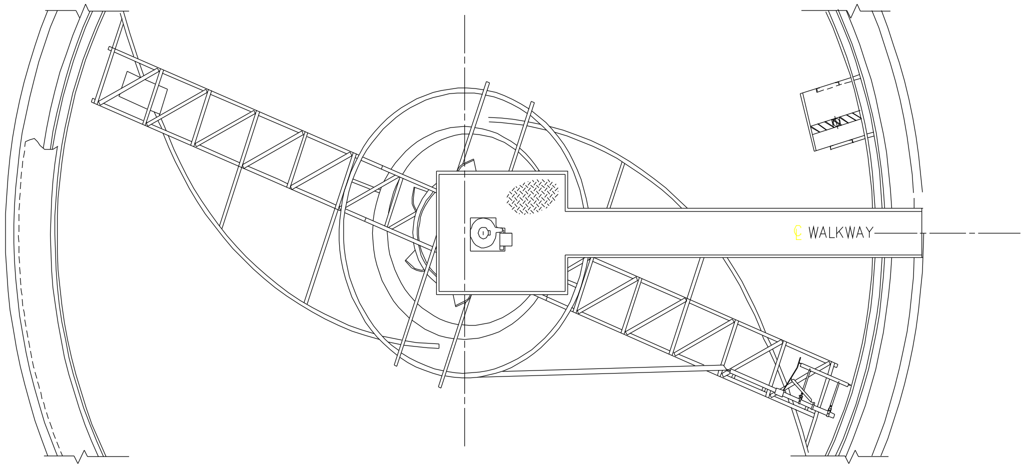
Disadvantages:

- Slightly higher capital costs

Applications:

- Any new or existing clarifier application

Spiral Rake Clarifiers



Models: COPC1, COPS4, COPT2

Description: Settled solids are continuously transported toward the center of the tank for removal by means of a spiral curved blade.

Advantages:

- Increased sludge transportation, resulting in greater solids thickening
- Moves sludge inventory from the outer portions of the tank to the center, resulting in lower solids over the weir and lower torques
- Reduces rat-holing
- Reduces denitrification flotation
- No clogging problems associated with other rapid sludge removal types
- Wide rages of operational applications
- Simplicity of design
- Not affected by location of settle sludge

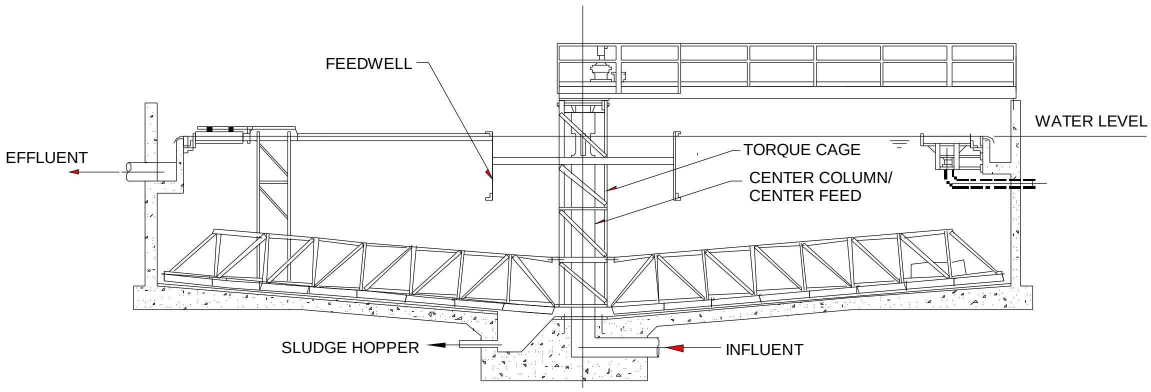
Disadvantages:

- None

Applications:

- Any clarifier application

Center Feed Clarifiers



Models: COPC1, COPT2, CLC15, CLC17, CLC18, CLC19, CLL15

Description: Flow is introduced to the clarifier at its center through a pipe running beneath the clarifier and up through the center support column. High velocity is maintained in the feed line to prevent the accumulation of settled solids. A feedwell or energy dissipating inlet are employed to contain the localized high velocity currents within the center area of the clarifier. The flow then propogates radially outward, through the settling and clarification zones and eventually exiting the clarifier over a peripheral weir and launder arrangement. Settled solids are removed from a centralized hopper.

Advantages:

- Radial flow of clarifier produces lower velocities, and thus greater clarity as the flow approaches the effluent weir
- Effectively handles large flow fluctuations
- Solids settle out uniformly around the clarifier
- Typically results in lower capital costs than peripheral feed

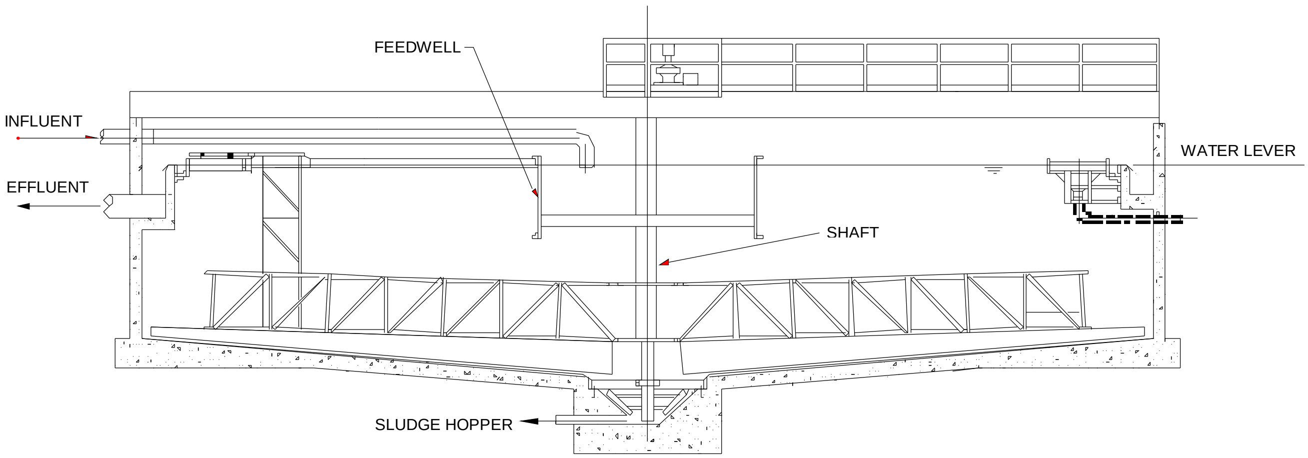
Disadvantages:

- Can result in severe hydraulic short-circuiting if baffling and geometery are not properly designed

Applications:

- Can be used in any clarifier application

Side Feed Clarifiers



Models: COPS4, CLS25, CLS27, CLS28, CLD25

Description: Flow is introduced to the clarifier at its center through a pipe running radially through or above the clarification zone and terminating in the feedwell. High velocity is maintained in the feed line to prevent the accumulation of settled solids. A feedwell or energy dissipating inlet are employed to contain the localized high velocity currents within the center area of the clarifier. The flow then propogates radially outward, through the settling and clarification zones and eventually exiting the clarifier over a peripheral weir and launder arrangement. Settled solids are removed from a centralized hopper.

Advantages:

Radial flow of clarifier produces lower velocities, and thus greater clarity as the flow approaches the effluent weir

- Effectively handles large flow fluctuations
- Solids settle out uniformly around the clarifier
- Typically results in lower capital costs than peripheral feed

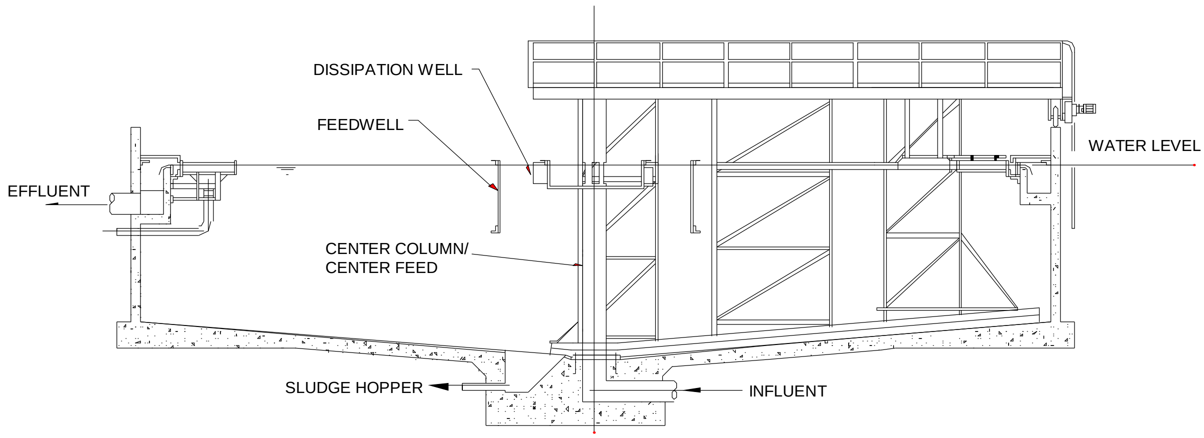
Disadvantages:

- Can result in severe hydraulic short-circuiting if baffling and geometery are not properly designed

Applications:

- Can be used in any clarifier application

Rim Drive Clarifiers



Model: COPT2

Description: Rake arms are rotated by a revolving walkway and peripheral drive. The drive incorporates traction wheels which rotate on the outer wall of the clarifier. A center slip ring provides power to the unit.

Advantages:

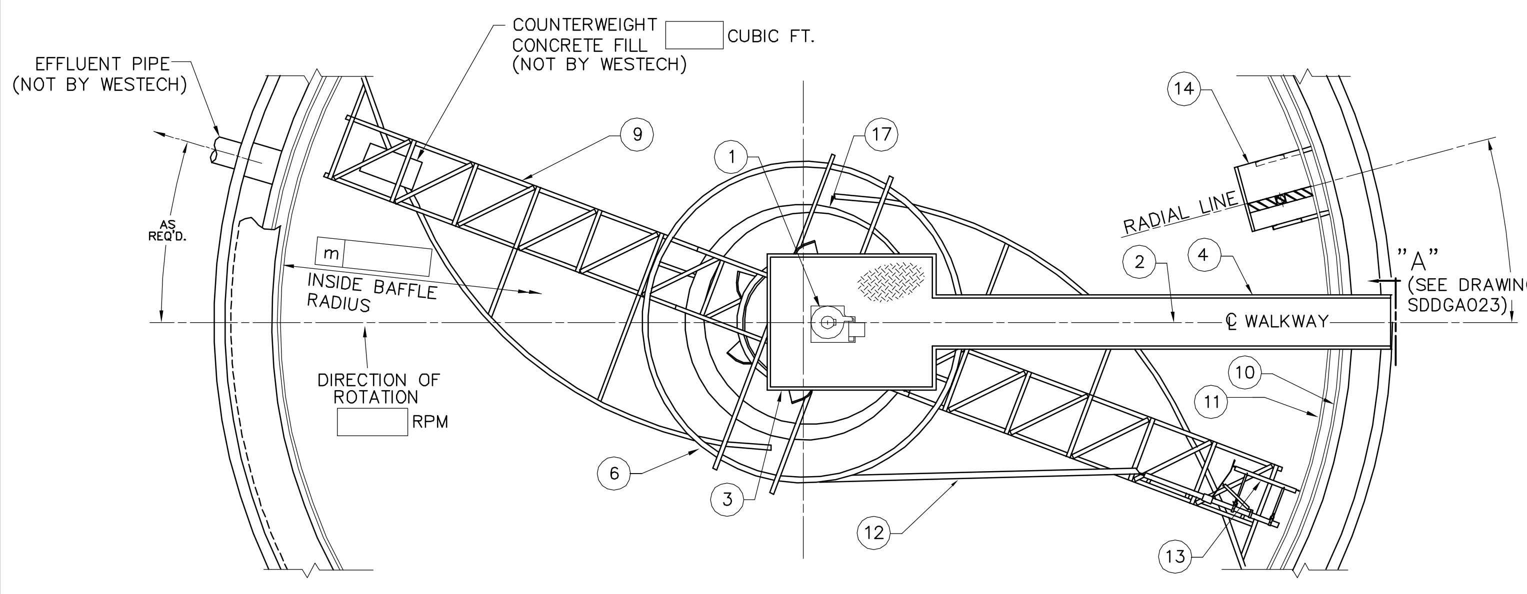
- Most cost effective drive
- Easy access to parts requiring maintenance
- Not affected by unbalanced loads on rakes or uneven settling of basins

Disadvantages:

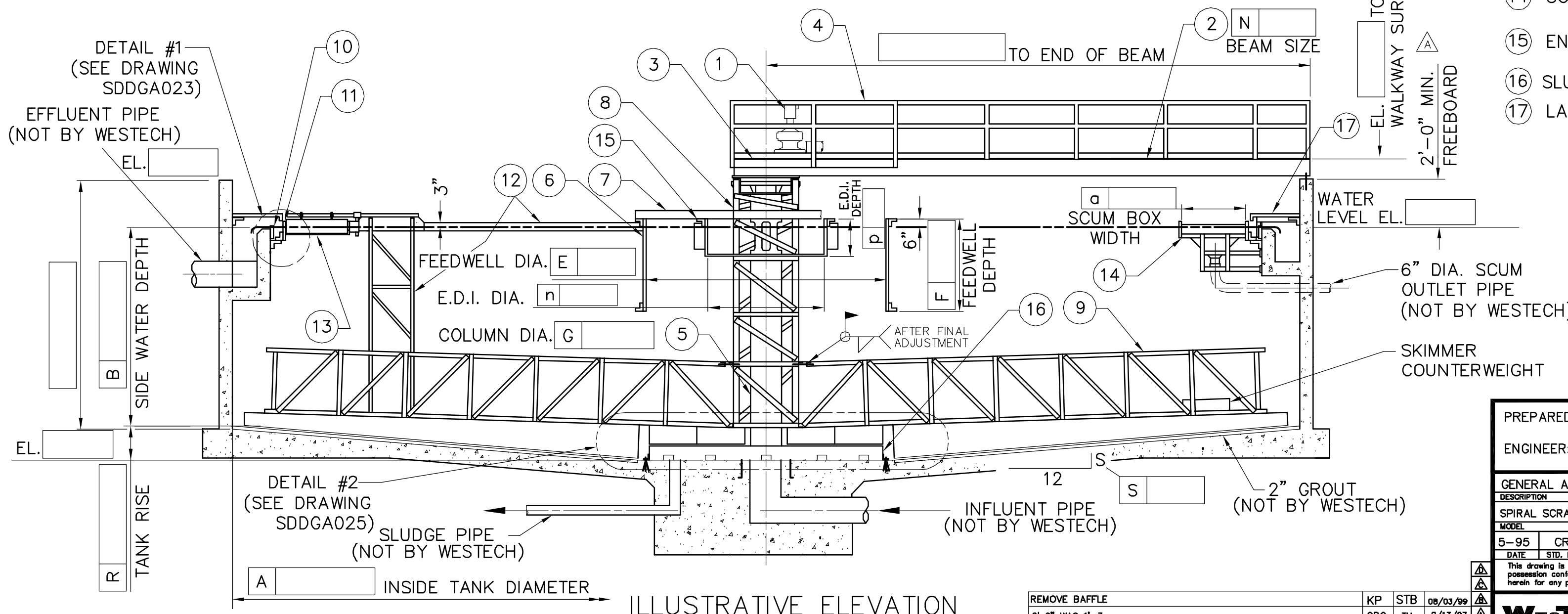
- There is a practical limitation to torque capacities
- The walkway rotates, which may be considered a safety hazard
- More long-term maintenance is required

Application:

- Any clarifier without high torque requirements



PLAN VIEW



ILLUSTRATIVE ELEVATION

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DRIVE UNIT W/TORQUE CONTROL DEVICE D FT. LBS. CONTINUOUS RUNNING TORQUE
2	WALKWAY
3	PLATFORM
4	HANDRAIL 42" HIGH DOUBLE RAIL W/ 1/4" x 4" KICKPLATE
5	CENTER INFLUENT COLUMN (1/4" WALL) W/ INFLUENT PORTS
6	FEEDWELL (3/16" PLATE) W/BAFFLED SCUM PORTS
7	FEEDWELL SUPPORTS
8	DRIVE CAGE
9	TWO (2) RAKE ARMS EA. W/SPIRAL BLADES, (1) PARELLEL SCRAPER, (2) OUTWARD BLADES, AND ADJUSTABLE SQUEEGEES. RAKE TWICE PER REVOLUTION
10	WEIR PLATE 3/16" X 9" DEEP W/ 90° V-NOTCHES
11	BAFFLE 3/16" X 12" DEEP W/SUPPORTS
12	SKIMMER BLADE WITH SUPPORTS
13	SCUM SCRAPER
14	SCUM BOX W/ (2) SUPPORTS & 6" FLEXIBLE COUPLING OUTLET
15	ENERGY DISSIPATING INLET W/MULTIPLE INLET GATES
16	SLUDGE WITHDRAWAL RING
17	LAUNDER COVER

NOTES:
1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT FOLLOWING PROPER PROCESS DESIGN CRITERIA.
2. SEE SDTGA034 FOR CONCRETE TANK ARRANGEMENT.
3. SEE SDDGA023 AND SDDGA025 FOR G.A. DETAILS.

REVISION	BY	CHKD	DATE	LTR
REMOVE BAFFLE	KP	STB	08/03/99	A
2' 0" WAS 1'-3	CRG	TH	2/13/97	A

PREPARED FOR:

ENGINEER:

GENERAL ARRANGEMENT – CLARIFIER

DESCRIPTION

SPIRAL SCRAPER CAGE DRIVE – COPC1 | 45' TO 100' DIAMETER

MODEL | SIZE COPC1X01 | 0313 x 32

DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
5-95	CRG	STB	TLD	NONE				

WESTECH

DRAWING NUMBER: COPC1X01 | PROJECT NUMBER: | REV. B

WesTech
Process Equipment. Process Driven.

CONVENTIONAL CLARIFIER

Conventional Clarifier Overview:

The WesTech Conventional Segmented Blade Clarifier is a capable option for smaller primary clarification applications. Each Conventional Segmented Blade Clarifier can be upgraded with several WesTech COP™ Clarifier Design features.

The WesTech COP™ Clarifier is the result of research and design focus on building a better clarifier. Each COP Clarifier is designed for the specific process requirements of each plant. Proprietary algorithmic computer programs are utilized and further refined to result in a clarifier that provides high performance, and is of benefit to plant operations overall. An acronym for Clarifier Optimization Package, this highly efficient clarifier design utilizes key design parameters to optimize the physical forces and limitations occurring in any clarifier to achieve superior performance:

1. **Scum Removal:** Removes scum buildup from within the feedwell and from the clarifier surface.
2. **Basin Configuration:** Uses deeper side water depth (SWD) and proper floor slope design for maximum capacity and highest effluent quality for the least cost.
3. **Density Current Baffle:** Eliminates wall currents and prevents short-circuiting. The wall-mounted baffle is low in cost and requires no maintenance.
4. **Flocculating Feedwell:** Promotes hydraulic flocculation in the inlet area and is designed to eliminate scouring of the sludge blanket.
5. **Energy Dissipating Inlet (EDI):** Converts the high energy feed from the center column into a lower velocity flow that is gently mixed in an impinged or tangential flow into the flocculating feedwell to maximize flocculation.
6. **Center Column:** Minimizes floc shearing and reduces influent energy.

WesTech Segmented Blade Clarifiers are designed to address clarification requirements where a spiral blade is not required for sludge transport. Rake arms are made up of several straight segments, usually set at 30° - 45° attack angle. Settled solids are transported through one blade width with each passing of a rake arm.

Features:

- Positive means of removing heavier solids
- Simplicity of design and operation

Benefits:

- Low mechanism cost
- No clogging from orifices or plugging of pipes
- Usually results in more thickened solids than suction type mechanism

Applications:

- Primary clarification
- Secondary clarification

Clarifiers

In the following pages, several different styles and models of clarifiers are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate clarifier model within this design catalog.

Each type of clarifier can have different features. Some of these features are outlined on the clarifier model number sheet. These features include:

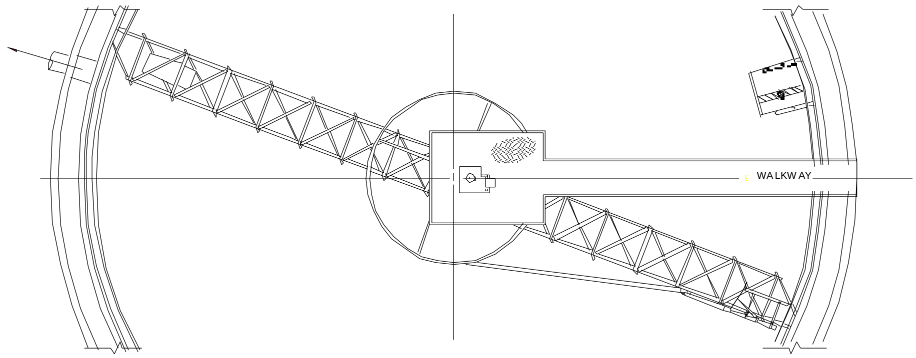
Drive type (cage, shaft, rim, etc.)
Feed type (center, peripheral, side, etc.)
Arm type (segmented plow, spiral, suction, etc.)

Options are also offered and can be combined with certain types of clarifiers. These options include:

Launder type (internal, external, inboard, crossflow, radial, etc.)
Skimmer (standard, ducking, brushes)
Lifting device
Corner Sweeps (for square or rectangular tanks)
Flocculating mixers
Feed distribution (feedwells, flocculation wells, energy dissipating inlets (EDI))
Launder covers
Sludge withdrawal ring
In tank baffles

These options and features are combined into standard model clarifiers as shown in the catalog. Other features and options can be combined for retrofit applications.

Segmented Plow Rake Clarifiers



Models: CLC15, CLS25

Description: Rake arms are made up of several straight segments, usually set at 30^{o}-45^{o} attack angle. Settled solids are transported through one blade width with each passing of a rake arm.

Advantages:

- Simple design
- Positive means of removing heavier solids
- Usually results in more thickened solids than suction type mechanisms
- Low mechanism costs
- No clogging from orifices or plugging of pipes
- Simplicity of design and operation

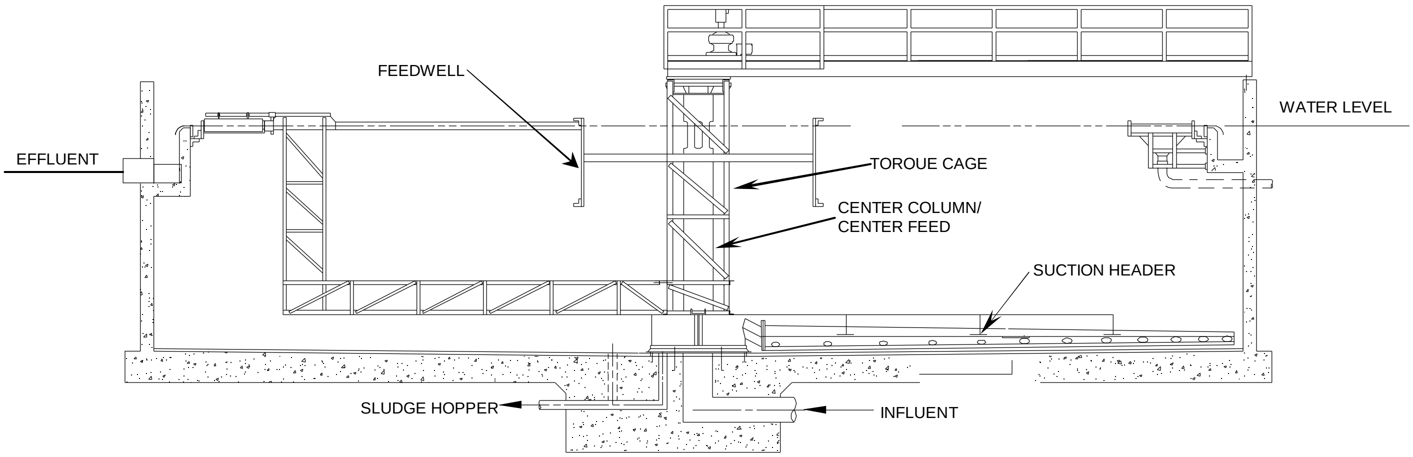
Disadvantages:

- Segmented blades only transport solids a small portion of the tank diameter, therefore many revolutions are required to move the solids to the center withdrawal hopper
- Potential for lower quality equipment due to widespread production
- Potential for rat-holing
- High denitrification potential in larger tanks

Applications:

- Performs best in tanks less than 50' diameter for biological solids, or any diameter for non-biological solids

Suction Header Clarifiers



Models: CLC18, CLC19, CLS28, CLC38, CLS38, CLC48

Description: Settled solids are removed through a rotating suction arm or header located at the bottom of the clarifier. The suction header is a sealed tube with orifices sized and spaced to ensure even solids removal over the entire clarifier bottom.

Advantages:

- Low capital costs
- Rapid removal of settled solids
- Reduces denitrification flotation
- Removes uniformly across tank floor
- Lowest disruption to clarification zone

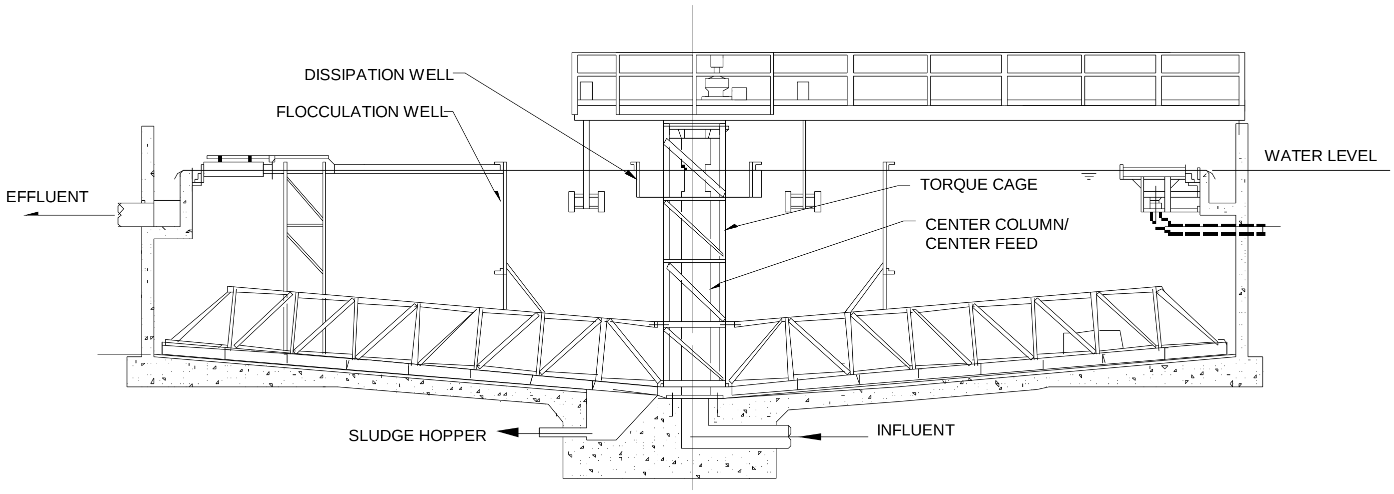
Disadvantages:

- There is no practical method during operation to verify that solids are removed evenly across the tank diameter or to verify that no orifices are plugged
- Nature of removal results in diluted solids concentrations
- Center manifold seals wear and will eventually fail, causing short-circuiting to the underflow
- Will not adequately remove heavier solids
- Diluted sludge requires increased RAS flows, therefore requiring increased pumping costs, lower SRT's and higher hydraulic loading on the clarifiers
- Usually not suited for field adjustment due to changing flows and/or solids loading rates
- Inability to make operational observations
- Narrow range of applications

Applications:

- Activated sludge clarifiers

Flocculating Clarifiers



Models: CLC15F, CLC17F, CLC18F, CLS25F, CLD25F, CLL15F

Description: Designed similar to standard clarifiers, but with a larger feedwell or flocculation well. Mechanical flocculators operate within the flocculation well to enhance settling.

Advantages:

- Aids settling of light or fine feed solids
- Provide mixing for chemical precipitates

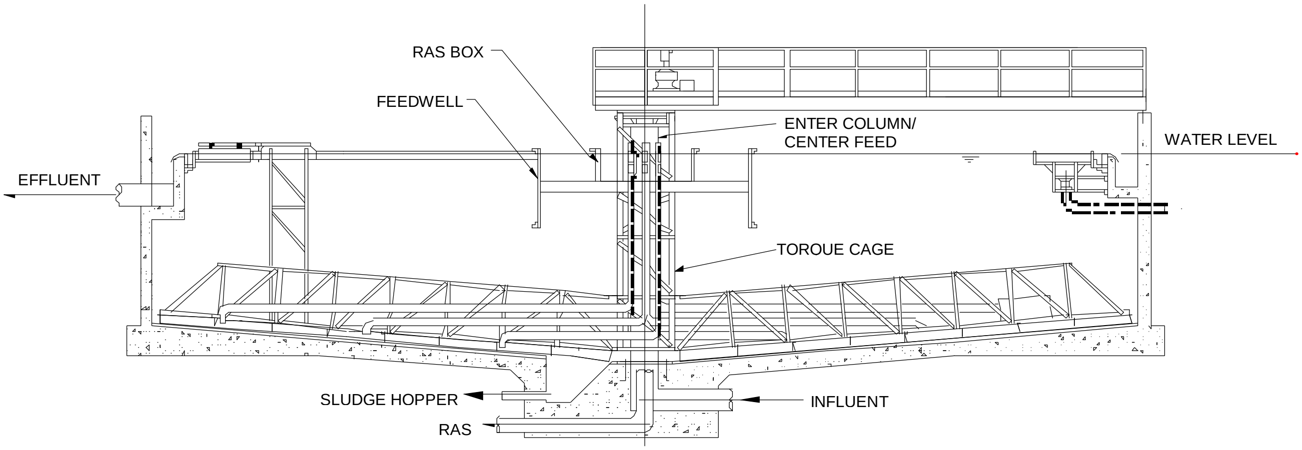
Disadvantages:

- Higher capital costs
- More maintenance on mechanical flocculator mechanisms

Applications:

- Final clarifiers, polishing clarifiers, tertiary clarifiers, water treatment clarifiers.

Suction Pipe Clarifiers



Models: CLC17, CLS27, CLC37

Description: Settled solids are removed through pipes mounted on the rakes arms. Head differentials between the clarifier liquid level and the liquid level in the RAS collection box cause continuous flow through the sludge withdrawal pipes. Rake blades form pockets and direct sludge to where the uptake pipes are located.

Advantages:

- Telescoping valves in the collection box give operators the ability to observe, sample, and control the flow of solids removed from each individual uptake pipe
- Rapid removal of settled solids
- Reduces denitrification flotation
- Adjustable sludge removal across tank floor

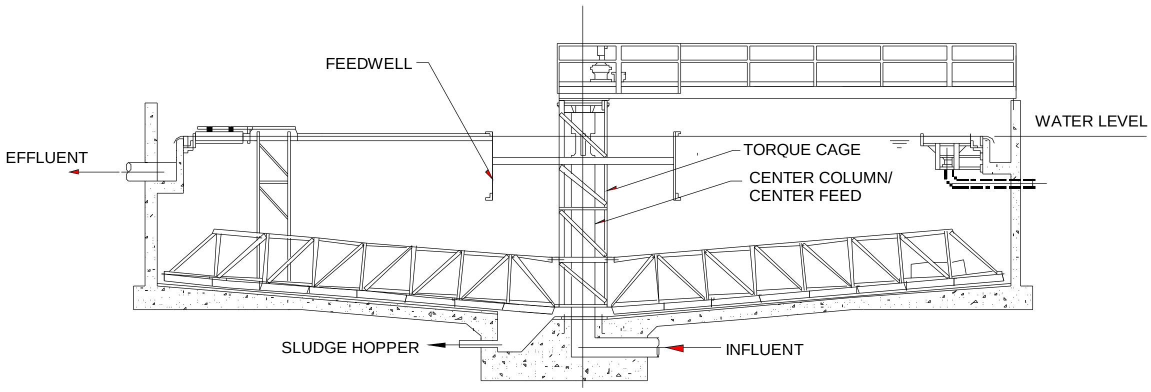
Disadvantages:

- Higher capital costs
- Nature of removal results in diluted solids concentrations
- Prone to plugging if flows are reduced
- Not able to effectively remove heavier solids
- Seals require higher maintenance
- Requires frequent adjustments as flow rates or solids loading change
- Dilution of sludge requires higher RAS flow, resulting in higher pumping costs, lower SRT's and higher hydraulic loading on the clarifier
- Higher operational costs
- Results in more disruption of the clarification zone
- Narrow range of applications

Applications:

- Activated sludge clarifier or outer portions of extremely large clarifiers to compensate for inadequate rake capacity.

Center Feed Clarifiers



Models: COPC1, COPT2, CLC15, CLC17, CLC18, CLC19, CLL15

Description: Flow is introduced to the clarifier at its center through a pipe running beneath the clarifier and up through the center support column. High velocity is maintained in the feed line to prevent the accumulation of settled solids. A feedwell or energy dissipating inlet are employed to contain the localized high velocity currents within the center area of the clarifier. The flow then propogates radially outward, through the settling and clarification zones and eventually exiting the clarifier over a peripheral weir and launder arrangement. Settled solids are removed from a centralized hopper.

Advantages:

- Radial flow of clarifier produces lower velocities, and thus greater clarity as the flow approaches the effluent weir
- Effectively handles large flow fluctuations
- Solids settle out uniformly around the clarifier
- Typically results in lower capital costs than peripheral feed

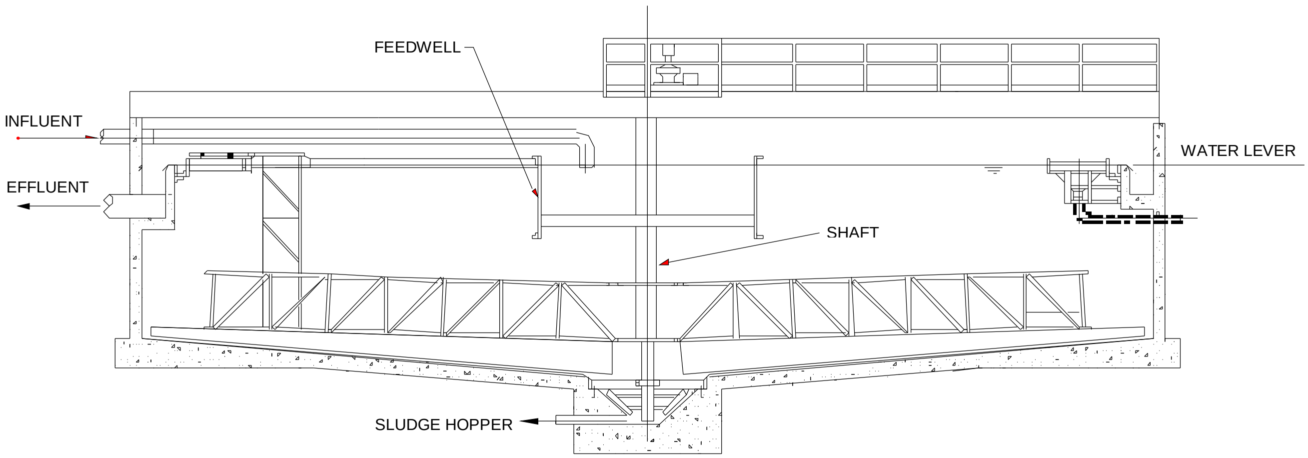
Disadvantages:

- Can result in severe hydraulic short-circuiting if baffling and geometery are not properly designed

Applications:

- Can be used in any clarifier application

Side Feed Clarifiers



Models: COPS4, CLS25, CLS27, CLS28, CLD25

Description: Flow is introduced to the clarifier at its center through a pipe running radially through or above the clarification zone and terminating in the feedwell. High velocity is maintained in the feed line to prevent the accumulation of settled solids. A feedwell or energy dissipating inlet are employed to contain the localized high velocity currents within the center area of the clarifier. The flow then propogates radially outward, through the settling and clarification zones and eventually exiting the clarifier over a peripheral weir and launder arrangement. Settled solids are removed from a centralized hopper.

Advantages:

Radial flow of clarifier produces lower velocities, and thus greater clarity as the flow approaches the effluent weir

- Effectively handles large flow fluctuations
- Solids settle out uniformly around the clarifier
- Typically results in lower capital costs than peripheral feed

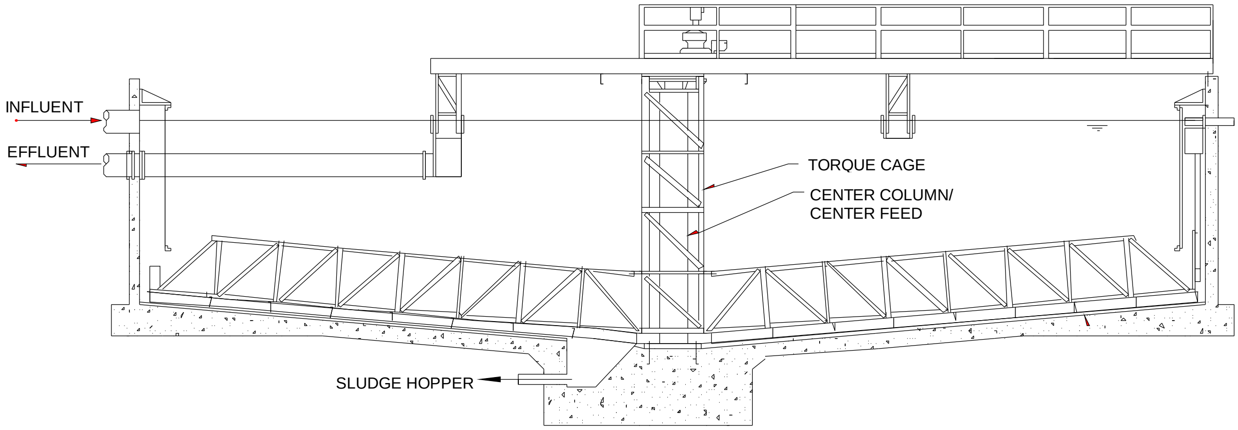
Disadvantages:

- Can result in severe hydraulic short-circuiting if baffling and geometery are not properly designed

Applications:

- Can be used in any clarifier application

Peripheral Feed Clarifiers



Models: CLC35, CLS35, CLC37, CLC38, CLS38, CLC48

Description: Flow is introduced at the perimeter of the clarifier, allowed to flow through the clarification zone, and removed from a centralized weir and trough or from an outer perimeter weir and trough. Settled solids are removed from a centralized hopper.

Advantages:

- Several studies have indicated that peripheral feed, center take-off clarifiers generally have a better hydraulic efficiency than a typical center feed clarifier. This would translate into longer detention times in the clarification zone, resulting in better effluent qualities.

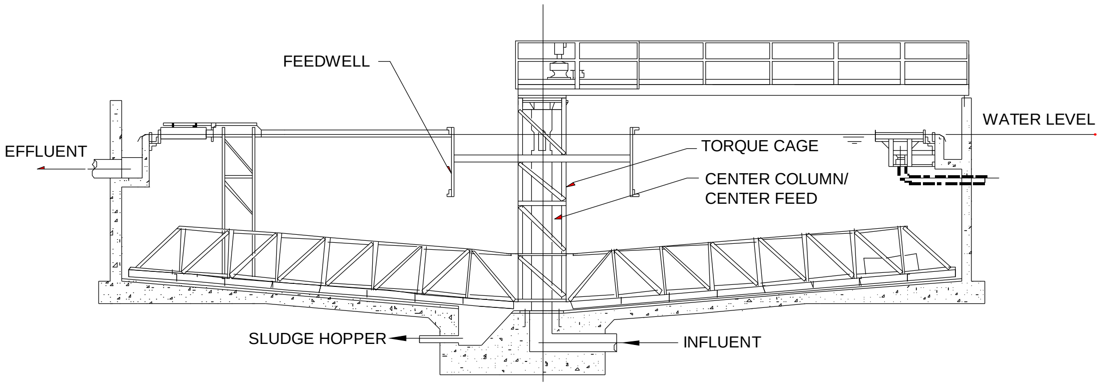
Disadvantages:

- More expensive than a conventional center feed clarifier
- Performance may be eratic under highly varying flow rates
- Documented waterfall effect of higher density influent results in uneven solids distribution over the clarifier bottom
- Scum removal is more complex
- Hydraulic energy increases as the flow exits the tank because of shorter weir lengths
- Potential freezing in raceway limits cold weather applications

Applications:

- Generally limited to final clarifiers where waterfall effect is less pronounced

Cage Drive Clarifiers



Models: All model numbers beginning with ‘CLC’ or ‘SCC’

Description: The drive is mounted on a stationary center pier. The rotating portion of the drive rotates a structural torque cage, which in turn rotates the sludge removal mechanism. The drive and center pier also support the walkway and center platform.

Advantages:

- Can develop high torques in compact units
- Center column can double as a walkway support and feed pipe
- Regular maintenance usually less than rim drives
- Safer than rim drives
- Allows for stationary walkways

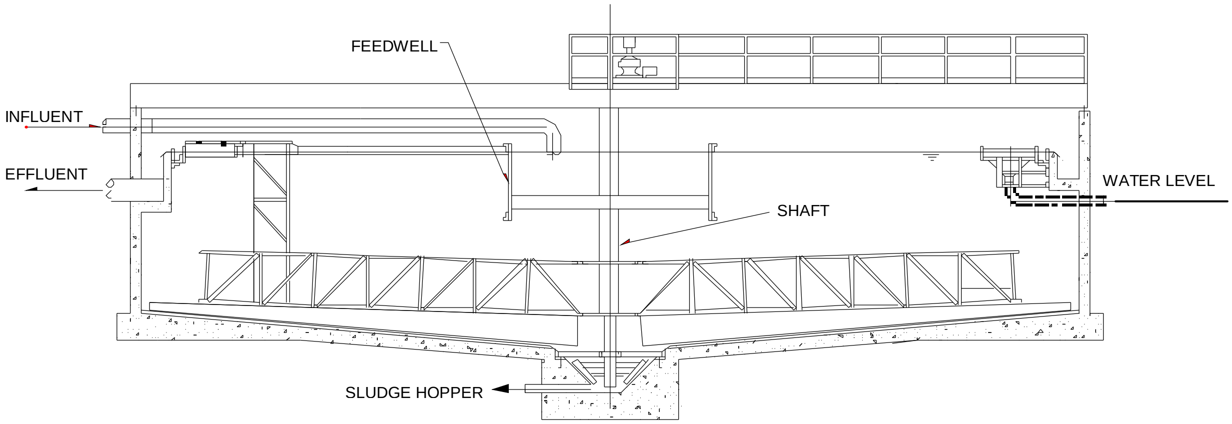
Disadvantages:

- More expensive than shaft drives or rim drives
- Access to main gear and bearing is more difficult due to the location under the center platform

Applications:

- Most economical when used in clarifiers 50 feet in diameter or larger, or where higher than normal torques are required.

Shaft Drive Clarifiers



Models: All 'CLS' or 'SCS' series

Description: The drive is mounted on the walkway or bridge. The rotating portion of the drive rotates a structural torque tube or shaft, which in turn rotates the sludge removal mechanism.

Advantages:

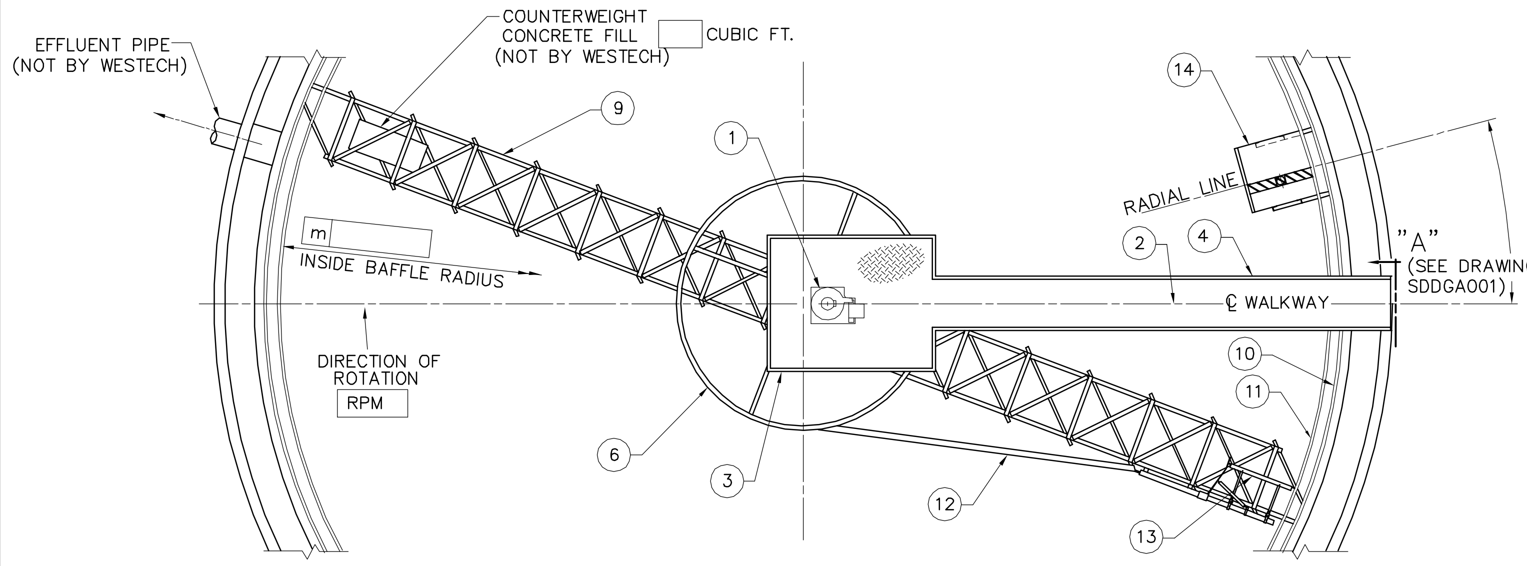
- Can develop high torques in compact units
- Torque tube is generally more economical than a torque cage
- Easy access to main gear, bearing and pinion
- Most economical way to provide lifting device for rake arms under severe torque loads
- Low regular maintenance requirements
- Safer than rim drives
- Allows for stationary walkway

Disadvantages:

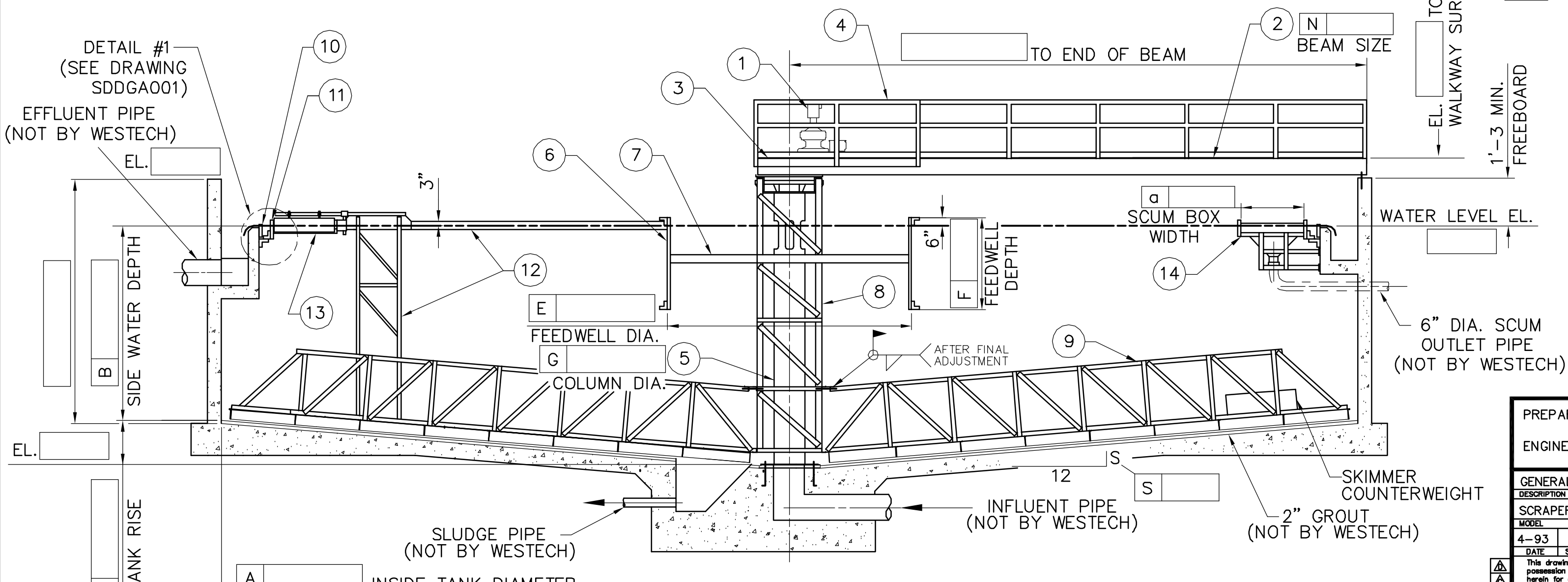
- Walkway or bridge must span the tank and support the weight and torque of the mechanism, therefore the bridge will be more expensive than for a center pier supported unit
- More expensive than rim drives

Applications:

- Most economical when used in clarifiers 50 feet in diameter or less, or where center feed is not economical or feasible.



PLAN VIEW



ILLUSTRATIVE ELEVATION

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DRIVE UNIT W/TORQUE CONTROL DEVICE D [ ] FT. LBS. CONTINUOUS RUNNING TORQUE
2	WALKWAY
3	PLATFORM
4	HANDRAIL 42" HIGH DOUBLE RAIL W/ 1/4" x 4" KICKPLATE
5	CENTER INFLUENT COLUMN (1/4" WALL) W/INFLUENT PORTS
6	FEEDWELL (3/16" PLATE) W/BAFFLED SCUM PORTS
7	FEEDWELL SUPPORTS
8	DRIVE CAGE
9	TWO (2) RAKE ARMS W/BLADES AND ADJUSTABLE SQUEEGEES (RAKE TWICE PER REVOLUTION)
10	WEIR PLATE 3/16" X 9" DEEP W/90° V–NOTCHES
11	BAFFLE 3/16" X 12" DEEP W/SUPPORTS *
12	SKIMMER BLADE WITH SUPPORTS *
13	SCUM SCRAPER *
14	SCUM BOX W/ TWO (2) SUPPORTS, 6" FLEXIBLE COUPLING OUTLET *

* OPTIONAL

NOTES:

1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT FOLLOWING PROPER PROCESS DESIGN CRITERIA.
2. SEE SDTGA002 FOR CONCRETE TANK ARRANGEMENT.
3. SEE SDDGA001 FOR GENERAL ARRANGEMENT DETAILS.

PREPARED FOR: ______

ENGINEER: ______

GENERAL ARRANGEMENT – CLARIFIER								
DESCRIPTION								
SCRAPER CAGE DRIVE – CLC15				25' TO 100' DIAMETER		CLC15X01	0313 x 32	
MODEL				SIZE				
4–93	CRG	STB	RCW	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

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REVISION	BY	CHKD	DATE	LTR

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
CLC15X01		△

RAPISAND™ BALLASTED FLOCCULATION

RapiSand™ Ballasted Flocculation Overview:

The WesTech RapiSand™ Ballasted Flocculation System is a high rate clarification process using rapid mixing and multi-stage flocculation, followed by sedimentation. RapiSand™ sedimentation is extremely fast and can be applied in a wide variety of suspended solids removal applications. The typical uses of RapiSand™ include expanding plant capacity, minimizing plant footprint, providing fast startup capabilities, and providing great performance characteristics. RapiSand™ can be the answer to your suspended solids process needs.

How it Works:

RapiSand ballasted flocculation is a four step process:

1. Coagulation: Raw water is mixed with coagulant in the first tank.
2. Flocculation: Coagulated water is mixed with polymer and recycled micro-sand in each of two flocculation tanks.
3. Clarification: The flocculated water flows into the clarification tank. There, the floc settles and clarified water passes up through tube settlers and enters the outlet launder to leave the system.
4. Separation: Settled floc and sand are raked and pumped to the hydrocyclone where the sand is separated from the solids. The solids are sent to waste and the separated sand is returned to the first flocculation tank.

The micro sand has a specific gravity of 2.6. The sand acts as ballast when attached to the floc via the polymer. Thus the term "ballasted floc". The ballasted floc settles at rates 15 to 35 times higher than conventional clarification. The resulting high rise rates allow the RapiSand system to fit into a fraction of the space required for conventional treatment systems.

Features:

- Hydrofoil Mixers
- Circular Rake System
- Industrial Recirculation Pump
- Hydrocyclone
- Chemical Feed Systems

Benefits:

- Ensures uniform mixing in all three mixing chambers.
- Guarantees rapid transport of settled sand/solids to a centrally located hopper, allowing for rapid process startup.
- Provides reliable recirculation of the clarifier underflow to the hydrocyclone.
- Provides separation of the sand and coagulated solids.
- Coagulant and polymer feed systems are designed for optimum performance and efficient chemical deployment.

SOLIDS CONTACT CLARIFIER™

Solids CONTACT CLARIFIER™ Overview:

The WesTech Solids CONTACT CLARIFIER™ has the ability to act as both an enhanced flocculation device as well as a high rate chemical precipitator. Mixing, internal solids recirculation, gentle flocculation and gravity sedimentation are all combined into a single unit.

How it Works:

Influent flow is mixed with previously settled solids within the draft tube. Gentle mixing within the reaction well promotes agglomeration of floc particles and/or chemical precipitates. The aggregated solids settle out more rapidly in the clarification area. Even better clarity is achieved when particles become enmeshed in a sludge blanket layer. Rotating sludge scrapers transport settled solids to the center of the basin for removal. Clarified overflow is removed through a radial launder system that draws water from the entire surface area to prevent solids carryover caused by uneven velocity currents. For high upflow rates, tube settlers can be added to increase the effectiveness of gravity sedimentation.

Because the Solids CONTACT CLARIFIER™ re-circulates previously settled solids many times over, less chemical input is needed and results are superior to conventional treatment methods.

Efficient recirculation is provided by a low shear, high volume pumping impeller. This impeller is unique to WesTech and improves on traditional radial impeller designs. The sweptback curved blades of the impeller minimize horsepower required and the shearing of floc particles.

WesTech has custom-designed hundreds of Solids CONTACT CLARIFIERS™ in many applications, and can also retrofit installations of other manufacturers to provide improved performance.

Features:

- Low energy mixing for chemical reactions and formation of floc particles.
- Unique low shear high volume impeller.
- Utilizes the reliable WesTech heavy duty concentric dual drive.
- Gravity sedimentation clarification and enhanced flocculation in one unit.

Benefits:

- Consumes less chemical input.
- Low horsepower requirements.
- Requires less space than conventional flocculation and sedimentation train.
- Considerable savings in terms of tankage, civil work, and operational costs.

SOLIDS CONTACT CLARIFIER™

Applications:

- Surface water clarification
- Cold lime softening / lime & soda ash softening
- Pretreatment to membranes
- Pretreatment to conventional filtration
- Acid mine drainage
- Tertiary wastewater treatment / Phosphorous removal
- Heavy metals removal

Clarifiers

In the following pages, several different styles and models of clarifiers are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate clarifier model within this design catalog.

Each type of clarifier can have different features. Some of these features are outlined on the clarifier model number sheet. These features include:

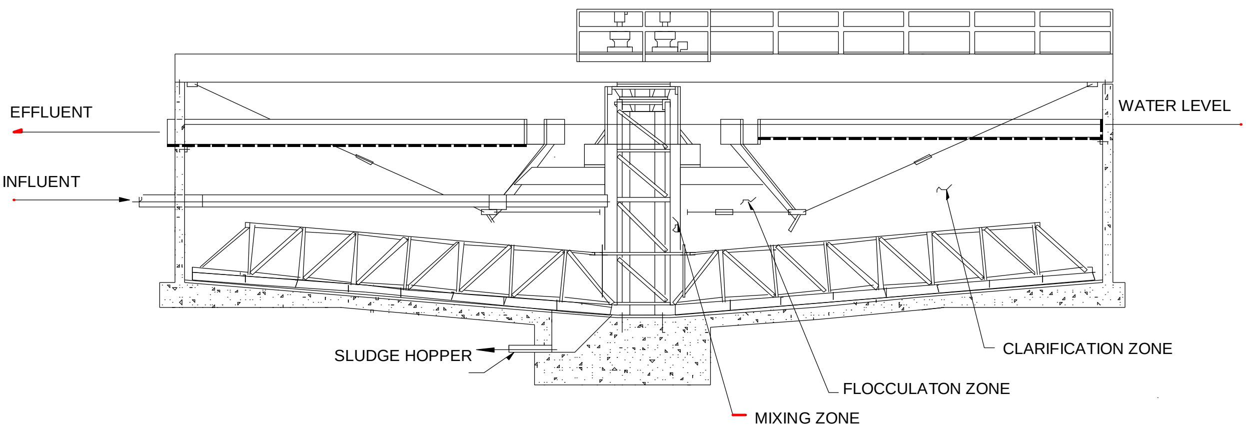
- Drive type (cage, shaft, rim, etc.)
- Feed type (center, peripheral, side, etc.)
- Arm type (segmented plow, spiral, suction, etc.)

Options are also offered and can be combined with certain types of clarifiers. These options include:

- Launder type (internal, external, inboard, crossflow, radial, etc.)
- Skimmer (standard, ducking, brushes)
- Lifting device
- Corner Sweeps (for square or rectangular tanks)
- Flocculating mixers
- Feed distribution (feedwells, flocculation wells, energy dissipating inlets (EDI))
- Launder covers
- Sludge withdrawal ring
- In tank baffles

These options and features are combined into standard model clarifiers as shown in the catalog. Other features and options can be combined for retrofit applications.

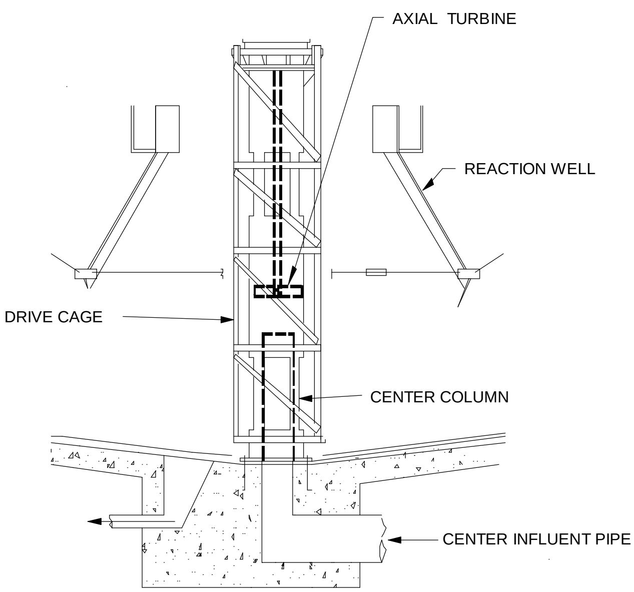
Solids Contact Clarifiers

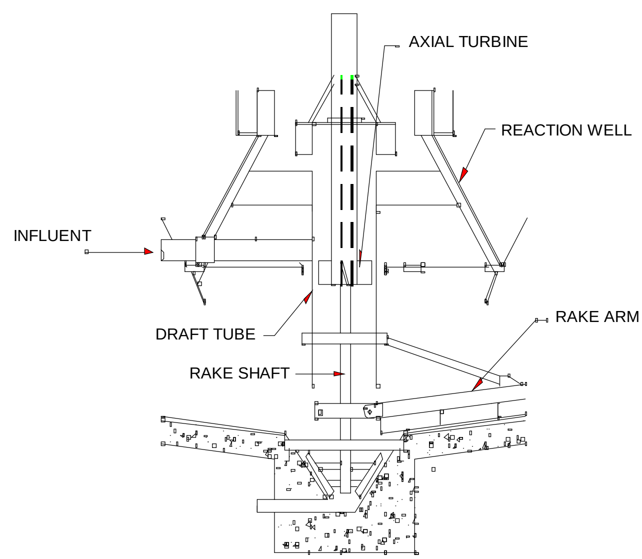


Model: SCC - Cage Drive, SCS - Shaft Drive

Description: Solids contact clarifiers combine the process of mixing, flocculation and sedimentation in a single compartmented unit. Mixing is produced by a radial or axial turbine. Flocculation occurs within the reaction well. Sedimentation occurs in the clarification zone, which has an increasing area as the water flows to the surface. The clarifier is comprised of (1) a mixing zone, (2) flocculation (reaction) zone, (3) sludge blanket zone, and (4) a clarification zone. A turbine draws concentrated settled solids from the bottom, mixes them with the low concentration influent and disperses it into the reaction well.

Turbine Options:





Solids Contact Clarifiers (Continued)

In the reaction well, solids coagulate, flocculate, and settle. The flow passes through the sludge blanket at the bottom edge of the reaction well, filtering out the fine particles that did not coagulate and settle. The flow then rises upward in the clarification zone to peripheral or radial launder troughs suspended at the surface. A small portion of the settled sludge is periodically "blown down" or drawn off from a sludge hopper by opening a valve with a timer. Usually associated with the blow down valve and line is a backflush that fills the blowdown line with clear water so the solids will not harden and plug the line.

Advantages:

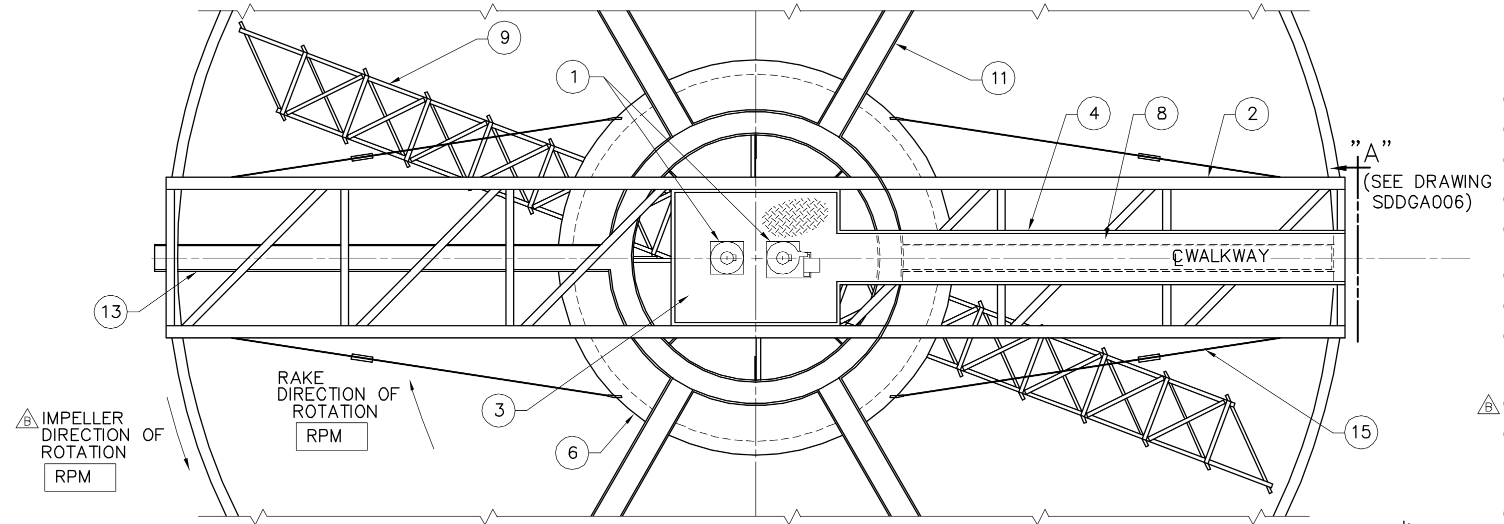
- Excellent means to enhance settling of light or fine feed solids
- Reduced space requirements
- Lower overall capital cost with combined processes.

Disadvantages:

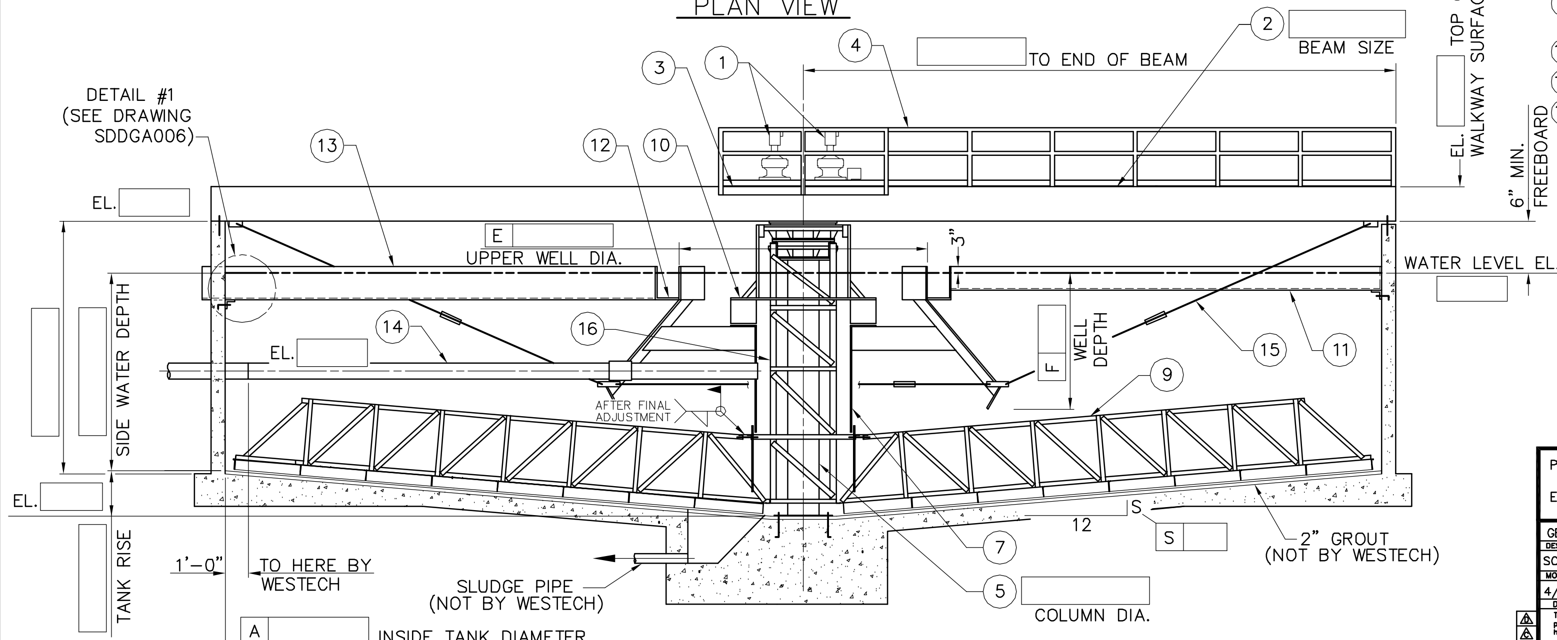
- Chemical addition can be required

Applications:

- Water softening and color and turbidity removal clarifiers in water treatment plants. Polishing or tertiary clarifiers in waste water treatment plants. These units are particularly advantageous in lime softening on groundwater since the precipitated solids help seed the flow, growing larger crystals of precipitate to provide a thicker waste sludge. The units have also been applied in the chemical treatment of industrial waste (like metal removal) and surface water supplies (river water treatment). Shaft drive units are usually used up to 100' dia. tanks with cage drive units being used thereafter



PLAN VIEW



ILLUSTRATIVE ELEVATION

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DUAL DRIVE UNIT W/TORQUE CONTROL DEVICE RAKE ____ FT. LBS. CONTIN. RUNNING TORQUE
2	MAIN SUPPORT BRIDGE
3	PLATFORM
4	HANDRAIL 42" HIGH DOUBLE RAIL W/ 1/4" x 4" KICKPLATE
5	CENTER COLUMN (1/4" PLATE)
6	REACTION WELL (1/4" PLATE) W/VORTEX BAFFLES
7	DRAFT TUBE (1/4" PLATE) & SUPPORTS
8	WALKWAY
9	TWO (2) RAKE ARMS W/BLADES AND ADJUSTABLE SQUEEGEES (RAKE TWICE PER REVOLUTION)
10	CENTRIFUGAL IMPELLER
11	RADIAL LAUNDERS (1/4" PLATE) W/EFFLUENT ORIFICES EQUALLY SPACED ____ REQ'D.
12	COLLECTION TROUGH (1/4" PLATE)
13	RADIAL EFFLUENT LAUNDER (1/4" PLATE) W/ORIFICES
14	INFLUENT PIPE (1/4" MIN. WALL)
15	REACTION WELL TIE ROD SUPPORTS
16	DRIVE CAGE

NOTES:

1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT FOLLOWING PROPER PROCESS DESIGN CRITERIA.
2. SEE SDTGA024 FOR CONCRETE TANK ARRANGEMENT.
3. SEE SDDGA006 FOR GENERAL ARRANGEMENT DETAILS.

REVISION	BY	CHKD	DATE	LTR
CHANGED RADIAL TURBINE TO CENTRIFUGAL IMPELLER	JWB	DGF	03/27/03	B
REVISED DRAWING	CRG	LDB	8-95	A

PREPARED FOR:

ENGINEER:

GENERAL ARRANGEMENT
DESCRIPTION

SOLIDS CONTACT CLARIFIER - SCC | 26' - 120' DIAMETER
MODEL | SIZE | SCCX1001 | .0313 x 32

DATE	STD. BY	STD.CHKD.	STD.APPVD.	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
4/93	CRG	STB	TH	NONE				

WESTECH | DRAWING NUMBER: SCCX1001 | PROJECT NUMBER: | REV. B

HORIZONTAL BELT FILTERS

Horizontal Belt Filter Overview:

WesTech Horizontal Belt Filters provide a continuous vacuum on a horizontal plane. Slurries are fed onto a filter cloth supported by a traveling drainage belt. Horizontal belt filters are especially adaptable to applications where low cake moisture and/or cake washing is desirable.

Backed by extensive practical experience gained from a wide range of applications worldwide, WesTech offers a complete engineering and contracting service to the liquid/solids separation industry. WesTech has worked closely with engineers and operators at many key installations to develop a horizontal belt vacuum filter that offers trouble-free operation and easy serviceability.

Today WesTech offers a wide range of horizontal belt filter units from the smallest 5 ft^2 pilot filter up to 2000 ft^2 in effective filtration area. All of these units are capable of running at speeds up to 148 ft/minute at vacuum levels of up to 25 inches of mercury at sea level.

Making use of the most modern materials of construction, WesTech's latest designs outperform traditional rotary drum, disc tilting pan and table filters in all situations, both in throughput and final cake moisture.

Features:

- Single Source Supplier for Full FGD Process Train
- Broad Process Experience
- Robust Construction

Benefits:

- High Efficiency Dewatering
- Low Cake Moisture

Applications:

- Coal
- Phosphoric acid
- Chemicals
- Copper leach
- Gold
- Industrial minerals
- Uranium
- Phosphate rock
- Iron ore
- Zinc
- Potash
- Nickel
- Flue gas desulfurization (FGD)
- Gypsum dewatering

Process Equipment. Process Driven.

Horizontal Belt Filter

Product Profile

Filtration of slurries containing fast settling solids high production rate high washing efficiency low maintenance cost filtration area up to 200 m^2.

Special features

Innovative deck design, Low drive power consumption, Modular design, Corrosion resistant materials for all wetted parts Low height of construction, Belt wash system available. Materials of construction to be selected according to operating conditions.

Applications

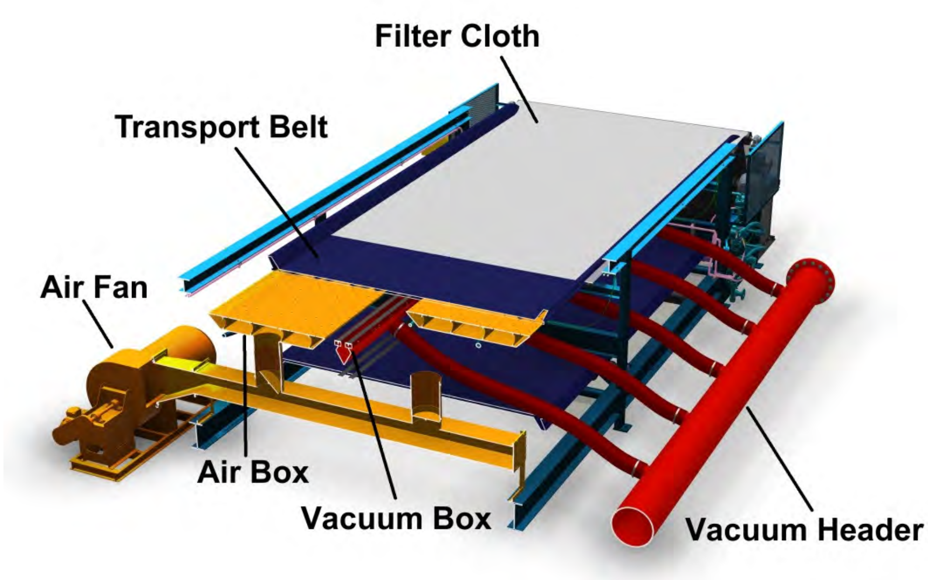
Horizontal Belt Filters should be used when:

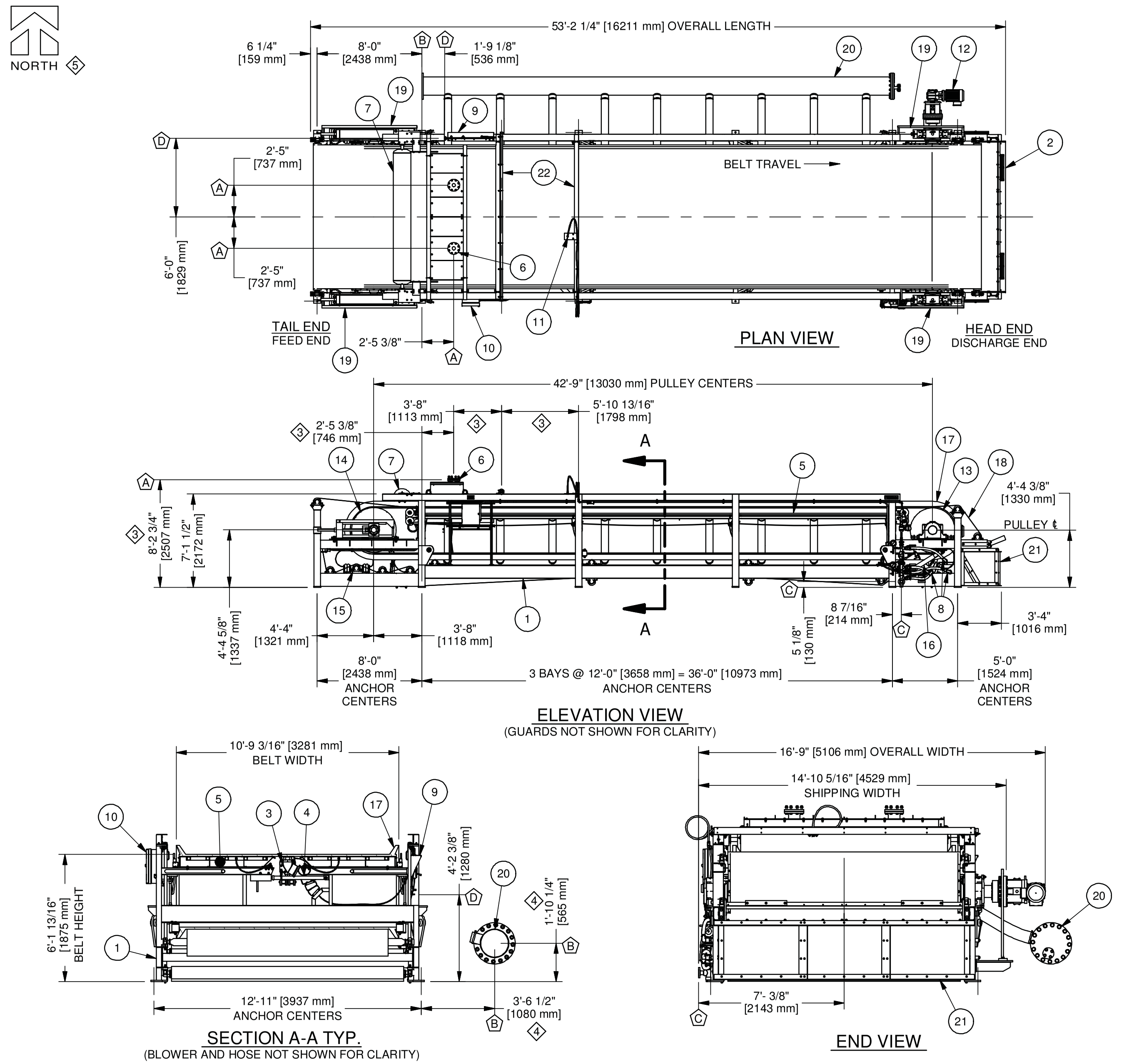
- Thorough cake washing is required
- Free settling solids
- Complete processing of feed materials
  - Maximum product recovery
  - Minimum operating cost
- A flexible range of operating conditions is required
- Simplicity of operation and maintenance are required
- Process contact requires exotic construction materials.

Low energy consumption and high filtration rate make Westech HBF an excellent choice for many processes like:

- Minerals processes
- Metallurgical ores
- Power wastes
- Chemical processing
- Food processing

Specific filtration rates of more than 300 lbs./$ft.^2$/hr. (depending on process) can be achieved.





PC	DESCRIPTION
1	FILTER FRAME
2	CLOTH SCRAPER ASSEMBLY
3	VACUUM BOX
4	VACUUM BOX LIFTING ASSEMBLY
5	BELT SUPPORT
6	SLURRY FEED ASSEMBLY
7	FEED DAM ROLLER
8	CLOTH WASH
9	AIR SERVICE PANEL
10	ELECTRICAL JUNCTION BOXES
11	CAKE THICKNESS SENSOR
12	DRIVE
13	HEAD PULLEY
14	TAIL PULLEY
15	CLOTH TRACKER ASSEMBLY
16	CLOTH TENSION UNIT
17	TRANSPORT BELT
18	FILTER CLOTH
19	GUARD
20	FILTRATE MANIFOLD
6 21	DISCHARGE CHUTE
6 22	1ST STAGE CAKE WASH

CONNECTION SUMMARY		
	SIZE/TYPE	DESCRIPTION
A	6" FLANGE	SLURRY FEED
B	16" FLANGE	MANIFOLD OUTLET
C	2" FLANGE	SERVICE WATER
D	1/2" FLANGE	SERVICE AIR

FOR INFORMATION ONLY

NOTES:

1. ALL FLANGES TO CONFORM TO ANSI B16.5 150#, HOLES TO STRADDLE CENTERLINES.
2. ALL PIPING CONNECTIONS MUST BE SUPPORTED INDEPENDENTLY.

3 REFERENCE LOCATION, FINAL LOCATION TO BE SET DURING START-UP.

4 RECOMMENDED LOCATION.

5 VIEW ORIENTATION TO BE VERIFIED BY ENGINEER.

6 OPTIONAL COMPONENTS

SHEET 1 of 1

WESTECH

USA - BRAZIL - CHINA - RSA - INDIA
3665 SOUTH WEST TEMPLE, SLC, UT 84115
801-265-1000. www.WesTech-inc.com
Process Equipment. Process Driven.

3.2m HBF GENERAL ARRANGEMENT	6/26/2012	MH	AGR	PP	NONE
TITLE	DATE	DRAWN BY	CHECKED BY	APPROVED BY	SCALE
3.20.3-111			PRP 2012		0
DRAWING NUMBER			PROJECT NUMBER		REVISION

REFER TO: 3.20.3-112, 3.20.3-113, PID03

MHOLMGREN PRINT DATE: 10/8/2012 D:\The Dog House\00001_Proposal\Standards\0111\Inventor\0111_HBF_GeneralArrangement_3203_33m2_Water.idw

VACUUM DRUM FILTERS

Rotary Vacuum Drum Filters Overview:

WesTech's continuous Rotary Vacuum Drum Filters provide a wide range of liquid-solids separation for many types of industrial processing flow sheets. They offer the operating flexibility to handle dewatering, washing and clarification applications, or a combination of the two. WesTech drum filters are available with drums up to 13.5 ft in diameter and 36 ft in length and are built to customer specifications.

Rotary Vacuum Drum Filter Designs Include:

Scraper Discharge is the most common drum filter discharge. After dewatering, the cake is removed from the filter cloth by a scraper blade just prior to the re-submergence of the drum. The scraper serves mainly as a deflector to direct the cake, dislodged by an air blowback, into the discharge chute.

Precoat Discharge is best applied to processes which have relatively low concentrations of solids or produce filter cakes which effectively blind the filter media.

Roll Discharge is especially good for thin, sticky cakes which have the unique property of sticking to themselves. The filter cake on the drum is pressed against a discharge roll packed with filter cake so that the thin cake is pulled or peeled from the drum. Solids are removed from the discharge roll with a knife blade.

String Discharge best applies to thin cakes and materials that are unstable and if disturbed too much will change from a solid to a liquid. Most generally applied in the starch and pharmaceutical industries, it is a system of endless strings or wires spaced about 0.5 inches apart that pass around the filter drum but are separated tangentially from the drum at the point of cake discharge. The strings return to the drum surface guided by two rollers with the cake separating from the strings as they pass over the rollers.

Belt Discharge offers the ability to discharge filter cakes and wash both sides of the filter cloth with each drum rotation. Westech Belt Discharge Drum Filters offer the ability to discharge filter cakes and wash the filter media with each drum rotation. Many applications using this type of filter produce thin, sticky and wet filter cakes which are not easily discharged without the aid of a discharge roll.

WesTech
Process Equipment. Process Driven.

VACUUM DRUM FILTERS

Features:

- High speeds and minimal pressure drop
- Low submergence
- Superior knife advance system and longer-lasting knife
- Low maintenance
- Low power requirements
- Vacuum is constant around the drum
- No individual drum sections
- Adaptive to a wide range of solids
- High capacity

Benefits:

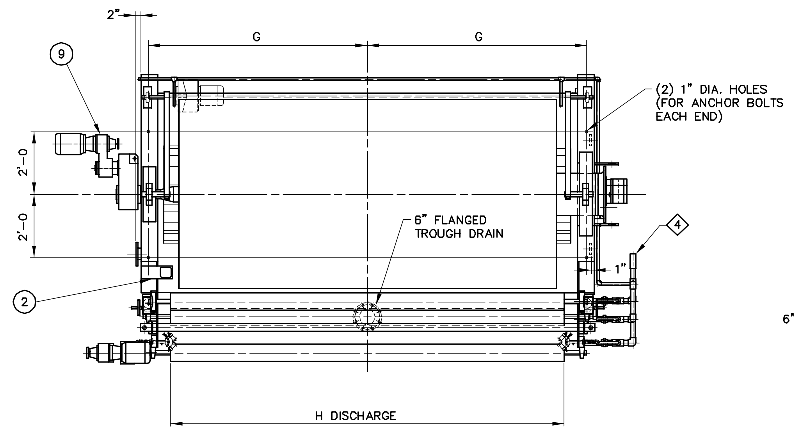
- No cake cracking
- No “sloughing off” of cake at beginning of precoat cycle
- Limited cake expansion and shrinkage
- Higher filtration rate per square foot of area
- Thinner precoat cuts
- Produces drier cake

Applications:

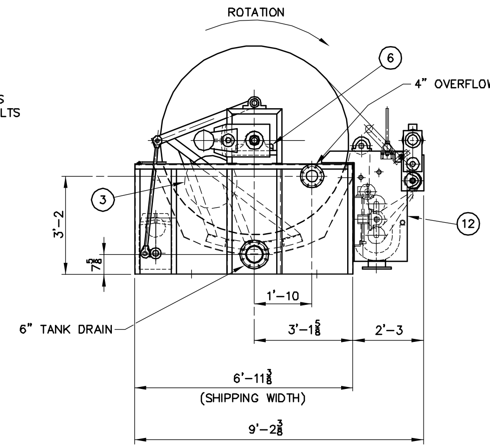
- Metal Hydroxide Waste
- Gypsum (FDG)
- Municipal Waste
- Lime Softening Sludge
- Potato Waste
- Corn Gluten
- Aluminum

A		B	D	E	F	G	H	I	J	K	L	M	N
DRUM LENGTH FEET	FILTER AREA SQ. FT.	OVER ALL FILTER LENGTH	TANK LENGTH	CENTER TO TANK LEG	CENTER TO VALVE END	CENTER TO MOUNT HOLES	DISCHARGE LENGTH	WASH WATER G.P.M.	WASH WATER G.P.M.	GALLONS IN TANK	1–6 MPR DRUM DRIVE	18 CPM AGIT. DRIVE	APPROX. EMPTY WEIGHT
4'–0"	75	9'–11"	6'–2 3/8"	2'–8"	3'–11 3/4"	2'–11 1/2"	4'–6"	14.4	14.4	244	1/2	1/2	6500 LBS.
6'–0"	113	11'–11"	8'–2 3/8"	3'–8"	4'–11 3/4"	3'–11 1/2"	6'–6"	21.6	21.6	309	3/4	3/4	7250 LBS.
8'–0"	150	13'–11"	10'–2 3/8"	4'–8"	5'–11 3/4"	4'–11 1/2"	8'–6"	28.8	28.8	374	1	1	8050 LBS.
10'–0"	188	15'–11"	12'–2 3/8"	5'–8"	6'–11 3/4"	5'–11 1/2"	10'–6"	36	36	439	1 1/2	1 1/2	8900 LBS.
12'–0"	226	17'–11"	14'–2 3/8"	6'–8"	7'–11 3/4"	6'–11 1/2"	12'–6"	43.2	43.2	504	1 1/2	2	9800 LBS.

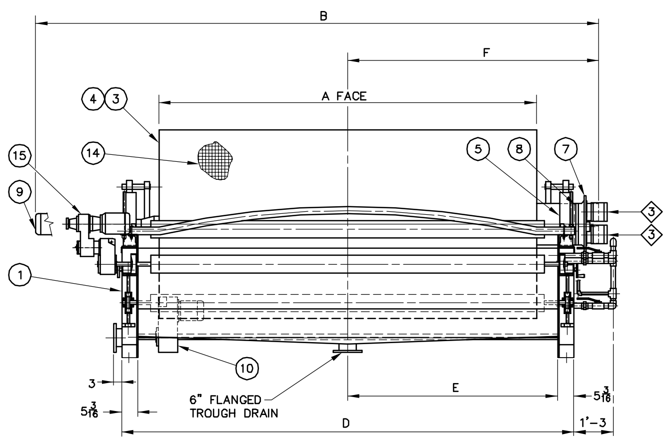
ITEM	DESCRIPTION
1	FILTER TANK – 3/16" THICK SHELL AND HEADS – MILD STEEL
2	WARRICK HIGH–LOW LEVEL CONTROL (OPTIONAL)
3	DRUM – 3/16" THICK SHELL AND HEADS – MILD STEEL – WITH (2) MANHOLES, (1) EACH HEAD SPACED @ 180° FROM EACH OTHER
4	SNAP–IN POLYPROPYLENE GRIDS – WING TYPE END RINGS AND DIVISION STRIPS WITH NEOPRENE STRIPS
5	TRUNNION BEARING WITH RENEWABLE LINER (VALVE END)
6	DRUM SHAFT BEARING – ANTIFRICTION TYPE (DRIVE END)
7	VALVE BODY – CAST STEEL – WITH MOVABLE BRIDGES
8	VALVE WEAR PLATE – RENEWABLE – UHMW–PE
9	FILTER DRIVE – EURODRIVE – (L) HP – OUTPUT SPEED 1 TO 6 M.P.R.
10	AGITATOR DRIVE – EURODRIVE – (M) HP – OUTPUT SPEED 18 R.P.M.
11	AGITATOR ARC AND RAKES – MILD STEEL
12	DISCHARGE ASSEMBLY – MILD STEEL – 3 " DISCHARGE ROLL, 4" TAKE–UP ROLL, 4" RETURN ROLL
13	SPRAY HEADER 1 1/2" MILD STEEL PIPES AND Y–STRAINER – 303 ST. STL. NOZZLES
14	FILTER CLOTH (VARIOUS MATERIALS AVAILABLE)
15	ROLL DRIVE – EURODRIVE



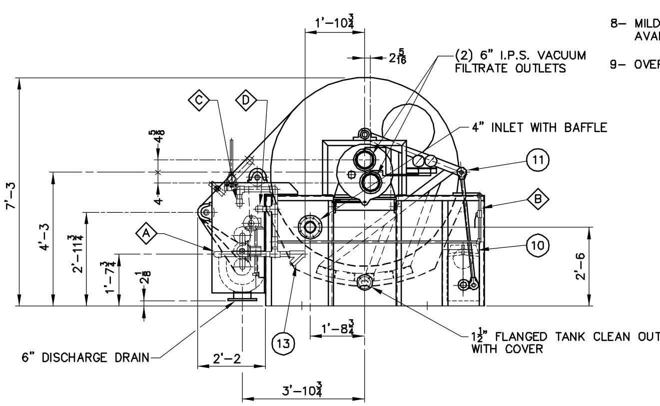
PLAN VIEW



DRIVE END VIEW



DISCHARGE ELEVATION



VALVE END VIEW

NOTES:

1– DRUM, AGITATOR AND ROLL DRIVE MOTORS ARE 3 PH, 60 HZ, 480 VAC, T.E.F.C., RATED FOR SEVERE DUTY / WASHDOWN ENVIRONMENT WITH 1.15 SERVICE FACTOR AND CLASS "F" INSULATION

2– ALL FLANGE DRILLING AND O.D. CONFORM TO 150 LB. A.N.S.I. – HOLES STRADDLE CENTERLINES

3 CUSTOMERS PIPING TO ALL CONNECTIONS MUST BE SUPPORTED INDEPENDENTLY

4 WASH WATER REQUIREMENTS – OUTSIDE BELT SPRAY PIPE A (CONTINUOUS) (I) G.P.M. – CLOTH EDGE CLEANING PIPE B (CONTINUOUS) 2.4 G.P.M. TOTAL FOR BOTH PIPES, INSIDE BELT SPRAY PIPE C (INTERMITTENT) (I) G.P.M., RETURN ROLL WASH PIPE D (INTERMITTENT) (J) G.P.M. – 60 P.S.I. MIN. REQUIRED

5– SURFACE PREPARATION – ST. STL. NONE – FABRICATED MILD STEEL ITEMS TO BE SANDBLASTED SSPC–SP10 NEAR WHITE METAL. PRIME PAINT WITH TNEMEC 66–1221 RED EPOXY PRIMER (5 MILS DFT) AND FINISH PAINT WITH TNEMEC 74–BB32 BLUE JAY HIGH–BUILD ACRYLIC POLYURETHANE ENAMEL (4 MILS DFT)

6– APPROX. EMPTY WEIGHT = N LBS.

7– APPROX. FILTER TANK CAPACITY @ 37% SUBMERGENCE = (K)

8– MILD STEEL CONSTRUCTION SHOWN, OTHER MATERIALS OF CONSTRUCTION ARE AVAILABLE

9– OVERALL LENGTH MAY VARY DEPENDING ON DRUM DRIVE CONFIGURATION

REVISION	BY	CHKD	DATE	LTR

DRUM BELT VACUUM FILTER
DESCRIPTION
BELT DISCHARGE – EDGE GUIDE | MODEL | 6'–0" DIA. SCHEDULED | SIZE | .0417 x 24

DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
7–94	MDJ	RRP		NONE				

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
FRV14001		

DAF CLARIFIERS AND THICKENERS

DAF/DNF Clarifiers and Thickeners Overview:

WesTech builds a complete line of Dissolved Air Flotation (DAF) and Dissolved Nitrogen Flotation (DNF) equipment for both municipal and industrial applications. The equipment incorporates many superior designs, both mechanical and operational.

Dissolved Air/Nitrogen Flotation is used in applications where the specific gravity of the solids or contaminants is very close to or less than 1.0. Dissolved air or nitrogen provides the driving force for separation. The gas is dissolved into a liquid (water) under pressure in a specially designed saturation tank. The saturated liquid flows under pressure to the mechanism. The pressure is then released by the back pressure control valve near the influent.

The sudden release of pressure causes the gas to come out of solution and form microscopic bubbles. These microscopic bubbles adhere to the incoming solids and form a buoyant blanket which rises to the surface for removal by mechanical means. The two main components of dissolved air/nitrogen flotation are the flotation mechanism and the pressurization system.

Processes:

- Storm Water
- Water Clarification
- Activated Sludge Thickening
- Algae Separation
- Oil and Grease Removal

Industrial Applications:

- Refineries
- Food Processing
- Chemical Processing
- Water Treatment
- Laundry
- Power Plants
- Pulp and Paper

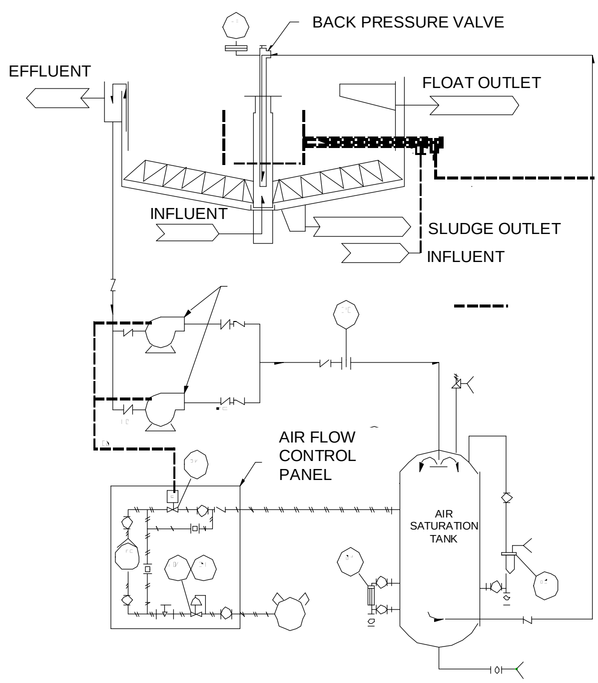
Dissolved Air Flotation (DAF) Thickeners or Clarifiers

In the following pages, several different styles and models of DAF's are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate DAF model within this design catalog.

General Description

Dissolved air flotation is the process of liquid-solid separation using dissolved gas (air, nitrogen, or other gases) as the driving force in lieu of gravity. This product is utilized in suspended solids applications, and can be applied for either clarification or thickening and many times a combination of both.

The tank mechanism includes surface skimmers which remove the floating solids, and bottom scrapers which remove the heavy solids. The heart of the system is the pressurized recycle stream used to separate the solids from the inlet. This pressurization system includes pumps, compressors, saturation tanks, air flow controls and a back pressure control valve. As the pressure is released at the back pressure control valve, air comes out of solution in the form of microscopic bubbles which attach themselves to the solids and separate themselves from the clean water.



Dissolved air flotation units come in either circular or rectangular configurations. Rectangular tanks comprise of two (2) mechanisms a chain and flight skimmer skimmer for the float, and a chain and flight scraper or screw conveyor for settled solids. Circular tank mechanisms comprise of one (1) mechanism for both surface skimmers and bottom scrapers (rake arms). Both have different advantages and disadvantages and offer different features.

The circular tank design is offered in both side feed or center feed configurations. The mechanism can be driven by either a cage drive or a shaft drive (size dependant). Combination units are provided to offer flotation and clarification using a Clarifier Flotator (Model DAFC5C).

Dissolved Air Flotation (DAF's) is used in a wide variety of applications including:

- Refineries, meat processing, food processing, laundries, packaging plants, pulp and paper, tanneries, dairies, storm water, water clarification (algae removal), and activated sludge thickening,

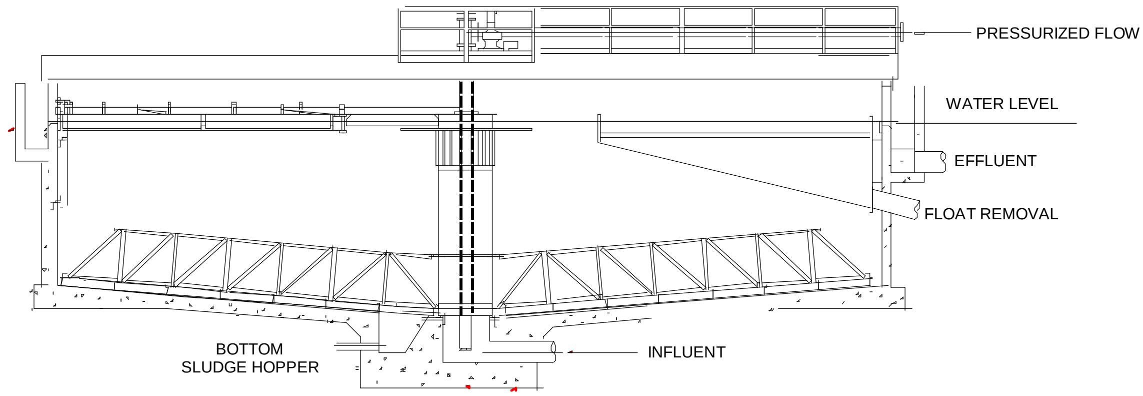
Advantages for circular DAF configuration:

- Radial flow provides variable velocities which decrease as the flow approaches the weir resulting is greater effluent clarity for multiple particle sizes.
- Concentration of float is greater then rectangular due to longer compaction time. (Hydraulics are with solids removal instead of against.)
- Maximum tank dia. of 80 ft. results in over 5000 ft^2 surface area. More than three times rectangular.
- Single drive unit for both the skimmer and scraper assemblies. (Less maintenance)
- Minimum skimmer assemblies without chain & flight arrangement. (Less maintenance)

Advantages for rectangular DAF configuration:

- Common wall construction helps with multiple tanks (rapid mix, flocculation, and DAF)
- Where space is an issue rectangular designs are geometrically easier to place.
- Rectangular designs allow for shipment of complete DAF assembly.

Center Feed DAF's



Models: DAFC, DAFS5, DAFC5C

Description: Influent is introduced to the DAF at its center through a pipe running beneath the DAF tank. The pressurized flow travels above ground over the walkway to the center of the tank. At this location the influent and the pressurized recycle flow are thoroughly mixed and travel vertically upward for introduction into the separation area of the DAF tank. A deflection plate is provided to distribute the feed uniformly over the surface of the DAF. The free air is used to float solids to the surface, while heavier solids settle to the tank floor. Clear water is removed from the DAF after traveling under an extended peripheral baffle and over a weir and launder system. The final effluent is accumulated in a drop box which is used as a source for the recycle stream. Floating solids are skimmed to a wide float box for removal. Settled solids are transported to a centralized hopper by rake arms for removal.

Advantages:

- Center well provides effective mixing and energy dissipation of pressurized flow and influent.
- Microbubbles are released at the center of the tank reducing turbulence due to bubble growth and increase capture percentage of solids.

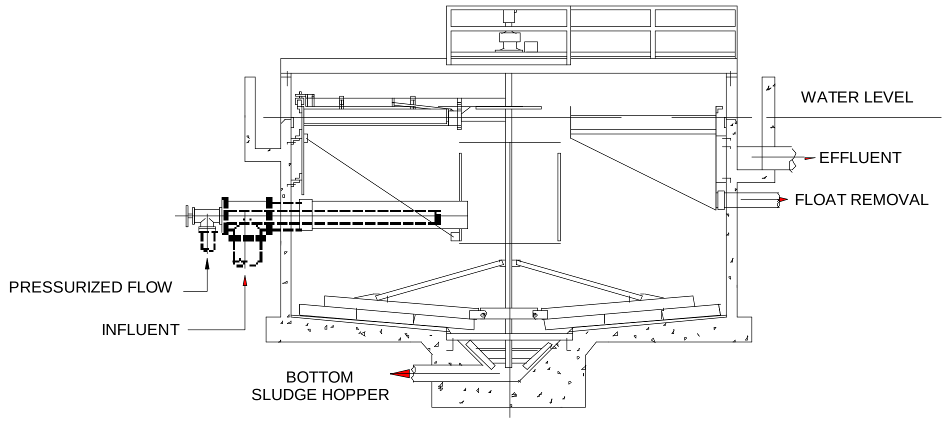
Disadvantages:

- Back pressure valve adjustment is in tank center and not right next to the rest of the pressurization system.

Applications:

- Can be used in any circular size DAF tank.

Side Feed DAF'S



Models: DAFS6

Description: Influent and pressurized flow are introduced through the side of the DAF and discharged near the center of the tank from the same orientation. At this location the influent and the pressurized recycle flow are thoroughly mixed and travel vertically upward for introduction into the separation area of the DAF tank. A deflection plate is provided to distribute the feed uniformly over the surface of the DAF. The free air is used to float solids to the surface, while heavier solids settle to the tank floor. Clear water is removed from the DAF after traveling under an extended peripheral baffle and over a weir and launder system. The final effluent is accumulated in a drop box which is used as a source for the recycle stream. Floating solids are skimmed to a wide float box for removal. Settled solids are transported to a centralized hopper by rake arms for removal.

Advantages:

- Center feedwell provides effective mixing of pressurized flow and influent.
- Feed pipe and back pressure valve are above ground and on the side of the tank for easy access.
- Back pressure valve adjustment can be located near the pressurization system but still releases at the tank center.

Disadvantages:

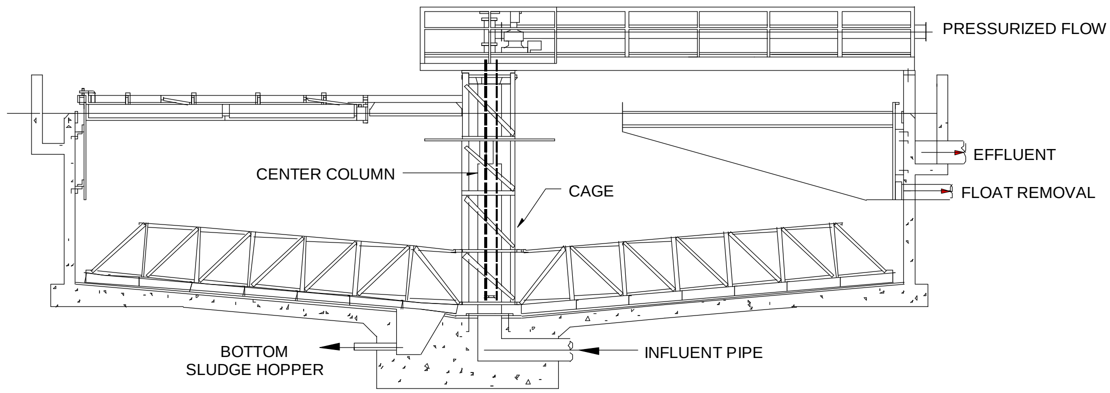
- Flow is not introduced concentric with the center of the tank.

Applications:

- Can be used in any DAF application. Usually limited to tanks less than 50' in diameter.

APPLICATION SUMMARY
DISSOLVED AIR FLOTATION

Cage Drive DAF's



Models: All model numbers beginning with DAFC

Description: This type of design utilizes a center column as the support for the majority of the mechanism weight. The center drive mechanism is mounted on the top of the center column and the remainder of the internal equipment hangs from the drive unit. The walkway bridge is then supported from the top of the drive unit and the tank wall. A single drive mechanism is used to rotate the structural torque cage which in turn rotate the skimmers and rake arms simultaneously. These two mechanism parts are designed to remove solids from both the water surface and tank floor. Other configurations may include a rotating cylindrical well in lieu of the cage design.

Advantages:

- Can develop high torques in compact units.
- Center column doubles as walkway support and feed pipe.
- Maintains more rigid rake arm and skimmer support.
- Bridge has shorter unsupported span and is less expensive in units over 50' in diameter.

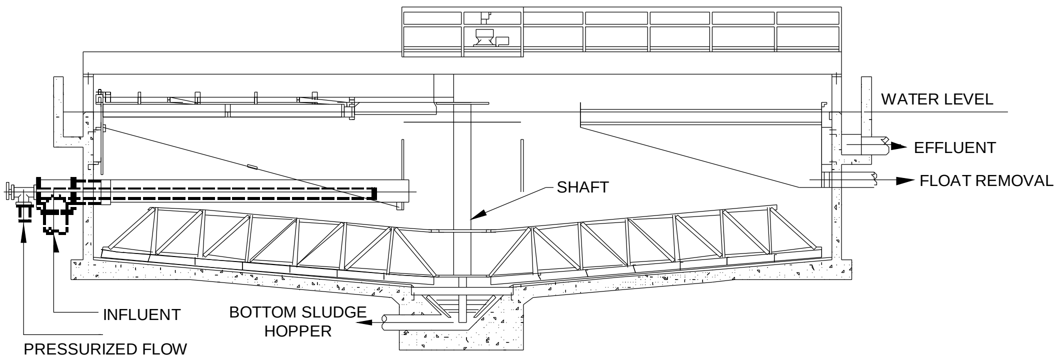
Disadvantages:

- More expensive than shaft drives.
- Access to main gear and bearing is more difficult due to the location under the center platform.
- Feed line is buried beneath the basin.
- Tanks are generally concrete to adequately support the center column.

Applications:

- Most economical when used in DAF tanks 50 feet in diameter or larger.

Shaft Drive DAF's



Models: All model numbers beginning with DAFS

Description: This type of design utilizes a full span beam bridge which is used to support the complete mechanism weight. The center drive mechanism is mounted on the top of the bridge and the remainder of the internal parts hang down from the drive unit at the center. A single drive mechanism is used to rotate the structural torque shaft which in turn rotate the skimmers and rake arms simultaneously. These two mechanism parts are designed to remove solids from both the water surface and tank floor.

Advantages:

- Can develop high torques in compact units.
- Torque tube is generally more economical than a torque cage.
- Easy access to main gear, bearing and pinion.

Disadvantages:

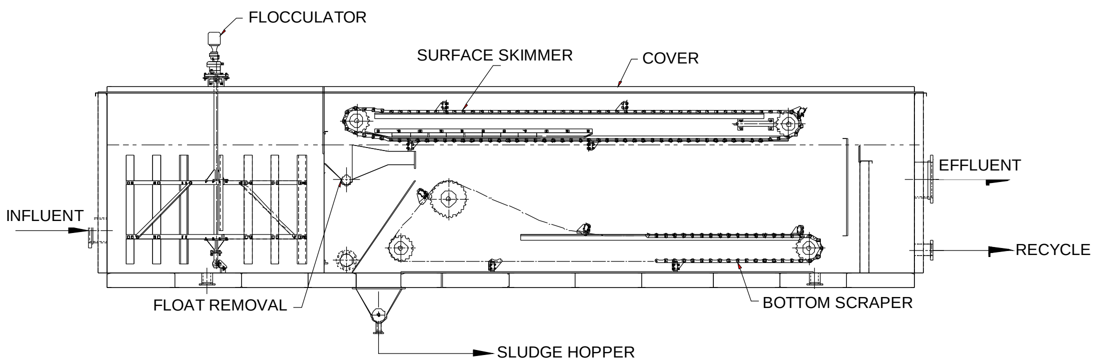
- Walkway or bridge must span the tank and support the weight and torque of the mechanism; therefore, the bridge will be more expensive than for a center pier supported unit.

Applications:

- Most economical when used in DAF 50 feet in diameter or less.

APPLICATION SUMMARY
DISSOLVED AIR FLOTATION

Rectangular DAF’s



Models: All model numbers beginning with DAFR.

Description: This type of unit is rectangular in shape. The influent and pressurized recycle flows are introduced together at one end of the basin. Flow moves in a plug flow pattern to the opposite end of the basin. Both floating and settling solids are continuously transported toward the influent end of the tank. The mode of transportation is the use of separate chain and flight assemblies. The settled solids are removed from a bottom sludge hopper and the float solids are removed from a float box. Clear effluent exits the tank after traveling under an extended baffle and straight weir design. The final effluent is accumulated in a drop box which is used as a source for the recycle stream. Most tanks are made of steel or stainless steel construction and can be completely shop assembled for shipment.

Advantages:

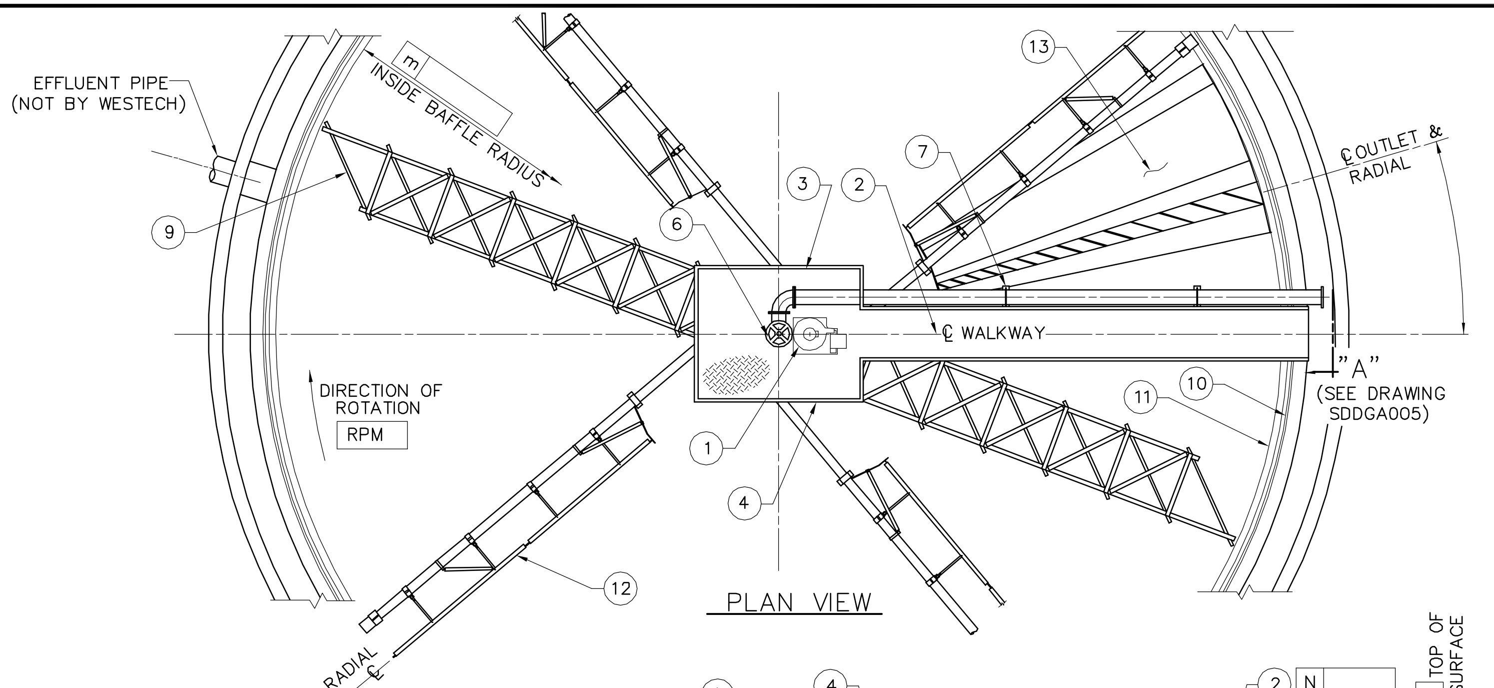
- Rectangular tanks allow common wall construction for multiple tanks (rapid mix, flocculation, and DAF).
- Control of liquid level easy with one straight weir.

Disadvantages:

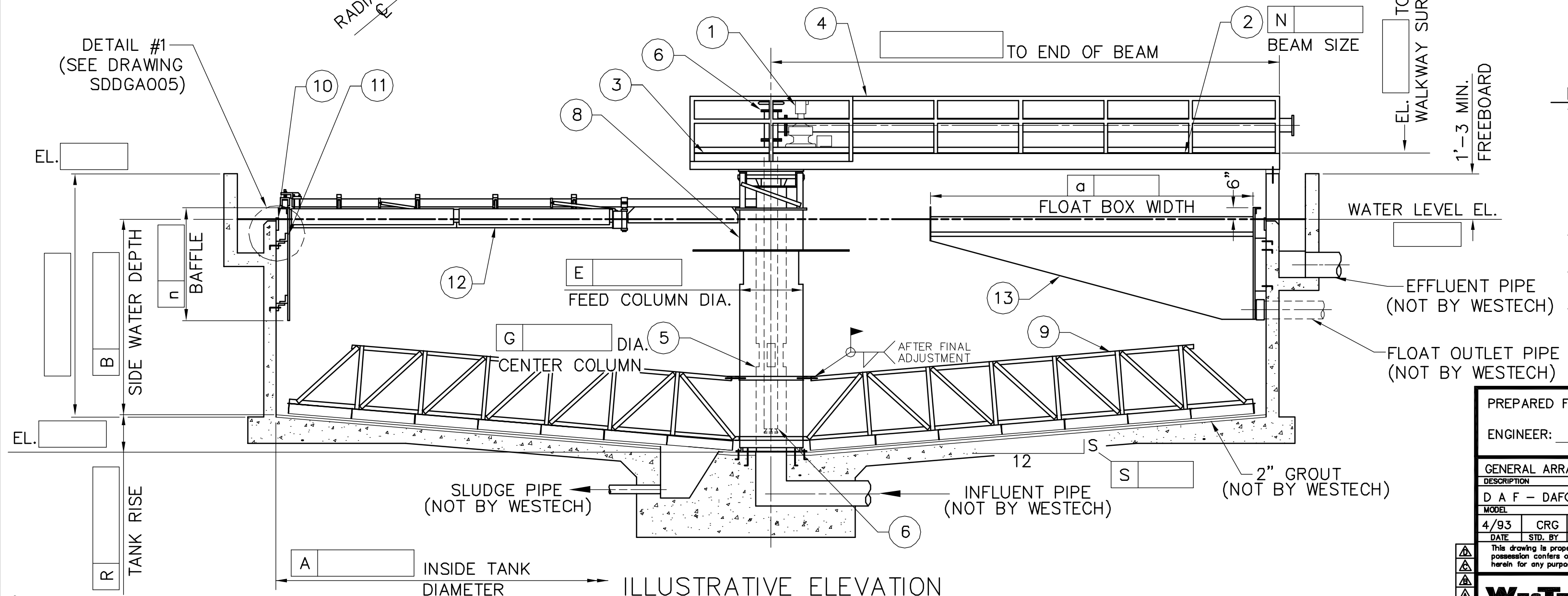
- Collected solids are conveyed against the hydraulic flow.
- Maintenance prone chains and sprockets. (More wear items)
- Control of internal flow velocities difficult.

Applications:

- Generally used where space is limited or smaller units that can be shipped as a complete unit from the shop.
- Smaller units under 200 gpm can use air saturating pumps which eliminate the need for saturation tank, air flow control panels and air compressor.



PLAN VIEW



ILLUSTRATIVE ELEVATION

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DRIVE UNIT W/TORQUE CONTROL DEVICE D FT. LBS. CONTINUOUS RUNNING TORQUE
2	WALKWAY
3	PLATFORM
4	HANDRAIL 42" HIGH DOUBLE RAIL W/ 1/4" X 4" KICKPLATE
5	CENTER COLUMN (1/4" WALL) W/INFLUENT PORTS
6	BACK PRESSURE PIPE & CONTROL VALVE (BPCV)
7	BPCV PIPE SUPPORTS
8	FEED COLUMN (1/4" WALL) W/INLET DEFLECTOR PLATE & INFLUENT PORTS
9	TWO (2) RAKE ARMS W/BLADES AND ADJUSTABLE SQUEEGEES (RAKE TWICE PER REVOLUTION)
10	WEIR PLATE 3/16" X 9" DEEP W/90° V-NOTCHES
11	BAFFLE (1/4" PLATE) W/SUPPORTS
12	FLOAT SCRAPERS ___ REQ'D. EQ. SPACED
13	FLOAT BOX W/WALL SUPPORTS & OUTLET CONNECTION

NOTES:
1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT PROPER PROCESS DESIGN CRITERIA BEING FOLLOWED.
2. SEE SDTGA007 FOR CONCRETE TANK ARRANGEMENT.
3. SEE SDDGA005 FOR GENERAL ARRANGEMENT DETAILS.
4. SEE DAFPSX04 FOR PRESSURIZATION SYSTEM DETAILS.

PREPARED FOR: ____________________

ENGINEER: ____________________

GENERAL ARRANGEMENT								
DESCRIPTION								
D A F – DAFC5				25' TO 85' DIAMETER		DAFC5X01		.0313 x 32
MODEL				SIZE				
4/93	CRG	STB	TH	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

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REVISION	BY	CHKD	DATE	LTR

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
DAFC5X01		△

GRANULAR ACTIVATED CARBON

Granular Activated Carbon Contactors:

WesTech granular activated carbon (GAC) pressure filters are an effective means for removal of low-molecular-weight contaminants from aqueous solutions. They are especially suited for the removal of dissolved organic compounds responsible for poor taste and odor in drinking water, as well as removal of chlorine from industrial waters. When used as pretreatment equipment, these filters will prolong the life and efficiency of demineralizing ion exchange resins and reverse osmosis membranes.

WesTech GAC pressure filters utilize a pressure vessel, typically with a conical underdrain for convenient GAC media replacement. These filters are sized according to the contact time required for contaminant removal and desired media replacement frequency. Filter piping and valving for multiple units can be arranged to easily change flow paths between parallel flow, series (lead/lag or daisy chain) flow, or single-unit flow patterns. Filters are typically backwashed only once upon new media installation, and the media usage front is then monitored via sample taps to allow for anticipation of media replacement.

Drinking Water:

- Iron and Manganese Removal
- Arsenic Removal
- Groundwater Under the Influence
- Pretreatment to Reverse Osmosis
- Granular Activated Carbon
- Fluoride Removal
- Ion Exchange

Industrial:

- Cooling Tower Make-up
- Surface Water Treatment
- Pretreatment to Reverse Osmosis
- Plant Process Water
- Granular Activated Carbon
- Mill Scale
- Free Oils

WesTech
Process Equipment. Process Driven.

GRANULAR ACTIVATED CARBON

Granular Activated Carbon Contactors:

Proper design of the GAC contactor vessel is critical to ensure effective and efficient use of the GAC media. Vessel design affects the frequency of GAC replacement, the ease in which the GAC is replaced, and the life of the vessel. WesTech GAC systems are designed to maximize the loading of organics on the carbon.

WesTech offers GAC contactors in a variety of standard sizes and configurations. Contactor vessels are designed to facilitate the installation and removal of GAC media, and allow easy operation and monitoring of the media life.

Systems can also be customized to fit into difficult footprints, minimize operator's time to replace the media, and many other unique site requirements.

WesTech offers both stand-alone and skid-mounted systems. In either case, piping, valves and automated controls can be provided. Allow WesTech's experienced engineers to help select the right configuration and components for your project.

GRAVITY FILTERS

Gravity Filter Overview:

Gravity filters are commonly used in applications where liquid-solids separation is required in a variety of different applications for finish water treatment. Gravity filters can incorporate various types of media such as sand, anthracite, greensand and GAC to meet each plant's water treatment needs. In addition, gravity filters allow for easy inspection during operation and typically have a smaller profile.

WesTech gravity filters are available in a variety of configurations and designs that can be customized to meet various constraints such as water quality, footprint, backwash requirements and flow requirements. Filter designs can be either round or rectangular and can be either single or multi-cell. In addition, systems can be designed for self-contained backwash storage eliminating the need for backwash pumps.

Gravity filters are commonly constructed of painted carbon steel; however, systems can be designed from corrosion-resistant materials such as stainless steel or aluminum. Gravity filters allow for design flexibility to help fit into tight footprint requirements when needed.

Gravity filter internals can be customized based on applications and the customer's preferences. Various options are available for underdrain and overdrain design. These options allow for different types of backwash and air scour, such as baffled overdrains for combined air and water backwash.

Features:

- Multi-cell or single cell design
- Prefabricated tanks
- Self-contained backwash designs available
- Available in in a variety of materials
- Wide media selection available for different applications

Benefits:

- Easy to inspect during operation
- Minimizes space requirements and can eliminate backwash pumps
- Low space requirements and ease of installation
- Minimal installation time and costs

GENERAL DESCRIPTION

In the following pages, several different styles and models of filters are presented. Each model has its own advantages and disadvantages and are therefore suited for specific applications. The following pages contain summarys of these advantages, disadvantages, and suitability and intended to direct the user to the appropriate filter within this catalogue.

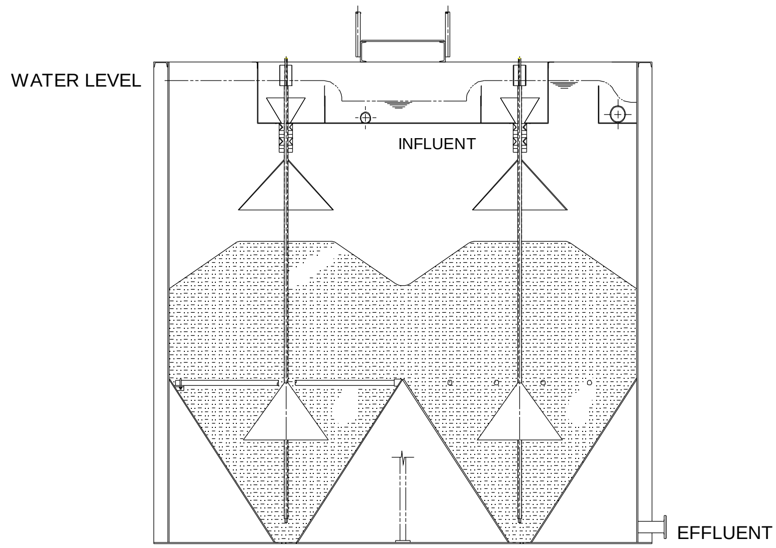
Each type of filter can have different features. Some of these features are outlined in the filter model number sheet. These features include:

Cells	- single, multiple
Backwash	- self stored, pumped, self generated, continuous
Tank	- circular, rectangular
Material	- carbon steel, stainless steel, aluminum, concrete

OPTIONS : Some of the options available with the above include;

Types of media	- sand, sand and anthracite coal; garnet, sand, and anthracite coal
Controls	- manual, stager controller, PLC
Valves	- manual, electric, pnuematic
Backwash	- water, air and water combined or separate
Underdrain	- header/lateral, false bottom/nozzles, direct retention

GRAVITY FILTERS -CONTINUOUS BACKWASH SUPERSAND^{TM} (UPFLOW)



Model FGX4XX

Description: Model is available in either single or multi-cell configuration. Single cell models are normally circular ranging from 2 ft. - 9 ft. diameter.

Multi-cell models have modules of either 25 sq. ft. or 50 sq. ft. packages in 2 to 8 module clusters.

Feed is introduced into the bottom cone and passes upward through the sand media and flows over an effluent weir as product. Sand falls down into the bottom cone where it is air lifted to the top of the filter, cascading into a waste box. Flocculated particles and suspended solids are separated from the sand during the turbulent transport up the air lift pump. Being lighter than the sand suspended solids and floc are carried away in a small waste stream over an adjustable weir. The heavier sand falls back through an annular opening onto the top of the filter bed. A stream of water flows up through the annular opening giving the falling sand a final wash. This water then carries the separated particles over the waste weir.

Advantages:

- No plugging or fouling of the filter bed due to continuous movement
- Minimal controls
- Effluent weir maintains water level in the filter compartment
- Returning sand is washed by filtered water
- No fine screens required to separate sand and filtered water
- Continuous waste stream verses periodic, higher flow waste streams

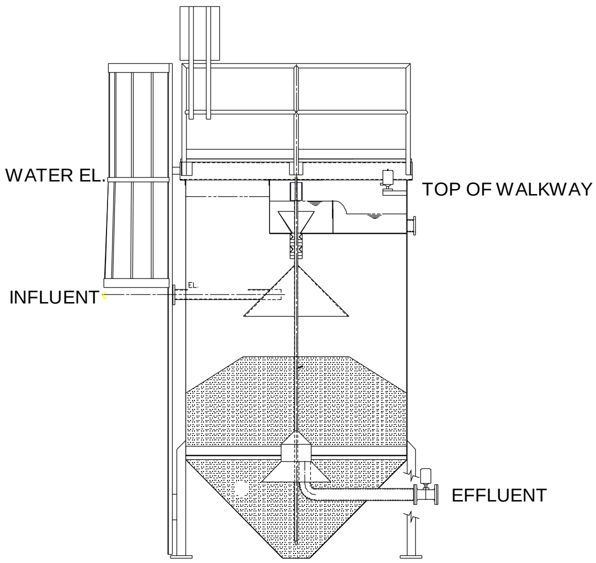
Disadvantages:

- Upflow mode limits available filtering headloss
- Top of filter media is loose packed providing poor filtration due to center flow of water
- Product water is exposed with potential contamination

Applications:

- Tertiary filtration of wastewater treatment plants to meet regulatory limits or for irrigation. Industrial wastes for solids removal or recovery.
- Possible water with pilot testing.
- Pretreatment of process water for suspended solids

GRAVITY FILTERS - CONTINUOUS BACKWASH SUPERSAND™ (DOWNFLOW)



Model FGX4XX

Description: Model is available in either single or multi-cell configuration. Single cell models are normally circular ranging from 2 ft. - 9 ft. diameter.

Multi-cell models have modules of either 25 sq. ft. or 50 sq. ft. normally arranged two wide by two to four long.

Feed is introduced into the top of the filter and flows down through the sand media, and is collected in a fine screen underdrain system located at the top of the bottom cone. Sand falls down into the bottom cone, where it is air lifted to the top of the filter, cascading into a waste box. Flocculated particles and suspended solids are separated from the sand during the turbulent transport up the air lift pump. The lighter suspended solids and floc are carried away in a small waste stream over an adjustable weir. The heavier sand falls back through an annular opening onto the top of the filter bed. A small stream of water flows up through the annular opening giving the falling sand a final wash. This water then carries the separated particles over the waste weir. Control of the water level over the filter media is by a level transmitter controlling an effluent modulating valve.

Advantages:

- Higher filtration rates possible due to down flow and greater utilization of bed depth.
- Filtered water is collected and transported away protected from contamination.
- Smaller continuous waste stream easier to dispose of.

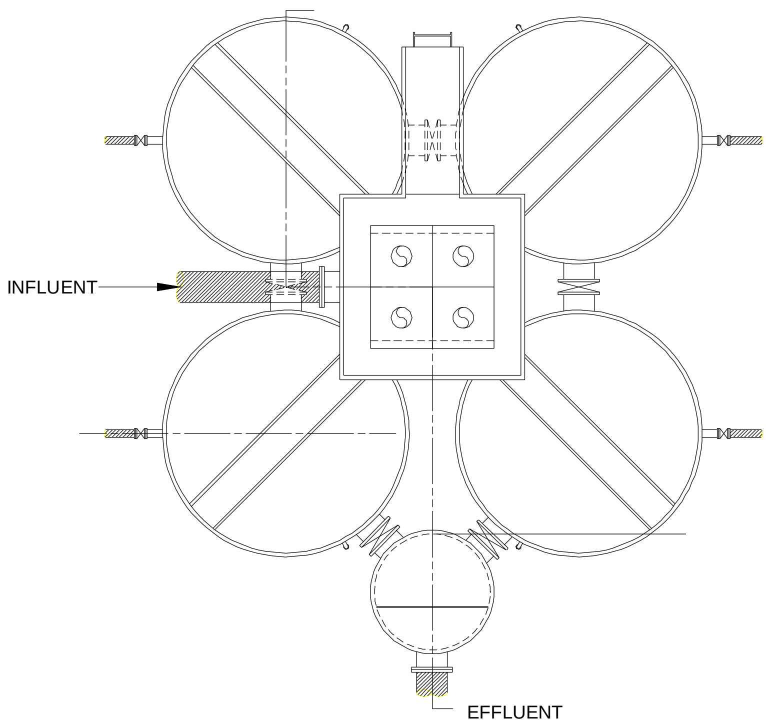
Disadvantages:

- More controls required.
- Sand is washed with raw water.

Applications:

- Tertiary filtration of wastewater treatment plants to meet regulatory limits or for irrigation. Industrial wastes for solids removal or recovery.
- Potable water with pilot testing.
- Pretreatment of process water.

GRAVITY FILTER- SELF GENERATED BACKWASH MODTECH™



Model FGM3XX

Description: Flow enters splitter box located over the center of the filter cluster.

Flow is split equally to the four cells. Water flows down through the filter media and into the underdrain system. Flow exits the filter over the effluent weir into the clearwell.

Headloss through the filter cells is measured, and on predetermined level, backwash is initiated. Draw down valve in one cell is opened lowering the level in that cell. The influent valve to that cell is closed. Higher water level in three remaining cells flows back into this cell, up through the media, over the weir and out of the waste valve to disposal. Individual cells can backwash sequentially or on high headloss.

Advantages:

- Wide choice of medias and underdrains
- Minimal controls; low operator attention
- Available in steel or concrete tanks
- No backwash pumps or tanks required

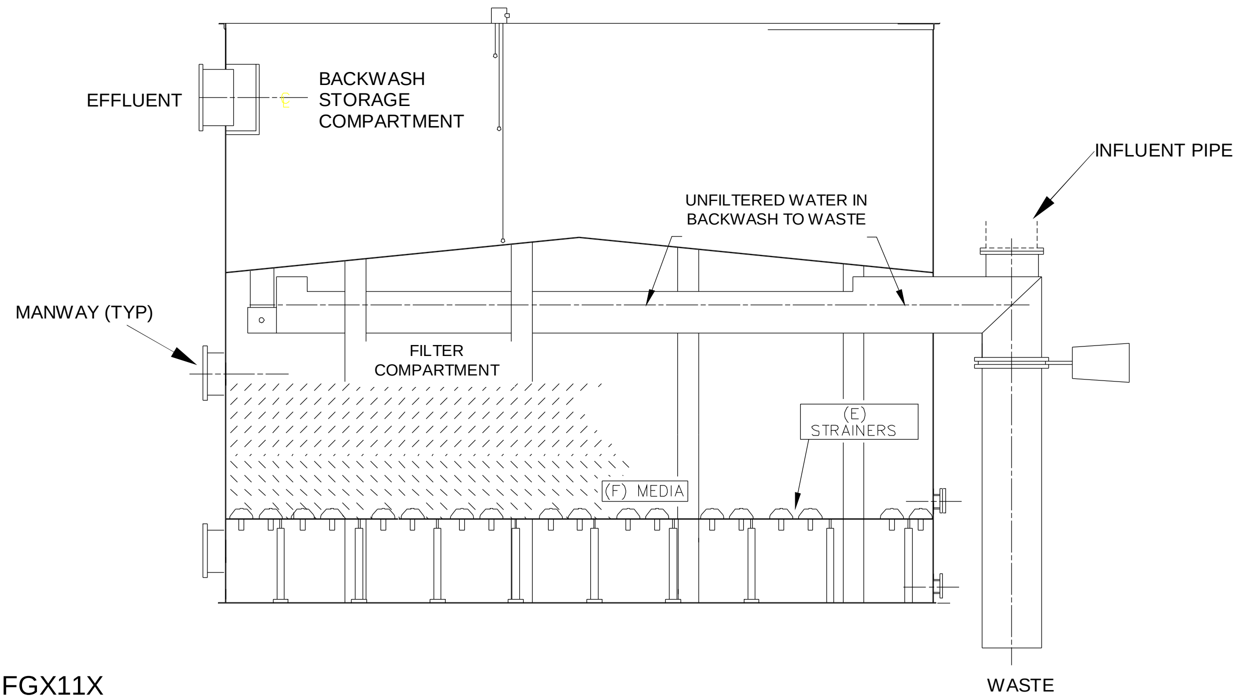
Disadvantages:

- Loss of effluent flow during backwash
- Low head available for backwashing
- Cluster of four tanks required (large footprint)

Applications:

- Most common uses for this filter is tertiary filtration of wastewater treatment plants to meet regulatory limits, or for water re-use (irrigation).

GRAVITY FILTER - SELF STORED BACKWASH



Model FGX11X

Description: Flow enters stand pipe adjacent to the filter and enters the tank below the storage compartment, but above the filter media. Liquid flows down through the media and underdrain and into false bottom of the tank. Head in the stand pipe forces filtered liquid out of the tank, up a transfer pipe, and into the storage compartment over the filter. When the storage compartment is full, liquid overflows outlet nozzle and flows as product. On high headloss, backwash is initiated. Influent valve closes, waste valve opens, and head in the storage tank causes reverse flow through the transfer pipe into the filter. Liquid flows up through the media and out of the waste valve to the sewer. On completion of backwash flow, waste valve closes, influent valve opens, and filtration continues. Filtered liquid will refill the storage compartment before overflowing as product

Advantages:

- No backwash pump required
- Small footprint
- Multi-cell arrangements available
- Choice of medias and underdrains
- Circular tanks are typically more cost effective

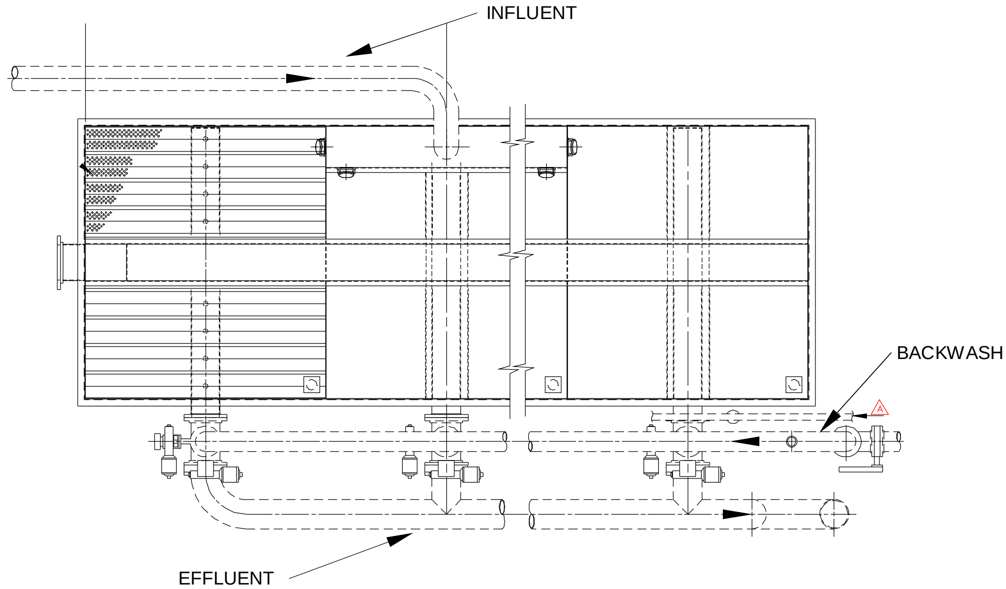
Disadvantages:

- Declining head during backwash
- Filter needs to be run prior to skimming of media (fill of storage tank)
- Difficult to inspect filter media
- Expensive to maintain double wall between filtered and unfiltered water

Application:

- Industrial pretreatment of process water

GRAVITY FILTER - PACKAGE TYPE



Model FGX22X

Description: Shop fabricated single or multiple cell filters. Flow enters splitter box and is divided into each cell. Flow is down through the media and into the underdrain. Effluent from each filtered cell is controlled by a modulating valve from the signal sent by level transmitter in the filter cell compartment. On high headloss, the flapper valve on the splitter box to individual cell closes allowing draw down of the liquid level. Optional air scour is started to loosen crust on the top of the filter media. Combined air and water backwash is possible. Backwash water raises level in the cell until it overflows into the waste trough which is common to all cells. With four cell filters, it is possible to pump effluent from three cells back into the cell being cleaned.

Advantages:

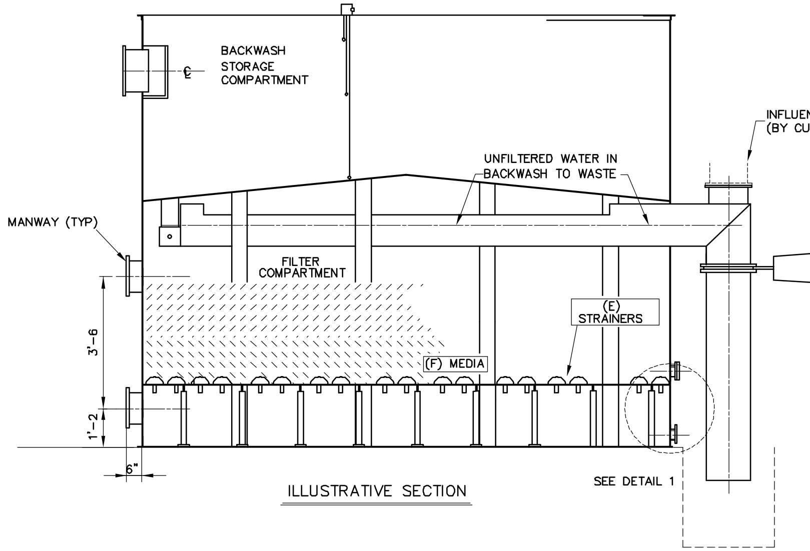
- Fabricated tanks 2,500 gpm. Capacity shipped ready for installation on customer's pad
- Wide choice of medias and underdrains
- Can be adapted for concrete tanks for large installations
- Low head units available for combining with existing clarifiers

Disadvantages:

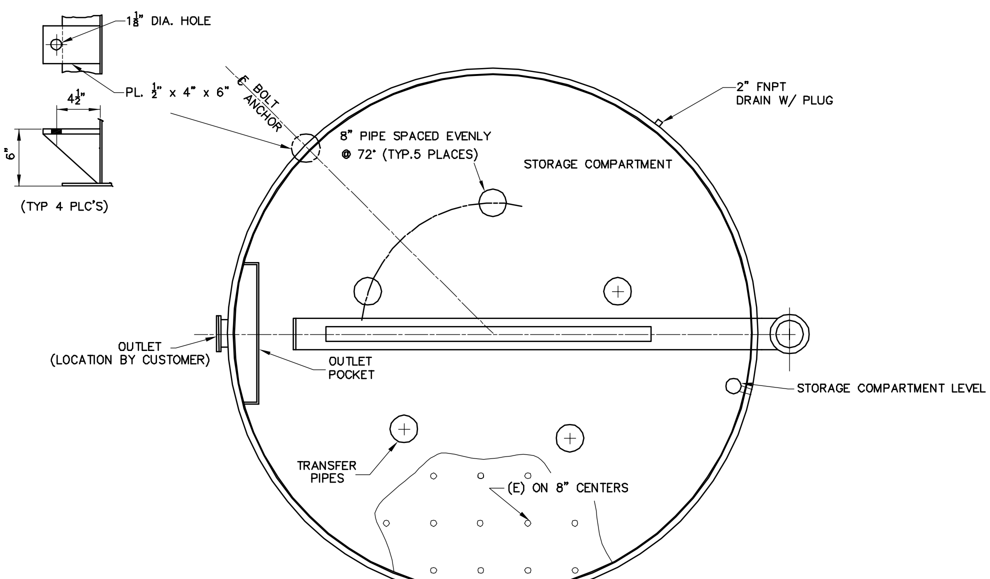
- Backwash pumps required
- No forward flow available during backwash

Applications:

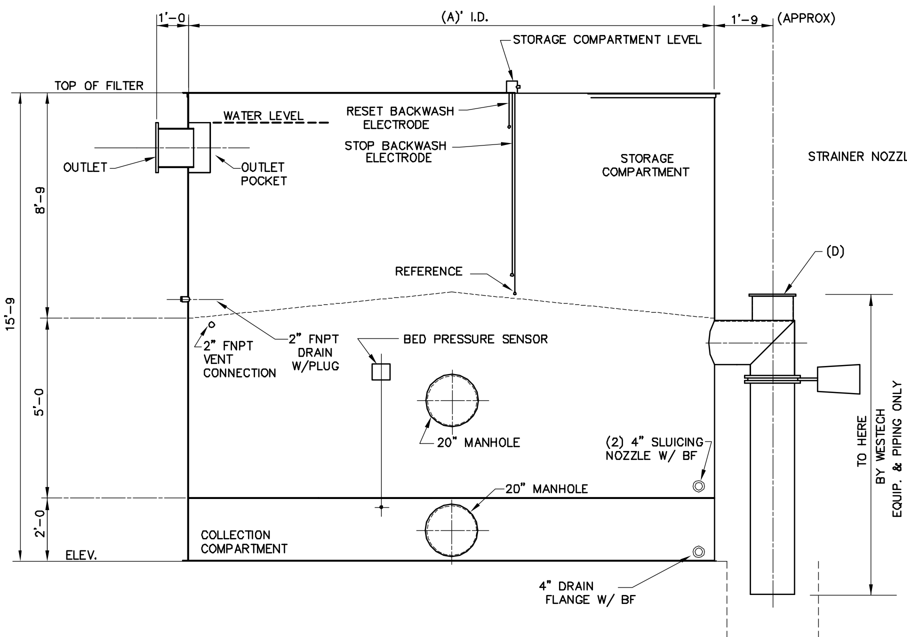
- Direct filtration for potable water
- Final filtration of clarified water
- Industrial pretreatment of process water
- Tertiary filtration of waste waters



ILLUSTRATIVE SECTION

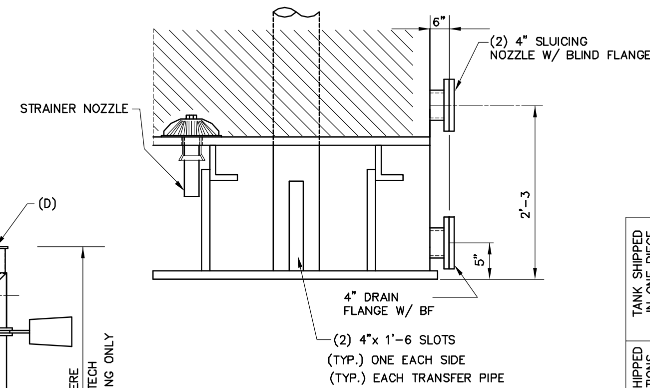


PLAN VIEW



ILLUSTRATIVE VIEW

SEE PLAN VIEW FOR TRUE ORIENTATION



DETAIL 1

NOTE:
SUMP AND DRAIN TO HANDLE BACKWASH
SIZED TO HANDLE (C) CUBIC FEET OF BACKWASH VOLUME

	(A) FILTER DIA. (FEET)	(B) FILTER AREA (SQ.FT.)	FLOW (GPM) @ 3 GPM/SQFT	FLOW (GPM) @ 4 GPM/SQFT	FLOW (GPM) @ 5 GPM/SQFT	(C) BACKWASH VOLUME (CU.FT.)	(D) INFLUENT LINE (IN)	(E) STRAINER NOZZLES	(F) MEDIA VOLUME (CU.FT.)	WEIGHT (FLOODED) LBS	WEIGHT (DRY) LBS
TANK SHIPPED IN ONE PIECE	5	20	59	78	98	157	6	43	59	28,900	4,150
	6	28	85	113	142	226	6	61	85	40,900	5,100
	8	50	151	201	252	482	8	106	151	70,400	6,910
	10	79	236	314	393	628	10	170	236	109,900	10,700
	12	113	339	452	566	905	10	245	339	136,347	12,550
TANK SHIPPED IN SECTIONS	14	154	462	616	770	1231	12	333	462	176,000	17,300
	16	201	603	804	1006	1609	16	436	603	241,000	20,750
	18	255	764	1018	1273	2036	18	551	764	303,800	24,500
	20	314	943	1257	1571	2514	18	681	943	372,800	28,800

DESCRIPTION	GRAVITY FILTER GENERAL ARRANGEMENT – ELEVATION
MODEL	1 CELL OPEN TOP
SIZE	SCHEDULED
DATE	7/94
STD. BY	MDJ
STD.CHKD.	RRP
STD.APPVD	
SCALE	NONE
DATE / PROJ. BY / PROJ.CHKD. / PROJ.APPVD	
DRAWING NUMBER	FGS11001
PROJECT NUMBER	
REV.	

.02083 x 48

WESTECH

LTR	REVISION	BY	CHKD	DATE

PACKAGE TREATMENT PLANTS

Trident®

When Microfloc® Trident® technology was first introduced, it represented a significant advance in water and wastewater treatment. Not only did it remove turbidity, suspended solids, color, iron, manganese, odor, taste and parasites such as Giardia lamblia and Cryptosporidium, but it did so at a lower capital cost than conventional systems, in a smaller space, and at higher flow rates per unit area. Today, more than 1000 Trident technology systems, large and small, are at work all across North America and the world.

Our Trident systems continue to evolve as we constantly strive to find ways to produce even higher quality treated water at higher flow rates per unit area and ways to further reduce installation and operating costs. Our development efforts focus on the three main elements of the Trident system: adsorption, clarification and filtration.

Trident® HS Provides Unmatched Multi-Barrier Water Treatment

The Trident® HS packaged treatment system provides multiple-barrier protection for surface water, groundwater and industrial process water treatment. The Trident® HS system design, which consists of packaged high-rate settling, adsorption clarification, mixed media filtration and UV disinfection, is the latest improvement of the original Trident system.

Proven at hundreds of installations worldwide, the Trident® process serves as the basis of the new packaged treatment system. By integrating a specialized high-rate pretreatment tube clarifier for removal of gross solids and a downstream UV disinfection system for final effluent treatment, the unique HS design is complete. Individually and collectively, the four major treatment stages of the new Trident® HS system maintain superior effluent performance. The multiple-barrier process is extremely well-suited for all surface and groundwater applications, including high turbidity and color, variable water conditions, enhanced coagulation operation and cold water conditions.

The Trident® HS offers four barriers of treatment protection for your water treatment plant. These innovations allow the Trident® HS to handle very high raw water turbidity and solids loading and achieve TOC reductions of up to 70% or more! In addition, all of these benefits can be achieved with a nearly 50% reduction in waste production.

Trident® HS systems provide you:

- Pre-engineered package treatment
- Tube clarifier with sludge recirculation
- Buoyant media upflow Adsorption Clarifier®
- Mixed Media polishing filter
- Optional Ultraviolet (UV) system for post treatment
- 350 to 4200 GPM treatment Systems
- Economical treatment of up to 400 NTU or 100 Color Units source waters

PACKAGE TREATMENT PLANTS

Features:

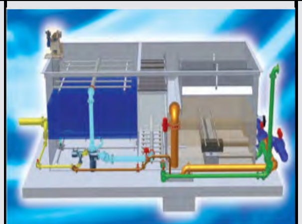
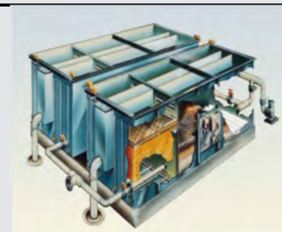
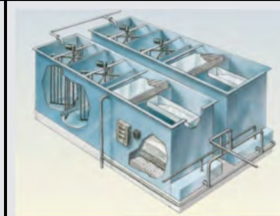
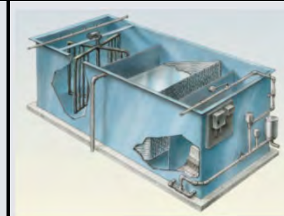
- Small footprint
- Pre-fabricated tankage
- Automatic operation
- Tube Clarifier and sludge recirculation
- Buoyant Media Clarifier
- As high as 7 log removal credit of Crypto and Giardia with combination of tube clarifier, Trident portion and UV system!
- General Filter MULTIBLOCK gravel-less underdrain system with Laser Shield® stainless steel media retaining plates.

Benefits:

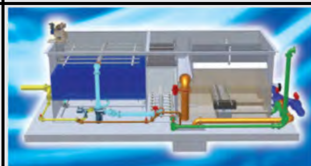
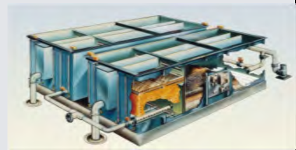
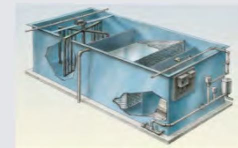
- Provides reliable, simple treatment for difficult waters
- Handles high turbidity and organic loads with ease
- Can achieve TOC reductions of up to 70% or more
- Can reduce disinfection by-product precursors (DBPP) and helps meet THM and HAA regulations
- Minimizes waste production
- Minimizes installation cost and time
- Minimizes operator effort
- Minimizes design costs
- Increased net production through raw water flush
- Smaller footprint compared to applicable conventional equipment
- Meets Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)
- Proven process through trials testing
- The Trident® HS System: Microfloc Trident HS systems minimize size and cost and maximize efficiency and performance for difficult to treat waters.

Installation Base: The Trident® HS is the newest addition to the Microfloc Trident® family, which was introduced in June of 1982. The number of locations realizing the benefits of Trident® Systems is over 1,000 and still growing.

WesTech Pre-Engineered Packaged Water Treatment Plants

	Trident HS	Trident	Trimite	Aquarius	Waterboy
Product Image					
Process Description	Multi-Barrier design for optimal water treatment, including Tube clarification with sludge recycling, Adsorption Clarifier (AC), Mixed Media filtration and UV disinfection.	Adsorption Clarification followed by Mixed Media Filtration.	A smaller version of the Trident design, incorporating the Adsorption Clarifier and Mixed Media filtration. It is a factory assembled water treatment system.	Two stage coagulation / flocculation, tube clarification and Mixed Media filtration	A smaller version of Aquarius design with single stage coagulation/flocculation, tube clarification and Mixed Media filtration. It is an efficient modular water treatment system with an uncomplicated design.
Treatment Capacity	700 gpm (160 m3/hr) to 2800 gpm (640 m3/hr) with two tank design (standard). 350 gpm (80 m3/hr) to 1400 gpm (320 m3/hr) with one tank design. 1050 gpm (240 m3/hr) to 4200 gpm (950 m3/hr) with three tank design.	350 gpm (80 m3/hr) to 2800 gpm (640 m3/hr) with two tank design (standard). 175 gpm (40 m3/hr) to 1400 gpm (320 m3/hr) with one tank design. 525 gpm (120 m3/hr) to 4200 gpm (950 m3/hr) with three tank design.	50 gpm (11 m3/hr) to 350 gpm 80 m3/hr). Multiple units can be used to treat higher flow rates.	350 gpm (80 m3/hr) to 1400 gpm (320 m3/hr) with two tank design (standard). 175 gpm (40 m3/hr) to 700 gpm (160 m3/hr) with one tank design. 525 gpm (120 m3/hr) to 2100 gpm (475 m3/hr) with three tank design.	10 gpm (2.3 m3/hr) to 100 gpm (23 m3/hr). Multiple units can be used to meet larger flow requirements.

WesTech Pre-Engineered Packaged Water Treatment Plants

	Trident HS	Trident	Trimite	Aquarius	Waterboy
Product Image					
Ideal Application	Used on waters with fluctuation in high turbidity / high suspended solids. The UV on the Trident HS allows for inactivation of Crypto and Giardia.	Used for waters with lower turbidity / suspended solids.	Used for waters with lower turbidity / suspended solids. It is ideally suited for installations where future expansion would be required. Expansion is a simple process, in which an additional tank would be added. The future additional tank would share the control panel, turbidimeter, blower and backwash pump of the first tank.	Used for waters with higher turbidity / suspended solids.	Used for waters with high turbidity / high suspended solids. Because of its compact size and ease of operation, it is ideally suited for small rural communities, low flow industrial applications, remote mining / exploration camps, military installations and hotel / resorts.
Influent	- 400 NTU Turbidity - 100 Color units - < 20 mg/l Fe and Mn	- 25 NTU Turbidity - 25 Color units - 8 mg/l Fe and Mn	- 25 NTU Turbidity - 25 Color units - 8 mg/l Fe and Mn	- 200 NTU Turbidity - 75 Color units - 10 mg/l Fe and Mn	- 100 NTU Turbidity - 75 Color units - 10 mg/l Fe - 5 mg/l Mn
Effluent	- < 5 Color Units - < 0.10 NTU - < 0.3 mg/l Fe - < 0.05 mg/l Mn - < 5 SDI	- < 5 Color Units - < 0.10 NTU - < 0.3 mg/l Fe - < 0.05 mg/l Mn - < 5 SDI	- < 5 Color Units - < 0.10 NTU - 0.3 mg/l Fe - < 0.05 mg/l Mn - < 5 SDI	- < 5 Color Units - < 0.10 NTU - < 0.3 mg/l Fe - < 0.05 mg/l Mn - < 5 SDI	- < 5 Color Units - < 0.10 NTU - < 0.3 mg/l Fe - < 0.05 mg/l Mn - < 5 SDI

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Vertical / Horizontal Pressure Filters Overview:

WesTech pressure filtration systems are designed for both municipal and industrial water treatment where the removal of suspended solids such as particulates, iron, manganese, free oils, mill scale, and other precipitates in ground or surface water is required. Pressure filters are commonly placed after WesTech clarification equipment. When used as pretreatment equipment, these filters will prolong the life and efficiency of WesTech granular activated carbon, ion exchange, and membrane systems.

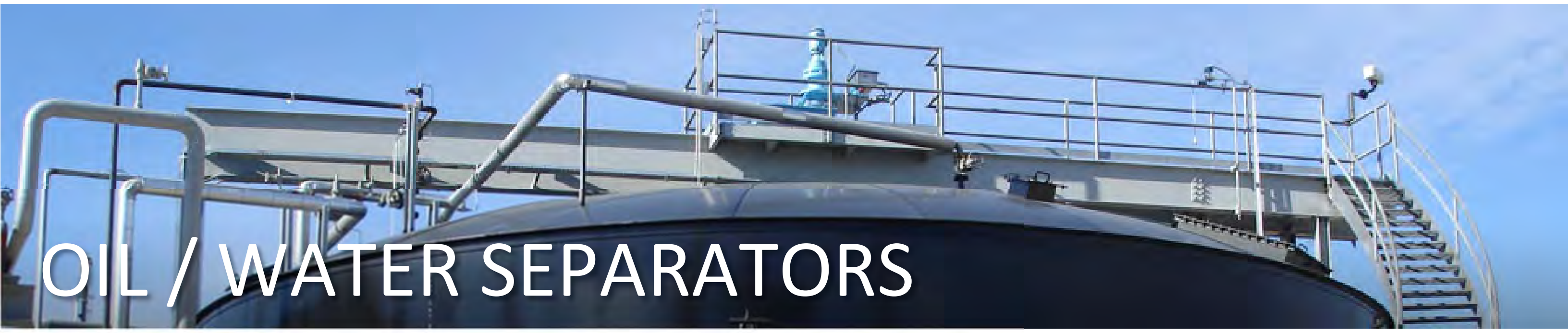
WesTech pressure vessels are available in a variety of configurations and designs that can be customized to meet various constraints such as water quality, footprint, bachwash requirements and flow requirements. Customers have the option of either vertical or horizontal (singe or multi-cell) pressure filters. Vessels are designed at various pressure capacities. They are commonly constructed of painted carbon steel but can also be constructed of other corrosion-resistant materials.

A variety of underdrain options are available, including (but not limited to) false bottom, header-and lateral, and arched plate. Several overdrain options are also available, including (but not limited to) splash-plate, header-and lateral, single point (i.e. upturned elbow), multi-point (i.e. 4-point "H" style, etc.), orificed pipe, and baffled (for combined air/water bachwash).

Media options and arrangements are several and depend on the application and internal piping arrangement but often consist of a dual-media sand-and anthracite arrangement (to minimize bachwash frequency) above a gravel support bed.

AeraFilter™ Iron and Manganese Removal Systems Overview:

WesTech AeraFilter™ Iron and Manganese Removal Systems offer a proven, efficient approach to iron (Fe) and manganese (Mn) removal from water. The AeraFilter combines three processes - aeration, oxidation detention, and granular media filtration in a single unit. The use of this system reduces the chemical feed demand for iron and manganese oxidation. Additionally, this unit is designed to eliminate the need for backwash storage tanks and backwash pumps through a self-generated backwash process. After iron, manganese, and other suspended solids removal is accomplished in the AeraFilter, water is prepared for granular activated carbon (GAC) treatment, ion-exchange softening, reverse osmosis, or to be sent directly to the water distribution system.



Oil / Water Separator Overview:

Designed according to API 421, WesTech Oil / Water Separators combine state-of-the-art separation, skimming and sludge transport technologies into a highly efficient primary oil separation device.

Removing the bulk of free oils and greases from the plant wastewater stream reduces overloading and other problems in downstream treatment processes. WesTech Oil / Water Separators are the right choice for general refinery wastewater, tank wash, bilge and ballast water, desalter waste, as well as storm wastewater run-off.

WesTech's unique ability to combine a vast experience base in liquid solids separation technology delivers the highest level of process performance and unsurpassed equipment quality.

WesTech Oil / Water Separator internals are easily configured to fit existing tanks for an effective retrofit, improving performance and extending the life of the equipment.

Features:

- Steel, stainless steel and concrete are primary materials of tank construction.
- All WesTech Oil/Water Separators can be equipped with VOC containment covers. Both fixed and floating styles are available.
- Highly efficient drum and disc type oil collection skimmers.

Benefits:

- Effectively dewaters the oil, making oil recovery much simpler.
- Long life and corrosion resistance.
- Eliminates bridging and plugging of viscous materials.

Applications:

- Reduce waste treatment load
- Recover free oil
- Improve process treatment
- Refinery wastewater
- Storm runoff water
- Bilge water
- Desalter waste
- Ballast water
- Reduce slop oil water

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HIFLO™ HIGH RATE THICKENERS

HiFlo™ High Rate Thickeners Overview:

WesTech HiFlo™ High Rate Thickeners are used in many types of process circuits to separate liquids and solids at very high rates. They are highly effective in coal refuse thickening, gold recovery, CCD Circuits, copper leaching, molybdenum processing and other mining and chemical flowsheets. Separation is effected rapidly because of the system hydraulics, which can be in excess of twenty times the hydraulics of conventional thickeners.

As a result of the innovative design and associated hydraulic efficiency, the plant area for the HiFlo High Rate Thickener is greatly reduced, even making indoor installations practical. The smaller equipment size substantially reduces capital, installation costs, and plant space when compared with conventional thickening units sized for the same production rates.

WesTech's technical staff can assist in testing process practicality, equipment sizing, and aid in solving other problems encountered in today's sophisticated and automated flowsheets. Pilot or laboratory size equipment is available for testing or purchase. WesTech's design provides for deaeration of the thickener feed prior to flow into the feedwell. Proper level of the flocculation can be carefully controlled. Feedwell design enhances the separation and pulp bed interface sensors are utilized for optimum performance. WesTech drives with lifting capability and high torque capacity contribute to the machine's superior performance.

Flocculation, pulp level, underflow density, overflow quality, torque, and rake lift position can all be easily managed. HiFlo sensor outputs are used in many installations by Distributed Control Systems to integrate thickener control with other plant functions, resulting in improved clarification of overflow and high solids concentration of underflow.

Features:

- Robust construction
- Self-diluting feedwell
- Enhanced polymer injection systems
- Cage and shaft lifting
- Broadly adaptable to process fluctuations

Benefits:

- Optimum flocculation
- Long service life
- Higher settling rate
- Prevents mechanism damage
- High solids transport efficiency
- Small space required
- Rapid separation of high flow rates

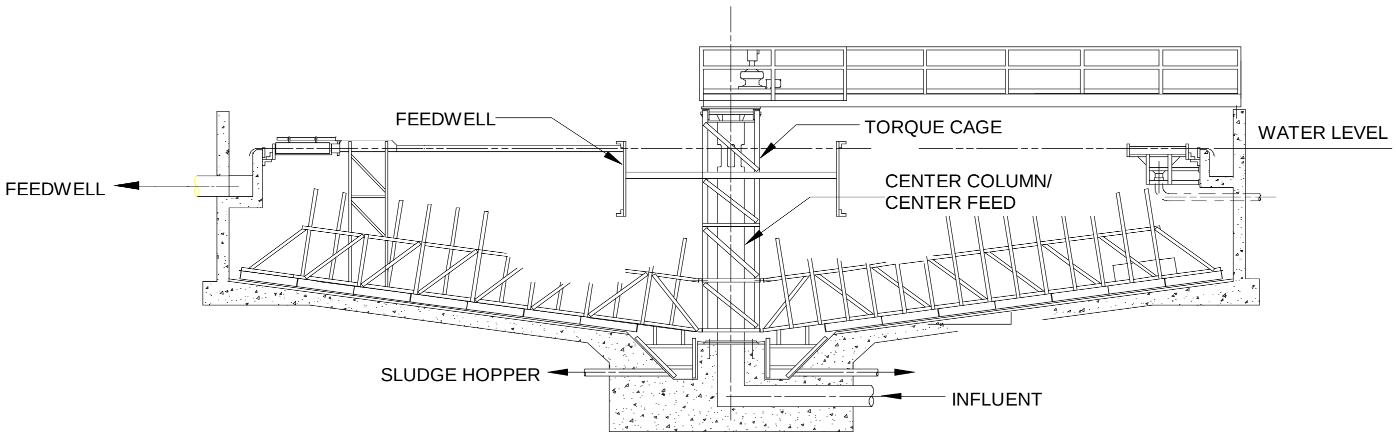
Applications:

- Grind Thickening
- Concentrate
- Tailings
- Leach thickening
- CCD Circuits
- Acid mine drainage

Thickeners

In the following pages, two different styles and models of thickeners are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate thickener model within this design catalog.

Center Feed Thickener



Model: THC

Description: The drive is mounted on a stationary center pier. The rotating portion of the drive turns a structural torque cage, which in turn rotates the sludge removal mechanism. The drive also supports the walkway and center platform.

Advantages:

- Maintains more rigid rake arm support mechanism
- Can handle extreme torque conditions
- Bridge has shorter unsupported span and is less expensive in units over 40 feet in diameter
- Center column doubles as a walkway support and feed pipe
- Lifting device option allows for inconsistent sludge loadings

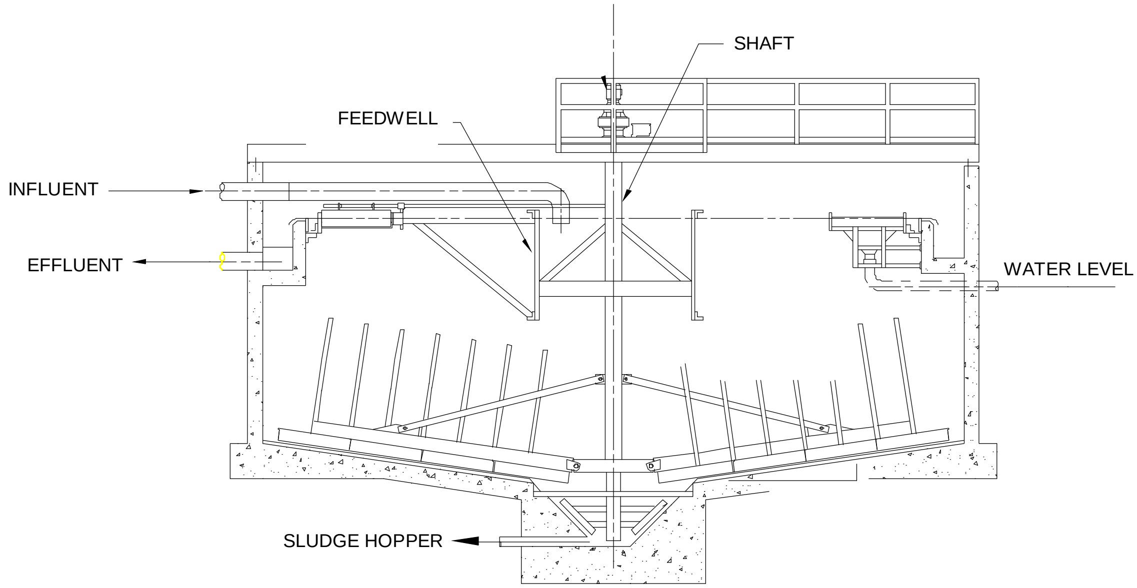
Disadvantages:

- Feed line must be buried beneath the thickener basin
- Tanks are generally concrete to adequately support the center column
- Center column and cage are more expensive than shaft driven rakes in smaller diameter tanks
- Access to main gear and bearing is more difficult due to the location under the center platform

Applications:

- Generally used in municipal thickener applications 40 foot diameter or larger, or in extreme torque industrial applications.

Shaft Drive Thickeners



Model: THS

Description: The drive is mounted on the walkway or bridge. The rotating portion of the drive turns a structural torque tube or shaft, which in turn rotates the solids removal mechanism.

Advantages:

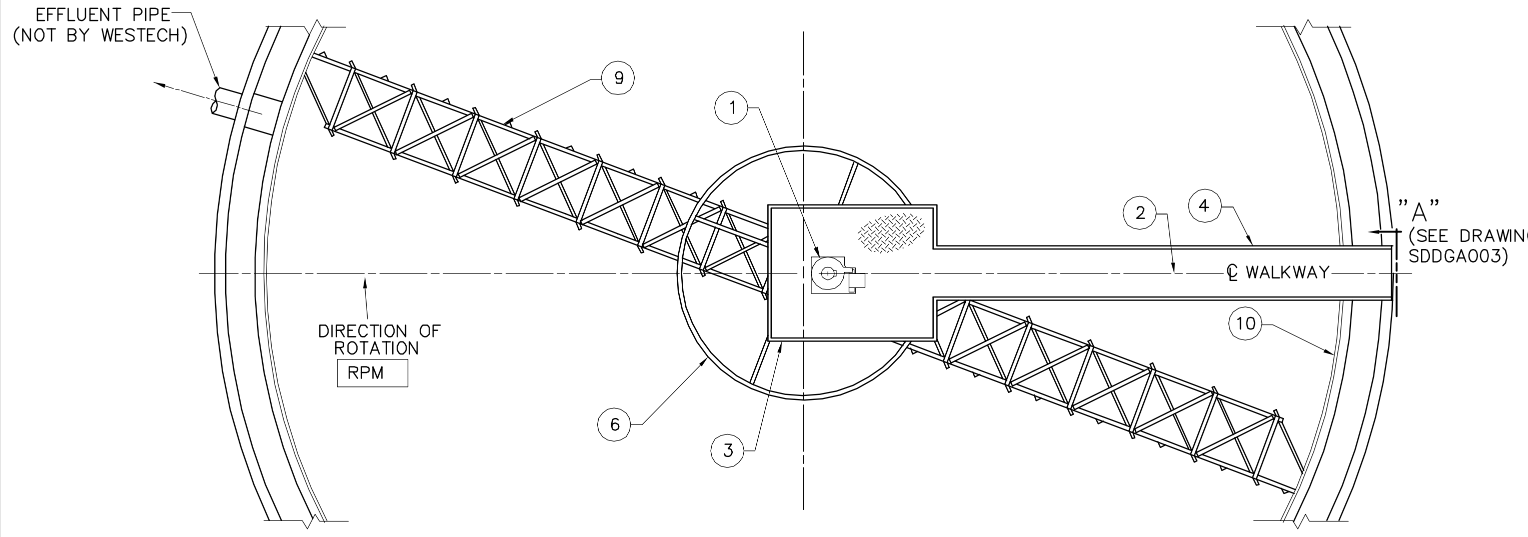
- Can develop high torques in compact units
- Torque tube is generally more economical than a torque cage in smaller units
- Easy access to main gear, bearing and pinion
- Generally the most economical way to provide lifting of rake arms under severe torque loads
- Easily adapted to various tank configurations
- Lifting device option allows for inconsistent sludge loadings

Disadvantages:

- Walkway or bridge must span the tank and support the weight and torque of the mechanism, therefore the bridge will be more expensive than for a center pier supported unit
- Torque shaft not as rigid as a comparable torque cage

Applications:

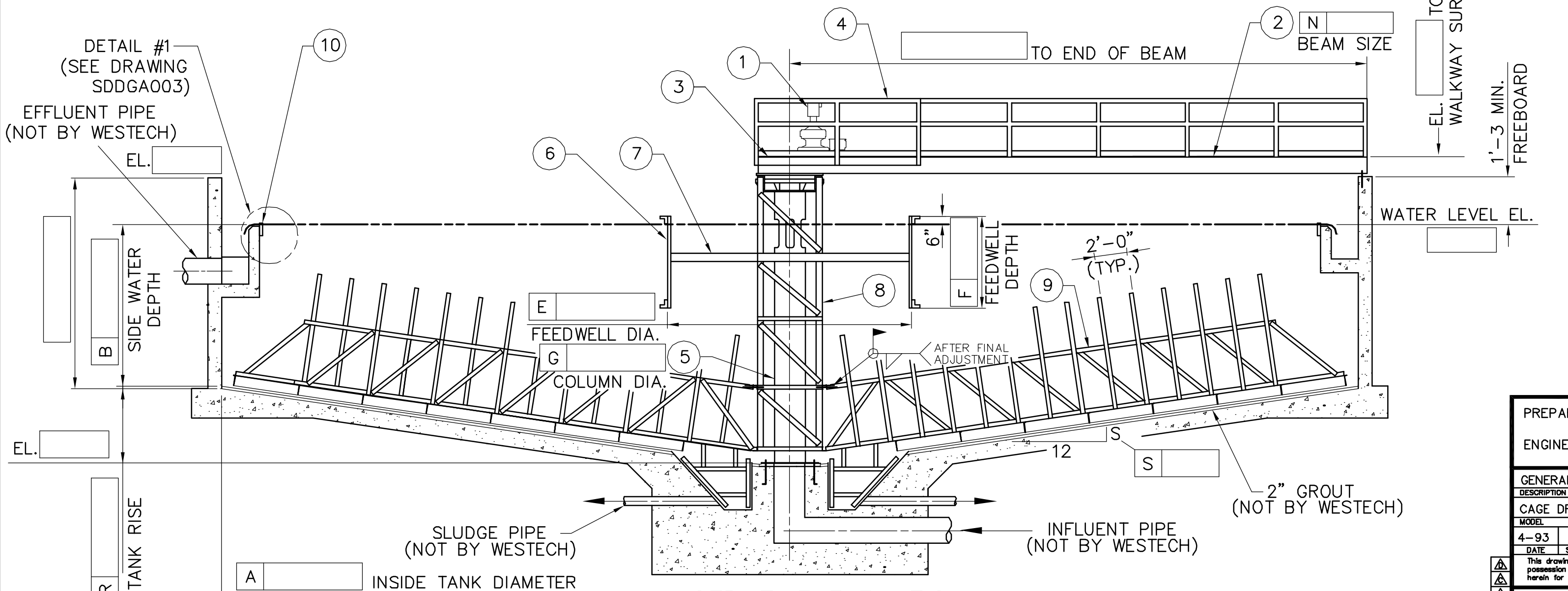
- Used frequently in municipal sludge thickening and industrial steel tank applications. Most economical in tank applications for basins 50 feet in diameter or less, or where center feed is not economical or feasible.



PLAN VIEW

EQUIPMENT LIST

ITEM	DESCRIPTION
1	DRIVE UNIT W/TORQUE CONTROL DEVICE D [ ] FT. LBS. CONTINUOUS RUNNING TORQUE
2	WALKWAY
3	PLATFORM
4	HANDRAIL 42" HIGH DOUBLE RAIL W/ 1/4" x 4" KICKPLATE
5	CENTER INFLUENT COLUMN (1/4" WALL) W/INFLUENT PORTS
6	FEEDWELL (3/16" PLATE) W/BAFFLED SCUM PORTS
7	FEEDWELL SUPPORTS
8	DRIVE CAGE W/SLUDGE PIT SCRAPERS
9	TWO (2) RAKE ARMS W/PICKETS, BLADES, & ADJUSTABLE SQUEEGEES (RAKE TWICE PER REVOLUTION)
10	WEIR PLATE 3/16" X 9" DEEP W/90° V-NOTCHES



ILLUSTRATIVE ELEVATION

NOTES:
1. THE CONFIGURATION AND DATA SHOWN ON THESE DRAWINGS IS FOR INFORMATION PURPOSES ONLY AND SHOULD NOT BE USED WITHOUT FOLLOWING PROPER PROCESS DESIGN CRITERIA.
2. SEE SDTGA019 FOR CONCRETE TANK ARRANGEMENT.
3. SEE SDDGA003 FOR GENERAL ARRANGEMENT DETAILS.

PREPARED FOR: ____________

ENGINEER: ____________

GENERAL ARRANGEMENT – THICKENER								
DESCRIPTION								
CAGE DRIVE – THC				25' TO 100' DIAMETER		THC1XP01	.0313 x 32	
MODEL				SIZE				
4–93	CRG	STB	RAC	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

REVISION	BY	CHKD	DATE	LTR

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
THC1XP01		△

PASTE THICKENERS

Paste Thickener Overview:

WesTech's HiDensity™ Paste Thickener produces non-settling thickened tailings with lower viscosities and underflow concentrations than what is produced in the Deep Bed™ Paste Thickener. The HiDensity™ Thickener also has a lower height-to-diameter ratio, which allows for on-the-ground construction and much larger diameters.

The HiDensity™ Thickener offers the advantages of paste and thickened tailings for very large tonnages. Water savings and tailings deposition can be accomplished with fewer tanks and at a lower capital cost than with the equivalent number of Deep Bed™ paste thickeners.

Reduced viscosity associated with the underflow concentrations of the HiDensity™ Thickener results in lower pumping costs — an important factor for deposition areas far from the plant.

Features:

- On-the-ground design
- Tunnel access to the underflow pumps
- Rake mechanism with full-length dewatering pickets
- Duty Rated Torque to over 4,000,000 ft-lbs
- Self-diluting feedwell
- Diameters 20m to over 50m

Benefits:

- Easier to pump low density paste
- Optimal flocculation
- Efficient paste discharge

Applications:

- Minerals tailings
- Deposit slope of 3-3%
- CCD circuits
- Extend pond life by changing to past
- Allows tailings deposit without dams

PASTE THICKENERS

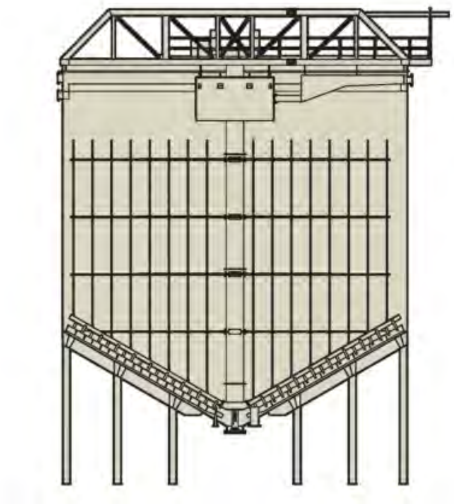
Deep Bed™ Paste Thickener

The original concept of the deep cone thickener was developed in the 1960s using a steep angled cone and thickener bed to increase underfow density. Over the years, this thickening technology has evolved to produce a non-settling solids suspension with underfow concentrations much higher than what is produced with conventional or high rate thickeners. WesTech's Deep Bed™ Paste Thickener is the latest advancement in the evolution of this style of thickener.

The WesTech Deep Bed™ Paste Thickener can thicken a tailings stream to non-settling paste at solids concentrations approaching that of a flter cake. Design characteristics of the Deep Bed™ result in maximum water recovery, maximum underfow density, and paste with minimal slump.

- Height-to-diameter ratios typically as high as 2:1
- A deep mud bed provides the required residence time and compression effects to produce paste
- Up to 45˚ floor slope promotes efficient paste discharge
- Rake mechanism with full-length dewatering pickets for maximum underfow density
- Typical Duty-Rated Torque to over 1,000,000 ft-lbs
- Self-diluting feedwell for optimal flocculation
- Diameters to over 20 m

Extra heavy-duty high torque drives power the raking mechanism without the need of a rake lift. Process controls allow the thickener to achieve the desired underfow density and overfow clarity with the minimum flocculant dosage.



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TOP™ THICKENER OPTIMIZATION PACKAGE

TOP™ Thickener Optimization Package Overview:

WesTech Engineering has taken the next step in advancing thickener technology with our Thickener Optimization Package (TOP™). The TOP thickener design approach adds ten innovative features to the thickener to provide a better process solution.

1. **EvenFlo™ Feedwell:** The feedwell is a core component for every thickener. Energy dissipation and even feed distribution from the EvenFlo feedwell help to minimize short-circuiting in the sedimentation zone.
2. **AirLift™ Feedwell Dilution:** This option allows thickener operators to target a specific dilution flow rate with controlled precision without upsetting quiescent settling conditions. Optimized feedwell dilution can minimize chemical consumption while maximizing the solids settling rate.
3. **Extreme Duty Drive:** WesTech's TOP thickener drive design includes direct in-line high-efficiency reducer and motor stacks, a durable precision bearing, state-of-the-art torque protection, rake lifting capability, and a customized design for each application.
4. **TOP Control System:** Each TOP control system package is customized to meet the specific needs for a given application. Designs can range from a reactive control logic, with a high level of operator interface to a proactive control logic, with complete automation and minimal operator interface.
5. **Inclined Dewatering Pickets:** As settling solids begin to compact together, water becomes trapped in the interstitial spaces between the solids. In contrast to vertical pickets, inclined pickets provide a progressive cavity that allows for a continuous and unhindered pathway for water to escape from the compacted zone.
6. **Low Profile Raking System:** Low profile rake support structures cut through the compacted slurry. Blade extension posts elevate the support structures from the solids transport zone. This results in lower energy consumption and more available torque for solids transport.
7. **Vortex Recirculation:** WesTech's Vortex recirculation system stabilizes underflow density control. An intermittent recirculation loop is used when underflow density is below specification.
8. **Dewatering Chamber:** The geometry of the TOP dewatering chamber provides additional solids residence time and a larger inventory for compacted solids. Inclined scrapers are used for further dewatering within the chamber.
9. **Customized Tank Design:** WesTech's approach to elevated tank design is unique. An algorithm has been developed to simultaneously analyze parameters such as beam size, beam quantity, leg size, and leg location. Designs are verified using structural analysis software.
10. **CFD Analysis:** Flow distribution patterns can be analyzed using Computational Fluid Dynamics (CFD). WesTech uses CFD technology as a tool to optimize the feed distribution system design.

TOP™ THICKENER OPTIMIZATION PACKAGE

Features:

- EvenFlo™ Feedwell
- AirLift™ Feedwell Dilution
- Extreme Duty Drive
- TOP™ Control System
- Inclined Dewatering Pickets
- Low Profile Raking System
- Vortex Recirculation
- Dewatering Chamber
- Customized Tank Design
- CFD Analysis

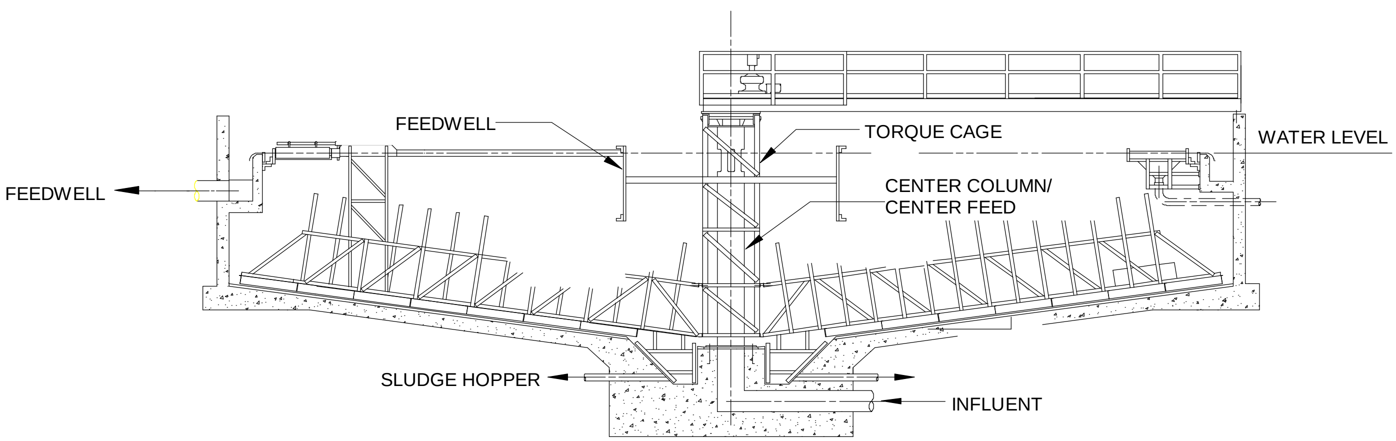
Benefits:

- Minimized short-circuiting in the sedimentation zone
- Minimized chemical consumption
- Maximized solids settling rate
- Low energy consumption
- More available torque for solids transport
- Additional solids residence time
- Larger inventory of compacted solids

Thickeners

In the following pages, two different styles and models of thickeners are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate thickener model within this design catalog.

Center Feed Thickener



Model: THC

Description: The drive is mounted on a stationary center pier. The rotating portion of the drive turns a structural torque cage, which in turn rotates the sludge removal mechanism. The drive also supports the walkway and center platform.

Advantages:

- Maintains more rigid rake arm support mechanism
- Can handle extreme torque conditions
- Bridge has shorter unsupported span and is less expensive in units over 40 feet in diameter
- Center column doubles as a walkway support and feed pipe
- Lifting device option allows for inconsistent sludge loadings

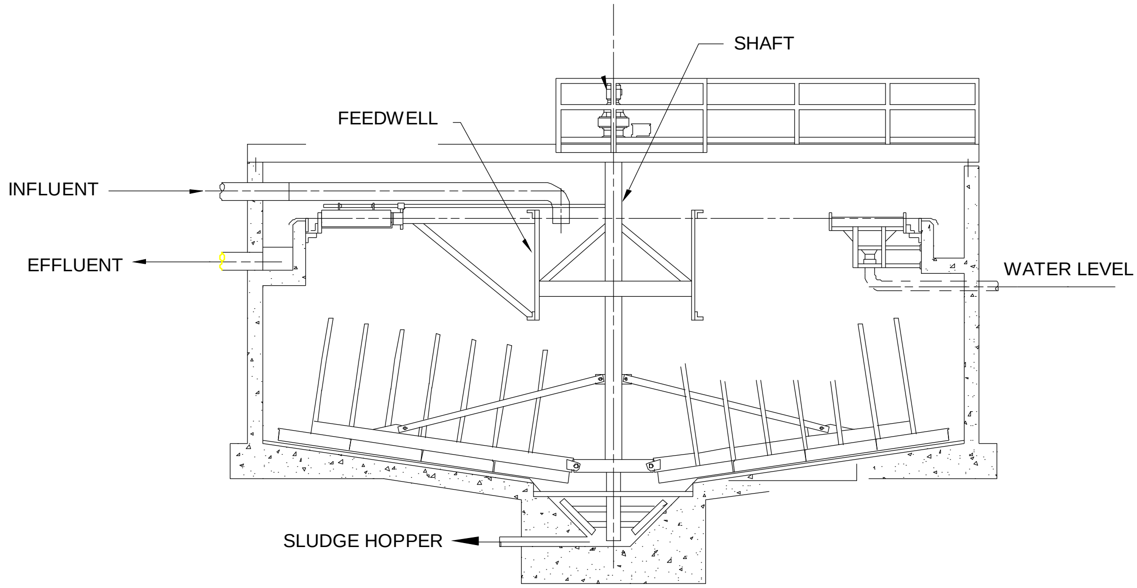
Disadvantages:

- Feed line must be buried beneath the thickener basin
- Tanks are generally concrete to adequately support the center column
- Center column and cage are more expensive than shaft driven rakes in smaller diameter tanks
- Access to main gear and bearing is more difficult due to the location under the center platform

Applications:

- Generally used in municipal thickener applications 40 foot diameter or larger, or in extreme torque industrial applications.

Shaft Drive Thickeners



Model: THS

Description: The drive is mounted on the walkway or bridge. The rotating portion of the drive turns a structural torque tube or shaft, which in turn rotates the solids removal mechanism.

Advantages:

- Can develop high torques in compact units
- Torque tube is generally more economical than a torque cage in smaller units
- Easy access to main gear, bearing and pinion
- Generally the most economical way to provide lifting of rake arms under severe torque loads
- Easily adapted to various tank configurations
- Lifting device option allows for inconsistent sludge loadings

Disadvantages:

- Walkway or bridge must span the tank and support the weight and torque of the mechanism, therefore the bridge will be more expensive than for a center pier supported unit
- Torque shaft not as rigid as a comparable torque cage

Applications:

- Used frequently in municipal sludge thickening and industrial steel tank applications. Most economical in tank applications for basins 50 feet in diameter or less, or where center feed is not economical or feasible.

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Process Equipment. Process Driven.

ALTAFILTER™ ULTRAFILTRATION

AltaFilter™ Ultrafiltration System Overview:

The AltaFilter™ Ultrafiltration Membrane System is an advanced filtration process used by municipalities and industries alike to produce high quality drinking and process water.

How it Works:

Membrane filtration is the process of removing particulate matter across a physical barrier. Particles larger than the pore opening of the membrane barrier are retained on the membrane surface while clean water and dissolved components pass through. The WesTech AltaFilter Ultrafiltration System is a low pressure, ultrafiltration membrane that removes particulate matter as small as individual viruses.

The AltaFilter utilizes robust, chemically-resistant, polysulfone hollow fibers housed in a uniquely configured pressurized module. The AltaFilter Ultrafiltration System has the most filtration surface area per module in the marketplace, providing a compact, economical solution for effective particulate removal. More filtration area per module allows the membrane system to be designed and operated at lower flux rates, extending membrane life. Unlike granular media filtration, the 0.01 micron ultrafiltration membrane doesn't require coagulant addition for effective filtration. Since the system uses fewer chemicals and operates at moderate flux rates, cleaning frequencies are reduced.

The AltaFilter Ultrafiltration System is supplied as a pre-engineered system with integrated piping, valves and controls, and has been successfully applied in potable water treatment, municipal wastewater filtration and industrial applications. Custom-engineered systems are available to meet unique needs.

Features:

- Toray membranes
- Shop-built, packaged units
- Nominal pore size of 0.01µm
- Barrier filtration
- Modular design
- Automated operation
- Chemically resistant polysulfone
- 99.999 % Cryptosporidium and Giardia removal
- Air assisted backwash
- Low pressure filtration
- Daily membrane integrity testing
- 130 µm automatic backwashing pre-filter
- Separate cleaning skid
- Skid piping, wiring, and testing completed prior to shipment

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ALTAFILTER™ ULTRAFILTRATION

Benefits:

- Simplified installation
- Compact footprint and height for reduced building size
- Improved virus and bacteria removal
- Does not require coagulant addition to achieve treated water turbidity requirements
- Reduced chemical consumption
- Easy expansion
- Minimal need for operator attention
- Extended membrane life
- Reduced reverse osmosis cost
- Reduced backwash volumes

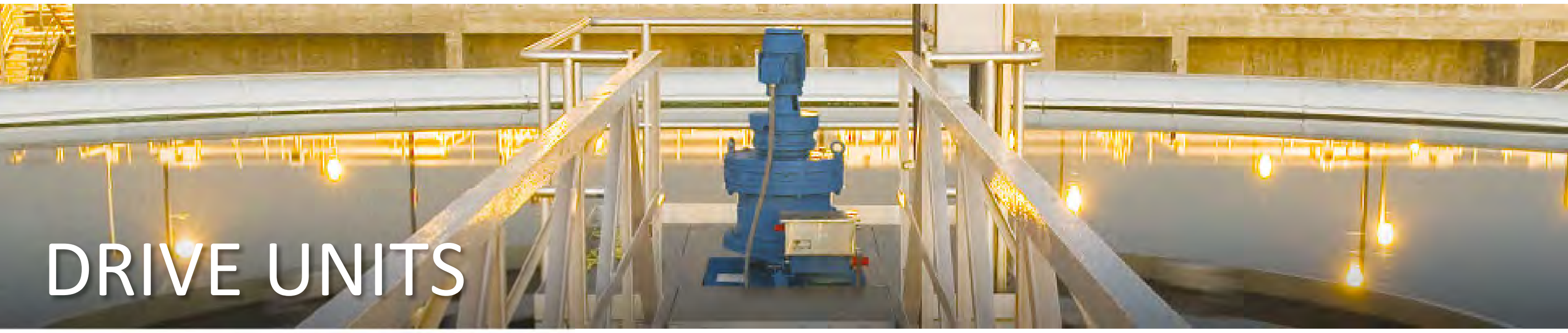
Applications:

- Surface water filtration
- Groundwater under the influence filtration
- Tertiary filtration of wastewater
- Reverse osmosis pretreatment
- Industrial process water
- Municipal drinking water

Specifications

- Surface area: 1227 ft2/114 m2 per module
- Housing material: PVC
- Length: 36.6 inches
- Diameter: 12 inches
- Raw water temperature: 32-95F
- Raw water pH: 2-12
- Max pressure in filtration: 36 psi
- Typical flow capacity per module: 10-45 gpm
- Dead end outside-in filtration

SECTION THREE – WESTECH DRIVES



DRIVE UNITS

Industrial Drive Unit Overview:

Clarifier and thickener drive units provide the rotational force necessary to turn the rake arms in a circular basin. The rotating rake arms transport settled solids to the center of the tank for removal. Because drive units are applied in water and wastewater treatment plants, as well as industrial facilities, WesTech has developed a premium drive unit for each application. WesTech drive units can be designed for torque requirements from 1,000ft-lbs to 6,000,000ft-lbs.

WesTech drive units are delivered to the job site as a single, completely assembled and shop-tested unit, ready to be installed on the thickener or clarifier center column. The result of a thorough design and meticulous component selection is a strong, reliable, high-quality drive that will provide a long service life with minimum maintenance.

One of the unique advantages of WesTech drives is the great flexibility of design. This allows the engineer to select a drive that will closely match the process and mechanical requirements. Using precision components manufactured by the foremost manufacturers in the industry, WesTech can guarantee the highest quality drive units available in pollution control today.

Features:

- Direct coupling throughout the drive.
- Torque overload control
- Pinion Shaft and Main Bearing tooth configuration
- Lower pinion bearing.
- Fabricated steel double plate housing design.
- Paint system is a three-step application of epoxy/polyurethane enamel.
- Both oil lubricated and grease lubricated models of all designs.
- Cycloidal type gearless reducers.
- Wide range of speed reduction ratios available.
- Precision main gear bearing: Calculated service life of over 100 years. The one-piece alloy steel gear is 285-350 BHN hardness. This has proven to be an optimal hardness for exceptional bearing life.

Benefits:

- Eliminates chain and belt transmissions.
- Makes accurate torque measurement, sounds alarm and cuts power per operator pre-sets.
- Improves safety and reduces maintenance requirements.
- Prevents overhung loads.
- Increases load distribution and reduces gear wear.
- Optimal corrosion resistance.
- Stronger and more rigid than cast iron with better fatigue strength and ductility.
- Ease of lubrication and ease of condensate removal for maintenance.
- High power transfer efficiency of 95% and greater.
- Handles high mechanism shock loads with no heat build-up or associated wear.

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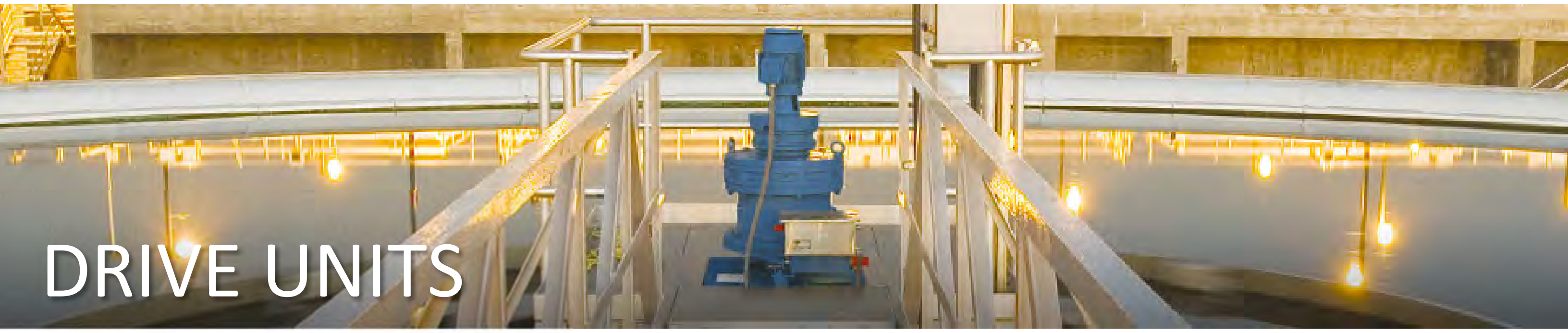

DRIVE UNITS

Applications:

- Contact Clarifiers for Raw Water
- Concentrate and Tailings Thickeners
- Paste thickeners
- CCD Circuits
- DAF units for Oily Wastes
- Circular Oil/Water Separators
- General Duty Clarifiers and Thickeners

Retrofit Drive Unit Overview:

When the option is rebuilding old equipment or buying new, consider the costs of each. Alleviate the maintenance headaches associated with rebuilding your existing drive and let a WesTech replacement drive provides you with the cost-effective solution. Our experience in building new drives and rebuilding other manufacturers' strip liner type drives shows that the costs associated with each are comparable.

With the infinite fabrication possibilities afforded from steel housings, WesTech can provide direct, bolt-in replacement drives for your old or failed drives. WesTech's line of replacement drives take advantage of the same efficient components and quality manufacturing as the WesTech standard drives, and provide your mechanism with the single best clarifier and thickener drives available.

WesTech representatives are available to visit your plant to assess proper retrofit procedures. Field Service is also available for installation and commissioning of your new drive.

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DRIVE UNITS

Advantages of WesTech Drives:

Fabricated steel base and gear housing:

A. Seal welded construction means that there is no need to coat the interior of the housing with a sealer to avoid leaks due to cracks or blowholes in a casting. The oil housing will not leak.

B. All moving parts are totally enclosed and are in an oil bath.

C. Steel is stronger and more rigid than cast iron.

D. Steel offers design flexibility to meet specific application conditions.

2. Non-rotating lift housing:

There is no need for a slip ring. The power to the lifting device is located in water-tight/weather proof conduit.

3. Bearing life:

The use of a precision bearing gives a calculated bearing life of at least 100 years and often over 1000 years, depending on the speed of the mechanism. This is much better than the calculated 10 to 20 year life of a strip liner bearing.

4. Maintenance:

A. Grease lubrication is easily accessible.

1. Main bearing, pivot bearing, lower support bearing, and bearings in the lift housing are lubricated with ease. These are the only bearings that require grease.

2. Level of oil bath for main gear is highly visible and oil is discharged with ease.

3. The cyclo gear reducer is grease lubricated. This means that it will have no oil leaks.

B. There is no need to replace a slip ring on the lift housing.

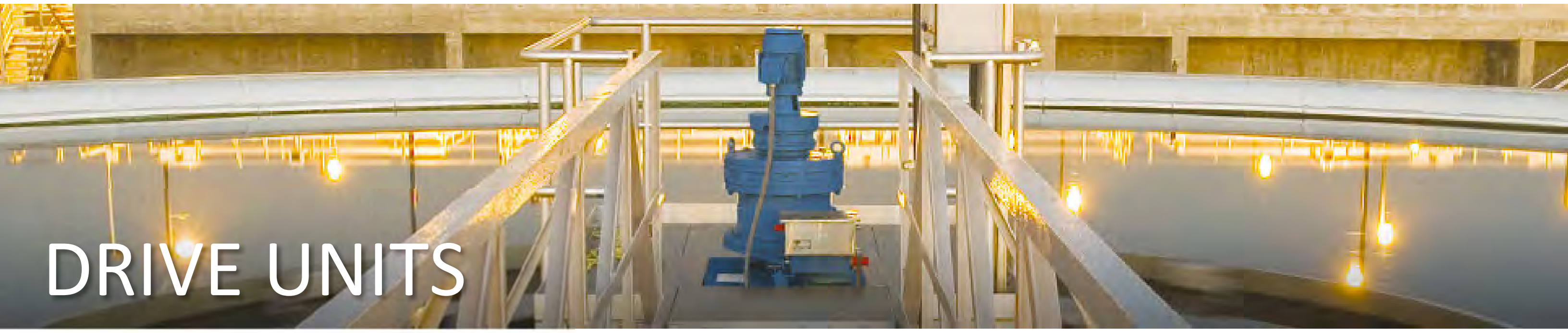
C. There are no chains or belts to replace or maintain.

D. Spare parts are usually in stock if they are needed. Standard industrial type bearings and seals are used to reduce maintenance costs and increase parts availability.

E. The moving parts of the drive unit are self contained. This helps to limit corrosion.

5. Cycloidal gearing:

High efficiency of cycloidal gearing versus worm gearing (95% versus 60-70%) cuts down on heat, which helps prolong the life of lubricants, bearings, and seals.



DRIVE UNITS

WesTech Shaft Drive:

The WesTech Shaft Drive is delivered to the job site as a single, completely assembled and shop tested unit, ready to be installed on the thickener or clarifier walkway beam. Direct coupling throughout the drive eliminates any chain and belt transmissions. This improves safety and reduces maintenance requirements considerably. The result of a thorough design and meticulous component selection is a strong, reliable, high quality drive that will provide a long service life with minimum maintenance.

One of the unique advantages of WesTech drives is the great flexibility of design. This allows the engineer to select a drive that will closely match the process and mechanical requirements. Using precision components manufactured by the foremost manufacturers in the industry, WesTech can guarantee the best quality.

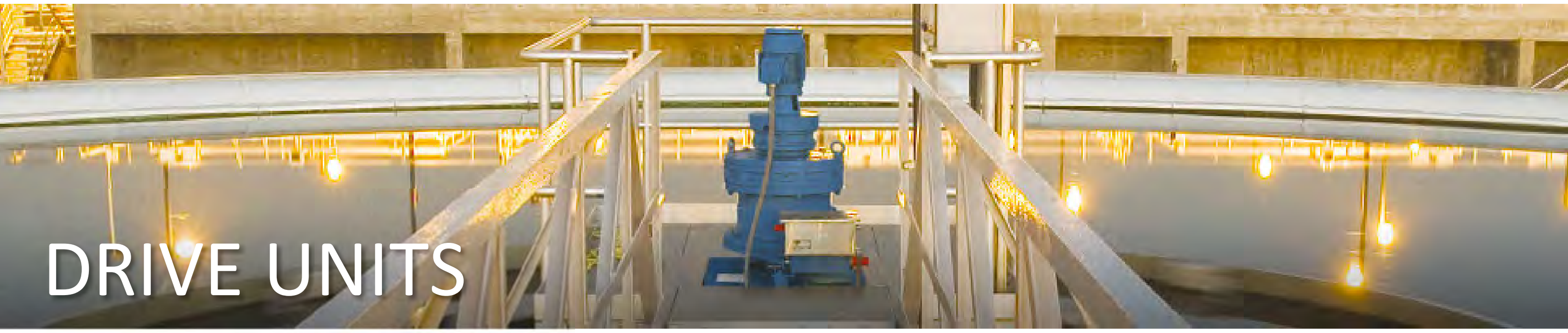
The drive unit consists of electric motor, speed reducer, drive control, external gear with integral bearing, and an all steel housing.

The electric motor, direct coupled to a speed reducer, operates the external gear by means of a pinion fastened to the output shaft of the speed reducer. The drive control pointer indicates the torque loading in percentages.

The electric motor is generally totally enclosed, suitable for outdoor installation, but other commercially available motors to suit environment or service such as explosion proof, can be furnished. When required, a suitable variable speed drive can be added to vary the final RPM of the drive.

The speed reducer, driven by the motor, is a completely sealed oil or grease lubricated unit. It is of a cycloidal type, which combines extremely high ratios with high efficiency and low wear in a compact unit. Torque transmitting elements roll, do not grind or slide, and because of this, the efficiency reaches 90 percent. Virtually, no wear failures have occurred in properly sized WesTech drives in 40 years of operation.

The Torkmatic drive control indicates and senses the output torque of the drive main gear. At excessively high torques, an alarm will sound or the motor will stop, thus protecting the drive unit and mechanism as well as the process.



DRIVE UNITS

Cage Drive Unit

The WesTech Cage Drive is delivered to the jobsite as a single, completely assembled and shop tested unit, ready to be installed on the thickener or clarifier center column. Direct coupling throughout the drive eliminates any chain and belt transmissions. This improves safety and reduces maintenance requirements considerably. The result of a thorough design and meticulous component selection is a strong, reliable, high quality drive that will provide a long service life with minimum maintenance.

One of the unique advantages of WesTech drives is the great flexibility of design. This allows the engineer to select a drive that will closely match the process and mechanical requirements. Using precision components manufactured by the foremost manufacturers in the industry, WesTech can guarantee the best quality.

The drive unit consists of electric motor, speed reducer, drive control, internal spur gear with integral bearing, and an all steel housing.

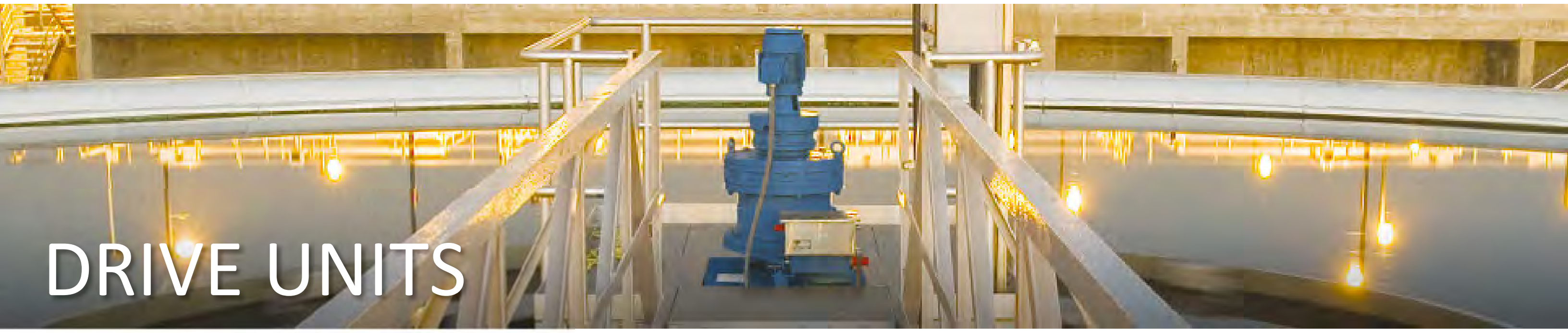
The electric motor, direct coupled to a speed reducer, operates the internal spur gear by means of a pinion fastened to the output shaft of the speed reducer. The drive control pointer indicates the torque loading in percentages.

The electric motor is generally totally enclosed, suitable for outdoor installation, but other commercially available motors to suit environment or service such as explosion proof, can be furnished. When required, a suitable variable speed drive can be added to vary the final RPM of the drive.

The speed reducer, driven by the motor, is a completely sealed oil or grease lubricated unit. It is of a cycloidal type, which combines extremely high ratios with high efficiency and low wear in a compact unit. Torque transmitting elements roll, do not grind or slide, and because of this, the efficiency reaches 90 percent. Virtually, no wear failures have occurred in properly sized WesTech drives in 40 years of operation.
The Torkmatic drive control indicates and senses the output torque of the drive main gear. At excessively high torques, an alarm will sound or the motor will stop, thus protecting the drive unit and mechanism as well as the process.

The precision forged steel internal tooth main gear is integral with the four point cross contact ball bearing. These two components are manufactured in the same facility to maintain higher quality, precision, and greater dependability than strip liner bearings usually found in these applications. As the turntable contains both bearing and gear in one complete and secured assembly, more precise backlash dimensions can be held and the gear will wear more uniformly. The gear bearing is also capable not only of severe shock loads and higher capacity, but also resists an overturning load which bearings with strip liners are completely incapable of handling.

The design of the WesTech drive is a culmination of many years of experience in pollution control drives. It offers you the most advanced and reliable drive unit available for sedimentation equipment.



DRIVE UNITS

Precision Bearing Advantages:

WesTech drive units for thickener and clarifier rake drives employ a precision and integral main gear and bearing unit. The summary below explains the reasons why WesTech chooses to use this bearing arrangement rather than the common strip liner bearing offered on sedimentation mechanism drives.

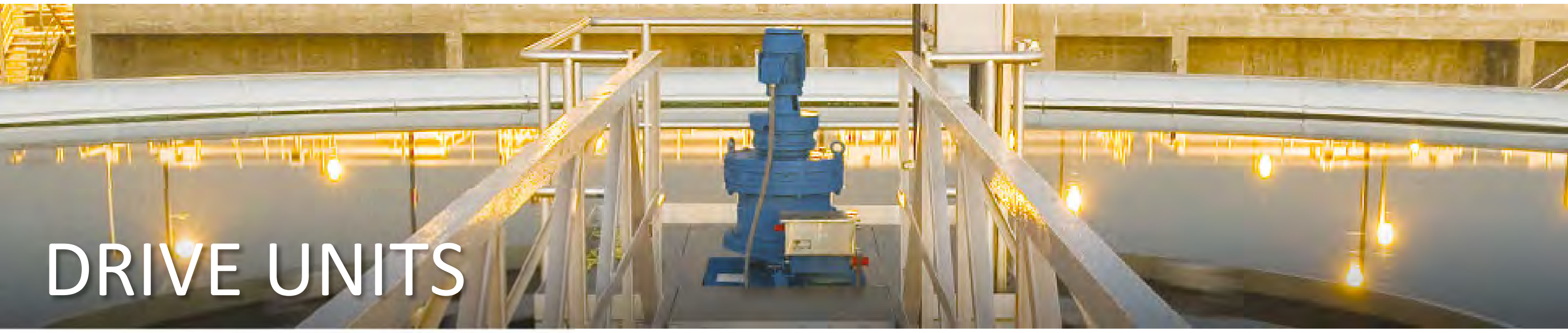
1. Precision manufacturing tolerances. The bearings utilized are acceptable for high load, high speed applications and are manufactured by recognized bearing companies. The use of these precision bearings is widespread among larger and more heavily loaded mechanisms common to the metallurgical industries.

2. Exceptional long life and load capacities of precision bearings. Instead of applying the bearing load in four points on the bearing balls as with standard strip liners, the precision bearing utilizes a full band contact race with hardness equal to that of the strip liners. Calculated bearing life is at least five times that for standard strip liners of the same ball size and diameter. The need for splitting gears and housings is eliminated because of superior service life.

3. Superior gear quality. The majority of all spur gear driving capacity comes from the stability of mounting and precision tolerance of its bearings. The use of an integral gear with bearing housing makes this precision inherent in the design. Avoiding an over-wide gear common to strip liner applications to meet AGMA calculated load values is also inherent in this gear design. AGMA 5 or better manufacturing tolerances are held for all gearing.

4. Overturning load capacity. Strip liner bearings have no inherent overturning load capacity and must rely only on mechanism weight for this feature. This capacity of the precision bearing makes the possible tank setting, misalignment, and lack of precision leveling of the drive during installation and operation a far less determining factor in premature bearing failure.

5. The main bearing is protected from dirt, oil contamination, gear chips, etc. inherent in large gearing housings by a separate sealed and grease lubricated cavity. The separate sealed feature is not available in the strip liner bearing arrangement. Bearing precision is not adequate for the use of any other than a loose felt seal for this location in a strip liner bearing arrangement.



DRIVE UNITS

Grease Lubrication Advantage

Ease of Maintenance

Oil changes are a thing of the past. The only required lubrication can be handled with just a grease gun and one lubricant. Most items on the drive unit require weekly lubrication from a manually operated grease gun. Years of experience has proven this to be reliable lubrication frequency.

Eliminates Condensation Build-up

WesTech totally grease lubricated drive units have drain holes that allow condensate to continuously drain from the drive, preventing water from getting into the main bearing and gear cavity. The elimination of condensate also eliminates the possibility of drive damage due to freeze-up. Unlike oil, grease cannot be displaced by water. For this reason, grease lubrication of the main bearing and gear will actually protect them better from the effects of humidity and condensation than an oil lubricated system.

No More Oil Spills Contaminating Your Clarifiers

Because there is no need to change the oil in the drive, the major cause of oil spills into the clarifier has been eliminated. Grease will not leak out of the drive unit like oil has a tendency to.

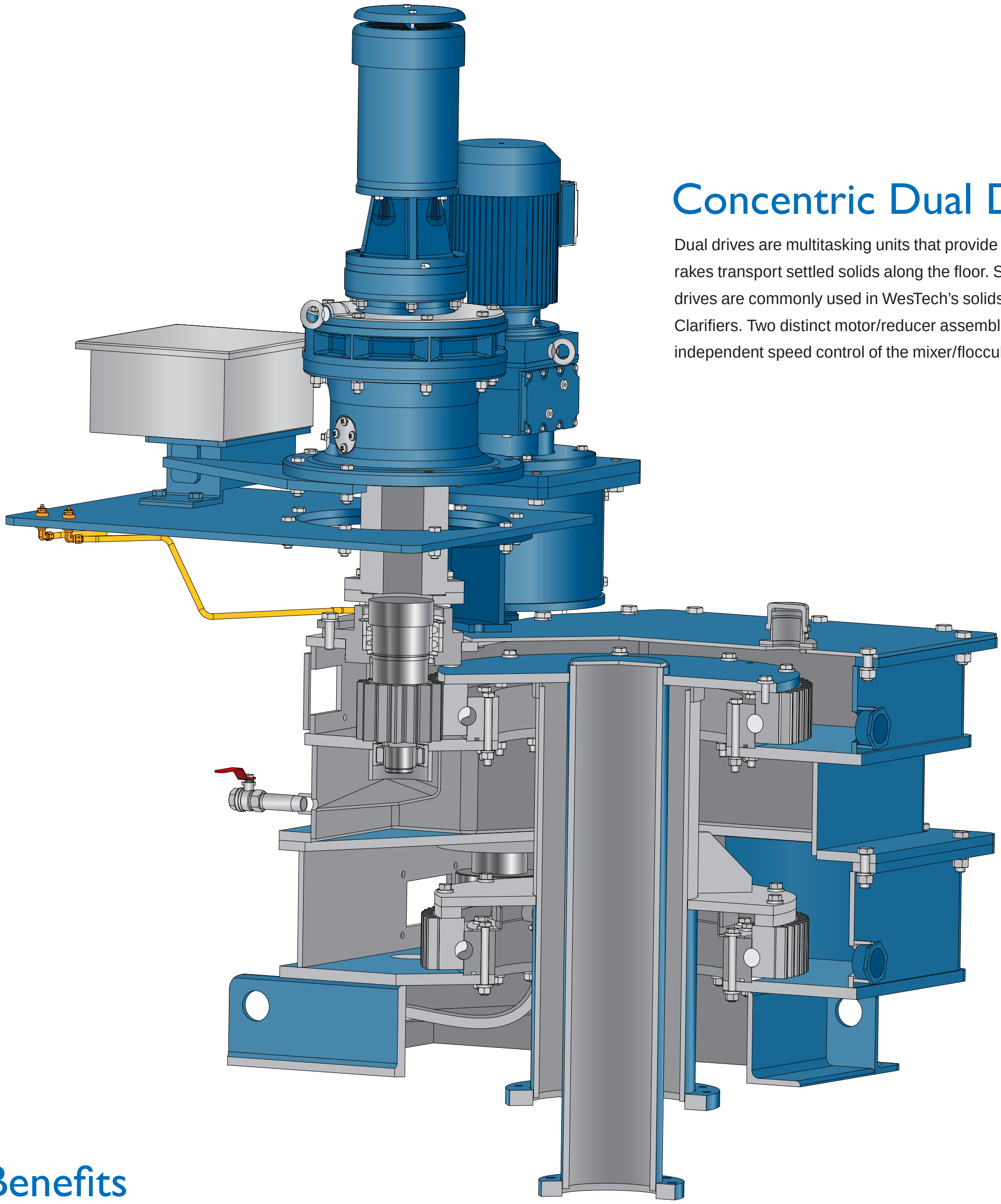
The Best Thing for Potable Water Plants

WesTech Totally Grease Lubricated Drive Units can be factory packed with food grade grease, eliminating the possibility of any contamination to the water supply.

The Best Lubrication for the Job

Grease is an excellent choice for slowly rotating and low temperature applications. According to the *Machinery Handbook 24th edition*, "Anti-friction bearings are normally grease lubricated, both because grease is much easier than oil to retain in the housing over a long period and because it acts to some extent as a seal against the entry of dirt and other contaminants into the bearings." While oil and grease are both excellent lubricants, oils are normally used in high speed applications where there is a need to dissipate heat. Slow speed equipment relies on lubricants which have a high surface tension (sticky) to ensure that lubricant is always present during surface contact. WesTech is able to use grease because of the tighter tolerance of our precision main bearing. The loose (sloppy) tolerances of the strip-liner type bearing do not allow for seals to retain grease.

Dual Shaft Drive



Concentric Dual Drive

Dual drives are multitasking units that provide independent mixing in the feedwell, while the rakes transport settled solids along the floor. Supplied in both shaft and cage designs, dual drives are commonly used in WesTech's solids CONTACT CLARIFIERS™ and Flocculating Clarifiers. Two distinct motor/reducer assemblies are combined into one unit, which allows for independent speed control of the mixer/flocculator and the rake arms.

Benefits

- Eliminates chain and belt transmissions.
- Makes accurate torque measurement, sounds alarm, and cuts power per operator presets.
- Improves safety and reduces maintenance requirements.
- Prevents overhung loads.
- Increases load distribution and reduces gear wear.
- Optimal corrosion resistance.
- Ease of lubrication and ease of condensate removal for maintenance.
- High power transfer efficiency of 95% and greater.
- Handles high mechanism shock loads with no heat buildup or associated wear.

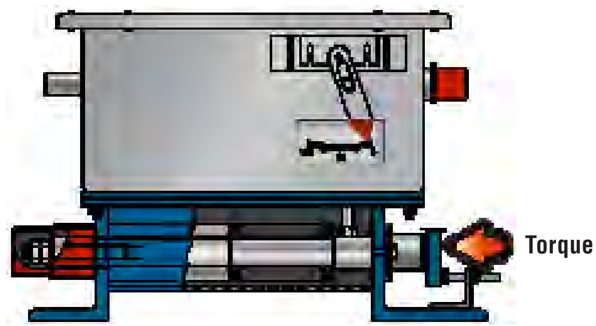
Direct coupling of motors, speed reducers, and shafts eliminates drive chains, belts and an oily mess around the drive. This design improves safety, reduces maintenance requirements and provides a neat and clean space saving design.

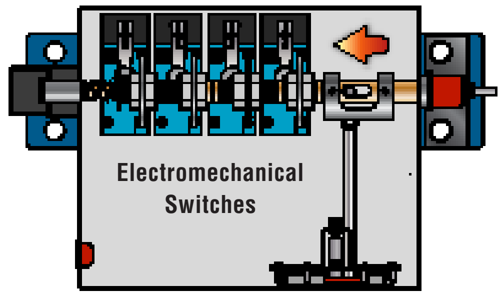
Precision main gear / bearings in WesTech drives have a calculated L-10 service life exceeding 100 years. The alloy steel gear teeth are hardened to 285-321 BHN for exceptional gear life. A modified-addendum main gear tooth geometry increases load distribution among gear teeth, reduces gear wear and prevents tooth breakage. The tight bearing tolerances maintain a proper gear-to-pinion alignment.

Heavy duty gear / bearing housings are available in mild steel, stainless steel, or cast iron. The steel and stainless steel designs use box construction to provide the strongest drive base on the market. Now you can select your preferred material of construction and combine it with the best drive mechanism design available.

Oil and grease lubricated options. While oil lubrication has been the standard for many years, WesTech also supplies an all-grease lubricated drive. Grease lubrication eliminates the need for periodic condensate draining, messy oil changes, and potential oil spills. Both systems of lubrication have been successfully used for years and help ensure a long bearing life.

Torkmatic™ Overload Protection





Cycloidal speed reducers can withstand momentary shock loads exceeding 500% of their rated continuous torque. At least two-thirds of the speed reducer teeth are engaged at any one time. The rolling action of the main lobes and pins reduces heat buildup and wear, while increasing efficiency to 95% per stage.

Torkmatic™ overload protection accurately senses the torque from the pinion shaft and displays it on the torque indicator. On every new drive, the electromechanical switches are factory set for high torque alarm and high torque motor cutout to protect the mechanism from damage. These settings can also be confirmed by field tests during start-up. Other options include rake arm lift, remote monitoring, redundant motor cutout, and explosion-proof torque boxes.

Lower pinion bearings eliminate overhung loads on the output bearing of the speed reducer. The upper and lower pinion bearings keep the pinion shaft in precise alignment with the main gear.

Design Flexibility

One of the unique advantages of premium WesTech drives is their great flexibility in design. This flexibility allows the engineer to select a drive that best matches the environmental and mechanical requirements. Our thorough design and meticulous component selection yields a strong, reliable, premium quality drive that will provide a long service life with minimum maintenance. Your drive unit will be delivered to the job site completely assembled, shop tested, and ready to be installed.

Cage Drive

Drive Unit Types

WesTech offers two main drive types, the Shaft Drive and the Cage Drive. The selection of the drive type depends on how the rotating mechanism and be supported in a given application.

Cage Drive

A cage drive unit rests on a stationary column mounted in the center of the tank. A half or full-span bridge then attaches to the robust housing of the drive unit. This column mounted drive transmits power to the sludge collection system through a center cage mechanism.

Shaft Drive

A shaft drive works well in smaller diameter tanks where the entire mechanism is supported by a full-span bridge. This bridge mounted drive transmits power to the sludge collection system through a center drive shaft.

Shaft Drive

Drive Unit Options

Concentric Dual Drive

Dual drives are multi-tasking units that provide independent mixing in the feedwell, while the rakes transport settled solids along the floor. Supplied in both shaft and cage designs, dual drives are commonly used in WesTech's solids Contact Clarifiers™ and Flocculating Clarifiers. Two distinct motor/reducer assemblies are combined into one unit, which allows for independent speed control of the mixer/flocculator and the rake arms.

Dual Shaft Drive

Lift Drive

In heavy-duty industrial applications where torque can peak unexpectedly, both shaft and cage drive units can be provided with a lifting device to raise the rake mechanism out of the dense, settled slurry. As the rakes are raised from the slurry, the torque load decreases and operation continues, which gives the operator time to make necessary system adjustments. The operator can then slowly lower the rakes back to their original position and avoid any shut-down time during the process.

D25 Gearless Shaft Drive

The D25 drive has the motor and speed reducer assembly directly mounted on the precision bearing for low torque applications. The precision bearing eliminates the need for a submerged bearing that is common with other gearless drives and some strip liner drives. In these low torque applications, the main gear-to-pinion reduction is not needed.

Direct Shaft Drive

For light duty applications, WesTech provides a drive unit that connects the center drive shaft directly to the output of the cycloidal speed reducer.

Multiple Pinion Drive

Heavy-duty industrial applications often require more torque than a single pinion can provide. In such cases, multiple pinions are used to drive a single precision bearing, which allows the torque design to double, triple, or quadruple in value.

Peripheral Drive

Rim drives travel along the periphery of a concrete tank and pivot the sludge collection system around the center support column. For large diameter tanks, rim drives can provide both mechanical and cost advantages. In minerals applications, heavy-duty traction drives are used for large diameter units with very high solids throughput requirements. Traction drives are designed to travel along either a smooth or geared rail, depending on site-specific torque requirements.

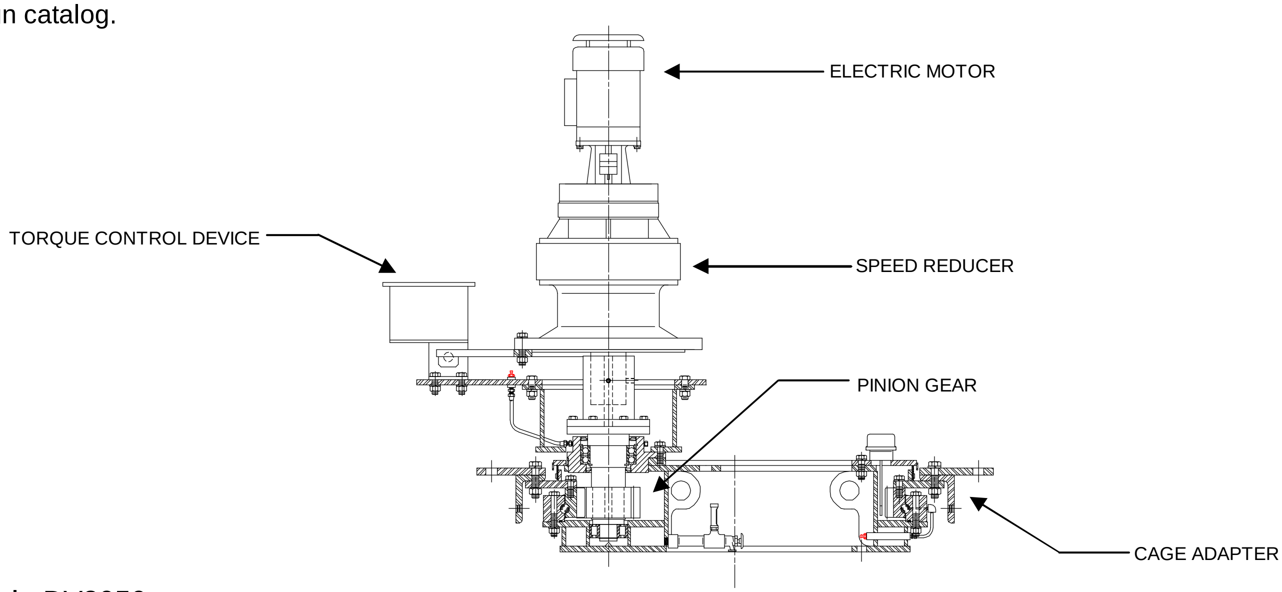
Shaft Drive with Lift

D25 Drive

Multiple Pinion Drive

Clarifier and Thickener Drives

In the following pages, the different styles and models of clarifier and thickener drives are presented. Each style has its own advantages and disadvantages, and is therefore suited for unique applications. The following summary of these advantages, disadvantages and suitable applications is intended to direct the user to the appropriate model within this design catalog.



Model: DV8050

Description: The drive is mounted on a stationary center pier. The rotating portion of the drive turns a structural torque cage, which in turn rotates the sludge removal mechanism. The drive also supports the walkway and center platform.

The main components of the drive are:

- Main internal gear and precision bearing
- Pinion
- Speed reducer(s)
- Torkmatic torque indicator and overload protection
- Fabricated steel base and housing
- TEFC motor

Advantages:

- Low Maintenance
- Can develop high torques in compact units
- Develops high overturning or unbalanced load capacity
- Typical main bearing L_{10} service life ratings in excess of 100 years
- High efficiency reducers result in low power consumption and low wear
- High shock load capacity
- Fabricated steel base and housing offer flexibility in design to meet individual plant needs
- Totally grease lubricated

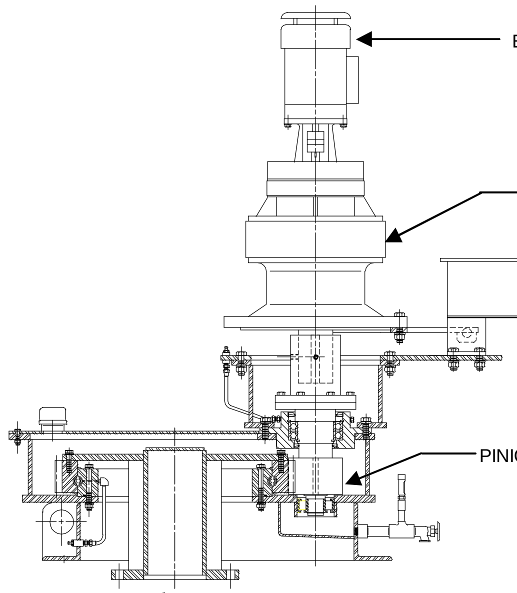
Disadvantages:

- More expensive than shaft drives or rim drives
- Access to main gear and bearing is more difficult due to the location under the center platform

Applications:

- Most economical when used in clarifiers 50 feet in diameter or larger, or where higher than normal torques are required.

Shaft Drive



Models: DV8003, DV8042 and DV8044

Description: The drive is mounted on the stationary bridge or walkway. The rotating portion of the drive rotates a structural torque tube or shaft, which in turn rotates the sludge removal mechanism. The main components of the drive are:

- Main gear and precision bearing (except model DV8003)
- Pinion (except model DV8003)
- Speed reducer(s)
- Torkmatic torque indicator and overload protection
- Fabricated steel base and housing
- TEFC motor

Advantages:

- **LOW MAINTENANCE**
- Can develop high torques in compact units
- Generally more economical than a comparable cage drive
- Develops high overturning or unbalanced load capacity
- Typical main bearing L_{10} service life ratings in excess of 100 years
- High efficiency reducers result in low power consumption and low wear
- Easy access to main gear, bearing and pinion
- Most economical way to provide lifting of rake arms under severe torque loads
- High shock load capacity
- Fabricated steel base and housing offer flexibility in design to meet individual plant needs
- Totally grease lubricated.

Disadvantages:

- Walkway or bridge must span the tank and support the weight and torque of the mechanism, therefore the bridge will be more expensive than for a center pier supported unit
- More expensive than rim drives

Applications:

- Most economical when used in clarifiers 50 feet in diameter or less, or where center feed is not economical or feasible.

Drive Units

For Clarifiers and Thickeners

ISO 9001 WesTech CERTIFIED QUALITY SYSTEM

WesTech

Drive Applications

WesTech is well known for providing top quality process equipment for municipal and industrial liquid-solid separation. We stand behind our equipment which has proven to meet the toughest of requirements. The WesTech drive unit helped us earn this reputation. Our drive gives you a flexible design, precision components, and strict quality control. WesTech guarantees a long drive life and the best fit for your process equipment needs.

Cage Drive Unit with 2,000,000 ft-lbs torque

The Basics

Clarifier and thickener drive units provide the rotational force necessary to turn the rake arms in a circular basin. The rotating rake arms transport settled solids to the center of the tank for removal. Because drive units are applied in water and wastewater treatment plants, as well as industrial facilities, WesTech has developed a premium drive unit for each application. WesTech drive units can be designed for torque requirements from 1,000 ft-lbs to 6,000,000 ft-lbs.

solids CONTACT CLARIFIER™

COP™ Clarifier

WASTEWATER

- Primary Clarifiers
- Secondary Clarifiers
- Tertiary Contact Clarifiers
- Gravity Sludge Thickeners
- DAF Thickeners

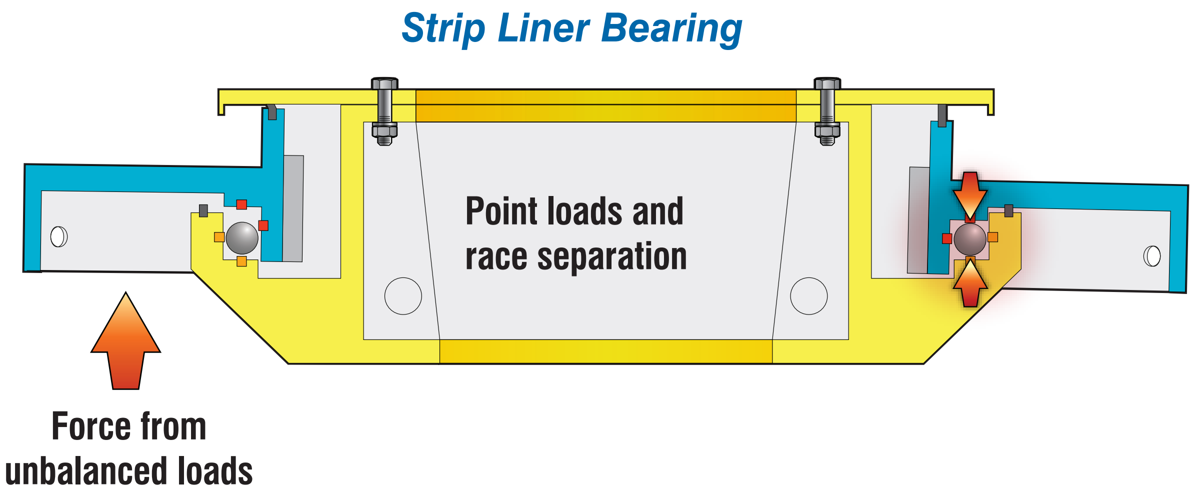
WATER

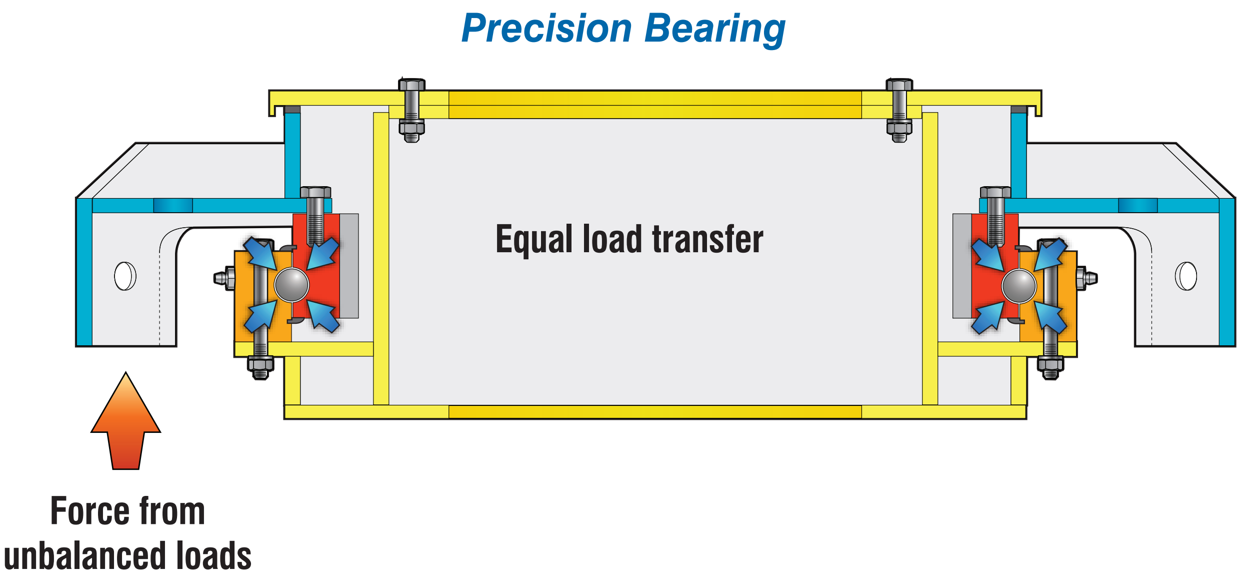
- Sedimentation Clarifiers
- Contact Clarifiers
- Flocculating Clarifiers
- Gravity Sludge Thickeners
- Filter Backwash Clarifiers

INDUSTRIAL

- Contact Clarifiers for Raw Water
- Concentrate and Tailings Thickeners
- Paste Thickeners
- CCD Circuits
- DAF units for Oily Wastes
- Circular Oil / Water Separators
- General Duty Clarifiers and Thickeners

Precision Bearing Drive





In the 1970's, WesTech became a respected process equipment company by promoting the precision bearing drive for municipal and industrial applications. The precision bearing can be found in other tough applications like overhead cranes, gun turrets, and track hoes. The precision bearing has several obvious advantages over the primitive strip liner bearing seen above.

The locked race precision bearing easily resists the powerful overturning movements created by unbalanced loads in sedimentation basins. As the figure above shows, the rotating turntable of the strip liner can easily separate from its stationary base, which causes a point load on one or two bearing balls. This separation can occur with the simple action of a skimmer riding over a scum box. The locked ring design of the precision bearing eliminates damaging point loads by equally transferring any unbalanced load to all of the bearing balls.

With a calculated L-10 service life five times longer than a strip liner bearing, the precision bearing has tighter tolerances, a harder continuous bearing raceway surface, and nylon spacers between the balls, which eliminate ball-to-ball contact wear.

The contact lip seals in a precision bearing protect the bearing from contaminants better than the felt seals of a strip liner bearing. Additionally, isolation of the bearing lubricant from the gear lubricant mitigates contamination to ensure a long bearing life.

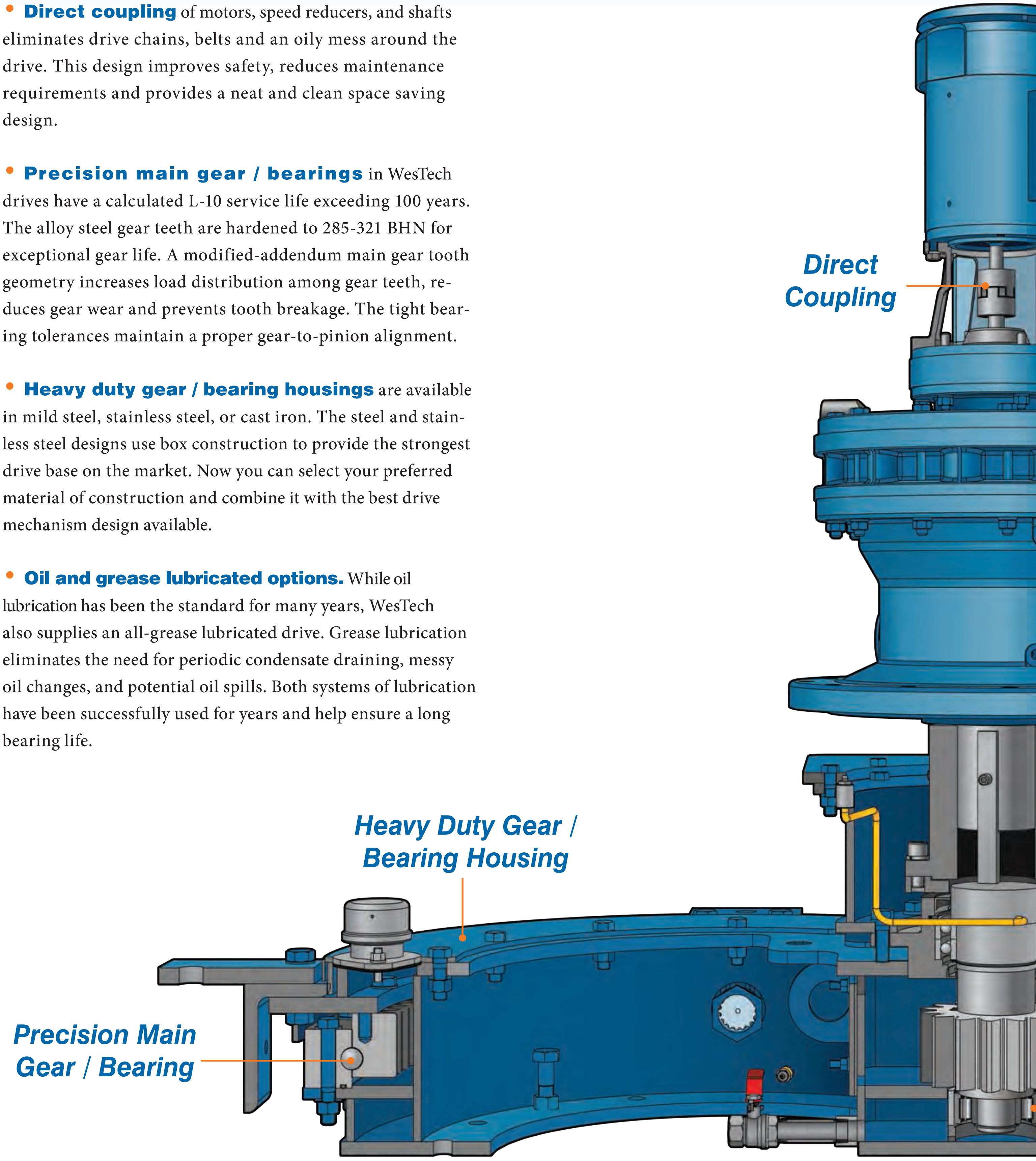
Understanding the WesTech Drive

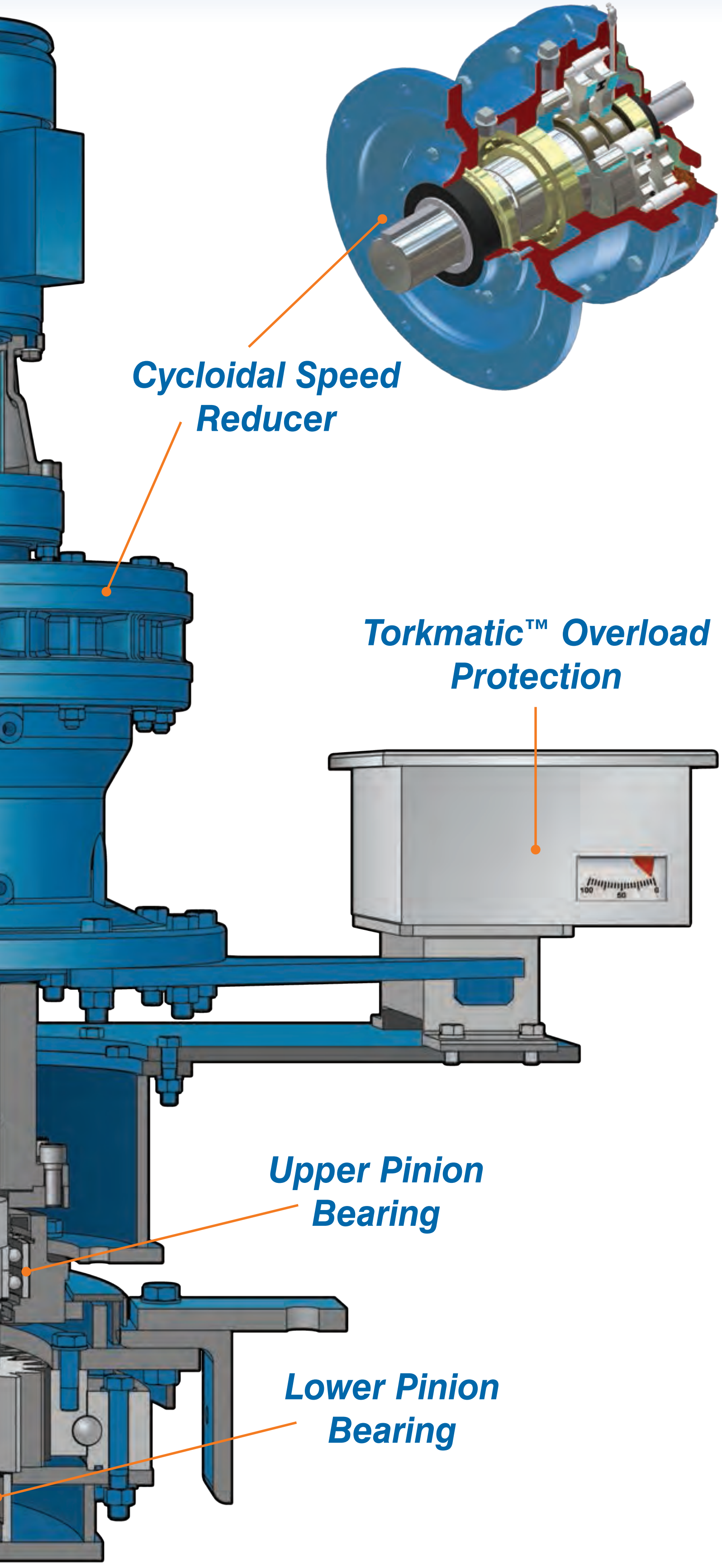
- **Direct coupling** of motors, speed reducers, and shafts eliminates drive chains, belts and an oily mess around the drive. This design improves safety, reduces maintenance requirements and provides a neat and clean space saving design.

- **Precision main gear / bearings** in WesTech drives have a calculated L-10 service life exceeding 100 years. The alloy steel gear teeth are hardened to 285-321 BHN for exceptional gear life. A modified-addendum main gear tooth geometry increases load distribution among gear teeth, reduces gear wear and prevents tooth breakage. The tight bearing tolerances maintain a proper gear-to-pinion alignment.

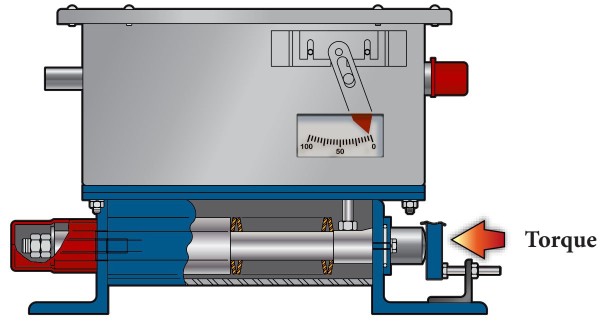
- **Heavy duty gear / bearing housings** are available in mild steel, stainless steel, or cast iron. The steel and stainless steel designs use box construction to provide the strongest drive base on the market. Now you can select your preferred material of construction and combine it with the best drive mechanism design available.

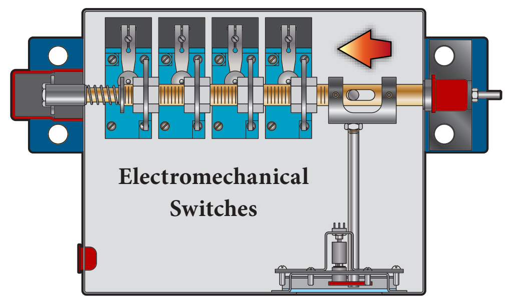
- **Oil and grease lubricated options.** While oil lubrication has been the standard for many years, WesTech also supplies an all-grease lubricated drive. Grease lubrication eliminates the need for periodic condensate draining, messy oil changes, and potential oil spills. Both systems of lubrication have been successfully used for years and help ensure a long bearing life.





Torkmatic™ Overload Protection





- **Cycloidal speed reducers** can withstand momentary shock loads exceeding 500% of their rated continuous torque. At least two-thirds of the speed reducer teeth are engaged at any one time. The rolling action of the main lobes and pins reduces heat buildup and wear, while increasing efficiency to 95% per stage.

- **Torkmatic™ overload protection** accurately senses the torque from the pinion shaft and displays it on the torque indicator. On every new drive, the electromechanical switches are factory set for high torque alarm and high torque motor cutout to protect the mechanism from damage. These settings can also be confirmed by field tests during start-up. Other options include rake arm lift, remote monitoring, redundant motor cutout, and explosion-proof torque boxes. An electronic load cell type torque protection is also available for use on new and existing drives.

- **Lower pinion bearings** eliminate overhung loads on the output bearing of the speed reducer. The upper and lower pinion bearings keep the pinion shaft in precise alignment with the main gear.

Design Flexibility

One of the unique advantages of premium WesTech drives is their great flexibility in design. This flexibility allows the engineer to select a drive that best matches the environmental and mechanical requirements. Our thorough design and meticulous component selection yields a strong, reliable, premium quality drive that will provide a long service life with minimum maintenance. Your drive unit will be delivered to the job site completely assembled, shop tested, and ready to be installed.

Cage Drive

Drive Unit Types

WesTech offers two main drive types, the Shaft Drive and the Cage Drive. The selection of the drive type depends on how the rotating mechanism will be supported in a given application.

- **Cage Drive**

A cage drive unit rests on a stationary column mounted in the center of the tank. A half or full-span bridge then attaches to the robust housing of the drive unit. This column mounted drive transmits power to the sludge collection system through a center cage mechanism.

- **Shaft Drive**

A shaft drive works well in smaller diameter tanks where the entire mechanism is supported by a full-span bridge. This bridge mounted drive transmits power to the sludge collection system through a center drive shaft.

Shaft Drive

Drive Unit Options

- **Concentric Dual Drive**

Dual drives are multi-tasking units that provide independent mixing in the feedwell, while the rakes transport settled solids along the floor. Supplied in both shaft and cage designs, dual drives are commonly used in WesTech's Solids CONTACT CLARIFIERS™ and Flocculating Clarifiers. Two distinct motor/reducer assemblies are combined into one unit, which allows for independent speed control of the mixer/flocculator and the rake arms.

Dual Shaft Drive

• Lift Drive

In heavy-duty industrial applications where torque can peak unexpectedly, both shaft and cage drive units can be provided with a lifting device to raise the rake mechanism out of the dense, settled slurry. As the rakes are raised from the slurry, the torque load decreases and operation continues, which gives the operator time to make necessary system adjustments. The operator can then slowly lower the rakes back to their original position and avoid any shutdown time during the process.

• D25 Gearless Shaft Drive

The D25 drive has the motor and speed reducer assembly directly mounted on the precision bearing for low torque applications. The precision bearing eliminates the need for a submerged bearing that is common with other gearless drives and some strip liner drives. In these low torque applications, the main gear-to-pinion reduction is not needed.

• Direct Shaft Drive

For light duty applications, WesTech provides a drive unit that connects the center drive shaft directly to the output of the cycloidal speed reducer.

• Multiple Pinion Drive

Heavy-duty industrial applications often require more torque than a single pinion can provide. In such cases, multiple pinions are used to drive a single precision bearing, which allows the torque design to double, triple, or quadruple in value.

• Peripheral Drive

Rim drives travel along the periphery of a concrete tank and pivot the sludge collection system around the center support column. For large diameter tanks, rim drives can provide both mechanical and cost advantages. In minerals applications, heavy-duty traction drives are used for large diameter units with very high solids throughput requirements. Traction drives are designed to travel along either a smooth or geared rail, depending on site-specific torque requirements.

Shaft Drive with Lift

D25 Drive

Multiple Pinion Drive

Retrofit Drive Applications

In addition to new installations, WesTech has upgraded many existing clarifiers and thickeners with our precision bearing drive. With every retrofit, WesTech visits the site to inspect the existing equipment, record detailed measurements, and plan for any special installation requirements.

WesTech Product Capabilities

Screening	**Sludge Mixers**	**Flocculators**	**Oil / Water Separators**
Grit Removal	**Digester Covers**	**Pressure Filters**	**Paste Thickeners**
Clarifiers	**Dissolved Air Flotation**	**Package Plants**	**Tankage and Erection**
Thickeners	**Gasholders**	**Ultrafiltration MBR**	**Parts and Field Service**
Biological Treatment	**Rotary Distributors**	**Vacuum Filters**	**Laboratory and Testing**

Call for all of your process equipment needs.

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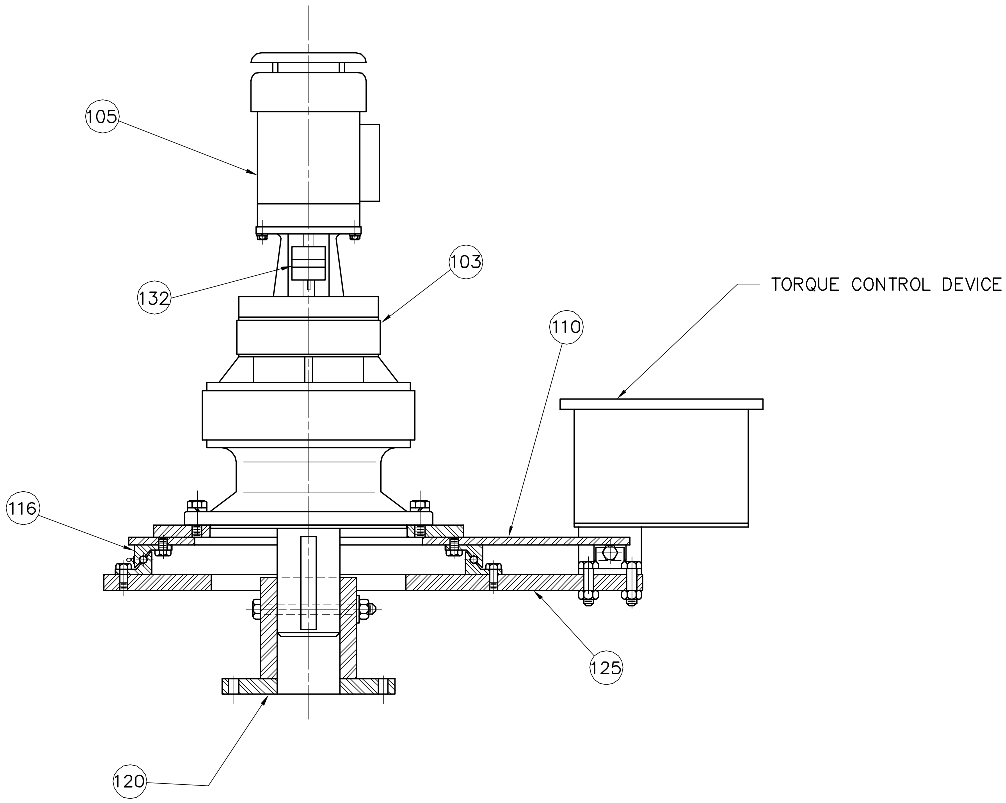
info@westech.com.br
www.westech.com.br
São Paulo, Brazil

WESTECH

Process Equipment. Process Driven.

Represented by:

ITEM	DESCRIPTION	QTY.	MAT'L
103	SPEED REDUCER	1	C.I./ST'L
105	ELECTRIC MOTOR	1	C.I./ST'L
110	ADAPTER PLATE	1	ST'L
116	PIVOT BEARING	1	ALLOY ST'L
120	DRIVE SHAFT	1	ST'L
125	DRIVE MOUNTING PLATE	1	ST'L
132	COUPLING	1	ELAS/STL



DRIVE TYPE A ______ SIZE B ______

TORQUE RATINGS

AGMA CONTINUOUS C ______ FT–LBS

MIN. MOMENTARY PEAK D ______ FT–LBS

ALARM E ______ FT–LBS (100%)

CUTOUT F ______ FT–LBS (120%)

OUTPUT SPEED H ______ RPM

OUTPUT SHAFT DIA. I ______

MOTOR J ______ HP, TEFC, ______ RPM

A 230/460 VOLT, 3 PHASE, 60 HZ

APPROXIMATE WT. K ______

PREPARED FOR: ______

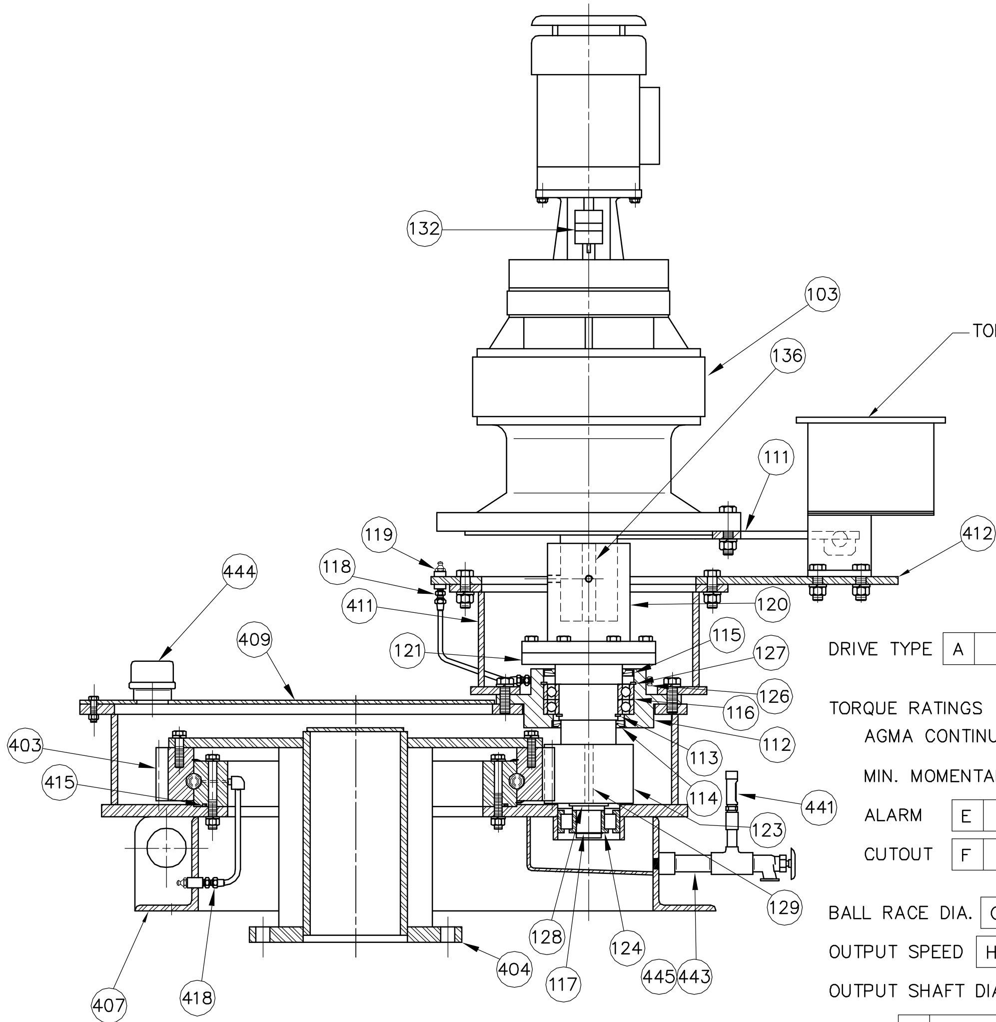
ENGINEER: ______

DRIVE UNIT GENERAL ARRANGEMENT								
DESCRIPTION								
DVSO – SHAFT DRIVE								
MODEL				SIZE				DVSOXX01 .25 x 4
3-93	DF	STB	MKD	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

REVISION	BY	CHKD	DATE	LTR
230/460 VOLTS WAS 360	RW	MDH	7–95	A

WESTECH

DRAWING NUMBER	PROJECT NUMBER	REV.
DV800301		



ITEM #	QT'Y	MAT'L	DESCRIPTION
103	1	CI/STL	SPEED REDUCER
105	1	CI/STL	ELECTRIC MOTOR
111	1	ST'L	TORQUE ARM
112	1	CI	UPPER BEARING HOUSING
113	1	ST'L	RETAINING RING
114	1	NBR/ST'L	SHAFT SEAL
115	1	NBR/ST'L	SHAFT SEAL
116	2	ALLOY STL	UPPER BEARING
117	1	ST'L	RETAINING RING
118	1	BRS/COP	UPPER BEARING LUBE LINE
119	1	ST'L	GREASE FITTING
120	1	ALLOY STL	REDUCER SHAFT ADAPTER
121	1	ALLOY STL	PINION SHAFT
123	1	ALLOY STL	PINION GEAR
124	1	ALLOY STL	CYLINDRICAL ROLLER BEARING
125	1	ST'L	KEY
126	1	ST'L	PRESSURE RELIEF FITTING
127	1	ST'L	RETAINING RING
128	1	ST'L	RETAINING RING
129	1	ST'L	KEY
132	1	NBR/STL	COUPLING
403	1	ALLOY STL	GEAR / BEARING
404	1	A36 STL	GEAR HUB
407	1	A36 STL	GEAR HOUSING
409	1	A36 STL	HOUSING COVER
411	1	A36 STL	TORQUE BOX ADAPTER SPACER
412	1	A36 STL	TORQUE BOX ADAPTER
415	1	NEOP	O-RING
418	1	BRS/COP	LUBE LINE
419	1	ST'L	GREASE FITTING
441	1	BRASS	OIL LEVEL SIGHT GLASS
443	1	ST'L	CONDENSATE DRAIN PIPING
444	1	ST'L	OIL FILL CAP
445	1	BRONZE	CONDENSATE & OIL DRAIN VALVE

DRIVE TYPE [A] SIZE [B]

TORQUE RATINGS

AGMA CONTINUOUS [C] FT-LBS

MIN. MOMENTARY PEAK [D] FT-LBS

ALARM [E] FT-LBS (100%)

CUTOUT [F] FT-LBS (120%)

BALL RACE DIA. [G]

OUTPUT SPEED [H] RPM

OUTPUT SHAFT DIA. [I]

MOTOR [J] HP, TEFC, [ ] RPM

△A 230/460 VOLT, 3 PHASE, 60 HZ

OVERTURNING MOMENT [K]

APPROXIMATE WT. [L]

REVISION	BY	CHKD	DATE	LTR
CHANGED TO NEW STYLE DRIVE	DK		7-99	B
230/460 VOLTS WAS 360	RW	MDH	7-95	A

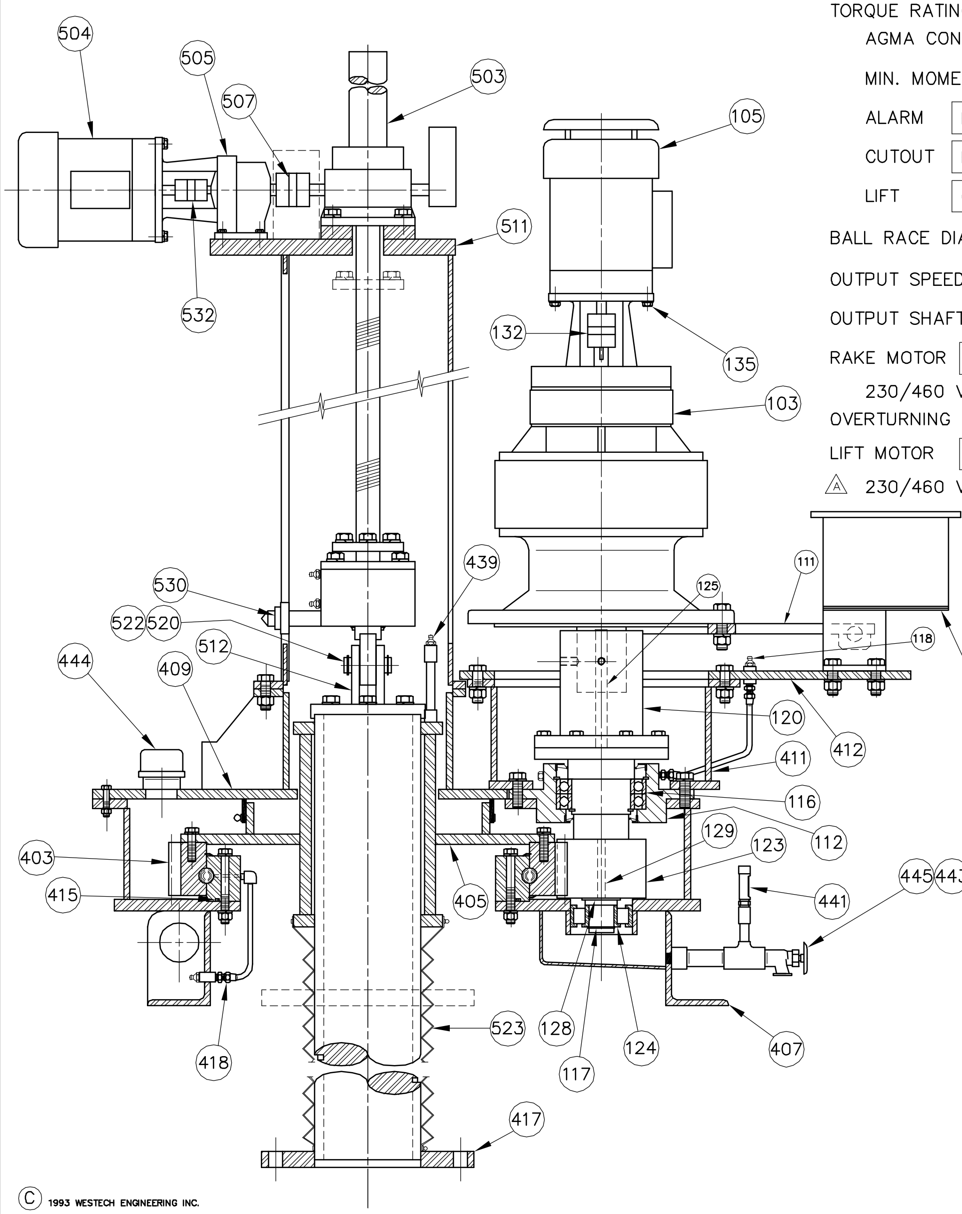
PREPARED FOR: ______

ENGINEER: ______

DRIVE UNIT GENERAL ARRANGEMENT
DESCRIPTION
DVS1 – SHAFT DRIVE
MODEL DVS1XX01 SIZE 25 x 4

DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
3-93	DF	STB	MKD	NONE				

WESTECH | DRAWING NUMBER DV804201 | PROJECT NUMBER | REV. △



DRIVE TYPE A ____ SIZE B ____

TORQUE RATINGS

AGMA CONTINUOUS C ____ FT-LBS

MIN. MOMENTARY PEAK D ____ FT-LBS

ALARM E ____ FT-LBS (100%)

CUTOUT F ____ FT-LBS (120%)

LIFT G ____ FT-LBS (110%)

BALL RACE DIA. H ____

OUTPUT SPEED I ____ RPM

OUTPUT SHAFT DIA. J ____

RAKE MOTOR K ____ HP, TEFC, ____ RPM

230/460 VOLT, 3 PHASE, 60 HZ

OVERTURNING MOMENT L ____ FT-LBS

LIFT MOTOR M ____ HP, TEFC, 1750 RPM

A 230/460 VOLT, 3 PHASE, 60 HZ

LIFT CAPACITY N ____

LIFT HEIGHT O ____

APPROXIMATE WT. P ____

ITEM #	QT'Y	MAT'L	DESCRIPTION
103	1	CI/STL	SPEED REDUCER
105	1	CI/STL	ELECTRIC MOTOR (RAKE)
111	1	ST'L	TORQUE ARM
112	1	CI	UPPER BEARING HOUSING
116	2	ALLOY STL	UPPER BEARING
118	1	BRS/COP	UPPER BEARING LUBE LINE
120	1	ALLOY STL	REDUCER SHAFT ADAPTER
121	1	ALLOY STL	PINION SHAFT
123	1	ALLOY STL	PINION GEAR
124	1	ALLOY STL	CYLINDRICAL ROLLER BEARING
125	1	ST'L	KEY
126	1	ST'L	PRESSURE RELIEF FITTING
127	1	ST'L	RETAINING RING
128	1	ST'L	RETAINING RING
129	1	ST'L	KEY
132	1	NBR/STL	COUPLING
403	1	ALLOY STL	GEAR / BEARING
405	1	A36 STL	GEAR HUB
407	1	A36 STL	GEAR HOUSING
409	1	A36 STL	HOUSING COVER
411	1	A36 STL	TORQUE BOX ADAPTER SPACER
412	1	A36 STL	TORQUE BOX ADAPTER
415	1	NEOP	O-RING
417	1	ST'L	ADAPTER SHAFT
418	1	BRS/COP	LUBE LINE
441	1	BRASS	OIL LEVEL SIGHT GLASS
443	1	ST'L	CONDENSATE DRAIN PIPING
444	1	ST'L	OIL FILL CAP
445	1	BRONZE	CONDENSATE & OIL DRAIN VALVE
503	1	CI/STL	WORM GEAR LIFT JACK
504	1	CI/STL	ELECTRIC MOTOR (LIFT)
505	1	CI/STL	LIFT DRIVE REDUCER
507	1	HTL/STL	SHAFT COUPLING
511	1	ST'L	LIFT HOUSING
512	1	A36 STL	SHAFT ADAPTER
513	1	A36 STL	THRUST BEARING HOUSING
514	1	A36 STL	THRUST BEARING HOUSING ADAPTER
520	2	ST'L	RETAINING RING
521	1	ST'L	SHAFT HANGER
522	1	ST'L	SHAFT HANGER PIN
523	1	NEOP	BELLOWS
530	1	ALLOY STL	POINTER ROLLER BEARING
532	1	NBR/STL	SHAFT COUPLING

PREPARED FOR: ____

ENGINEER: ____

DRIVE UNIT GENERAL ARRANGEMENT

DESCRIPTION: DVS1XL - SHAFT DRIVE

MODEL / SIZE: DVS1XL01 .25 x 4

DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
3-93	DF	STB	MKD	NONE				

REVISION	BY	CHKD	DATE	LTR
CHANGED TO NEW STYLE DRIVE	DK		7-99	A
230/460 VOLTS WAS 360	RW	MDH	7-95	A

WESTECH

DRAWING NUMBER: DV804401 | PROJECT NUMBER: | REV.: A

DRIVE TYPE | A | SIZE | B

TORQUE RATINGS

AGMA CONTINUOUS | C | FT–LBS

MIN. MOMENTARY PEAK | D | FT–LBS

ALARM | E | FT–LBS (100%)

CUTOUT | F | FT–LBS (120%)

BALL RACE DIA. | G

OUTPUT SPEED | H | RPM

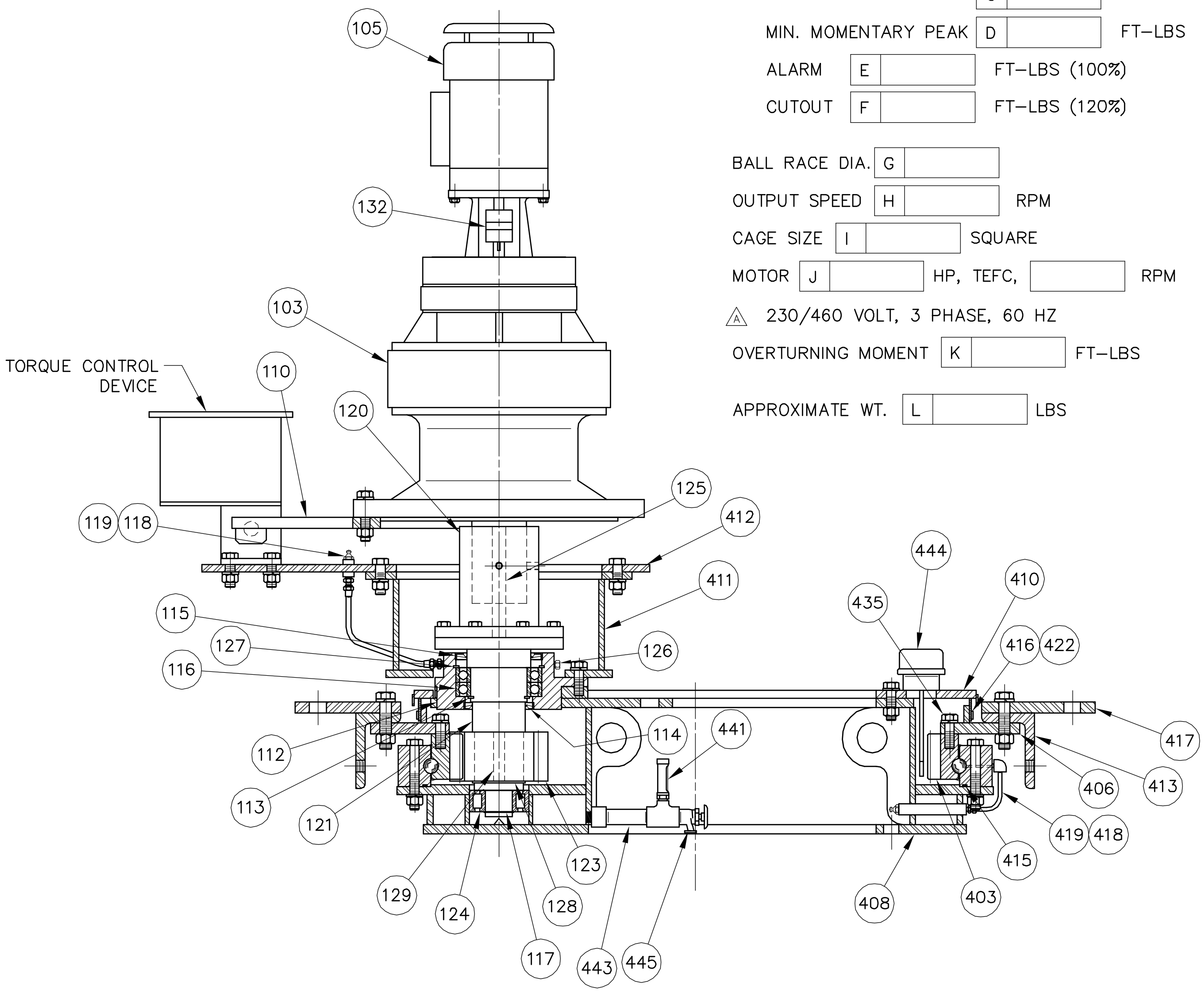
CAGE SIZE | I | SQUARE

MOTOR | J | HP, TEFC, | RPM

A 230/460 VOLT, 3 PHASE, 60 HZ

OVERTURNING MOMENT | K | FT–LBS

APPROXIMATE WT. | L | LBS



ITEM #	QT'Y	MAT'L	DESCRIPTION/REMARKS
103	1	CI/STL	SPEED REDUCER
105	1	CI/STL	ELECTRIC MOTOR
110	1	A36 STL	TORQUE ARM
112	1	CI	UPPER BEARING HOUSING
113	1	STL	RETAINING RING
114	1	NBR/STL	SHAFT SEAL
115	1	NBR/STL	SHAFT SEAL
116	2	ALLOY STL	UPPER BEARING
117	1	STL	RETAINING RING
118	1	COP/BRS	UPPER BEARING GREASE LINE
119	1	STL	GREASE FITTING
120	1	ALLOY STL	REDUCER SHAFT ADAPTER
121	1	ALLOY STL	PINION SHAFT
123	1	ALLOY STL	PINION GEAR
124	1	ALLOY STL	CYLINDRICAL ROLLER BEARING
125	1	STL	KEY
126	1	STL	PRESSURE RELIEF FITTING
127	1	STL	RETAINING RING
128	1	STL	RETAINING RING
129	1	STL	KEY
132	1	NBR/STL	SHAFT COUPLING
403	1	ALLOY STL	GEAR/BEARING
406	1	A36 STL	CAGE HUB
408	1	A36 STL	GEAR HOUSING
410	1	A36 STL	HOUSING COVER
411	1	A36 STL	TORQUE BOX ADAPTER SPACER
412	1	A36 STL	TORQUE BOX ADAPTER
413	4	A36 STL	CAGE ADAPTER
415	1	NEOP	O–RING
416	1	NEOP/S.S.	DUST SHIELD
417	4	A36 STL	ADJUSTING ROD PLATE
418	2	COP/BRS	GEAR/ BEARING GREASE LINE
419	2	STL	GREASE FITTINGS
441	1	BRASS	OIL LEVEL SIGHT GLASS
443	1	STL	OIL LEVEL SIGHT GLASS PIPING
444	1	STL	OIL FILL CAP W/DIPSTICK
445	1	BRONZE	OIL & CONDENSATE DRAIN VALVE

PREPARED FOR: ____________

ENGINEER: ____________

DRIVE UNIT GENERAL ARRANGEMENT
DESCRIPTION

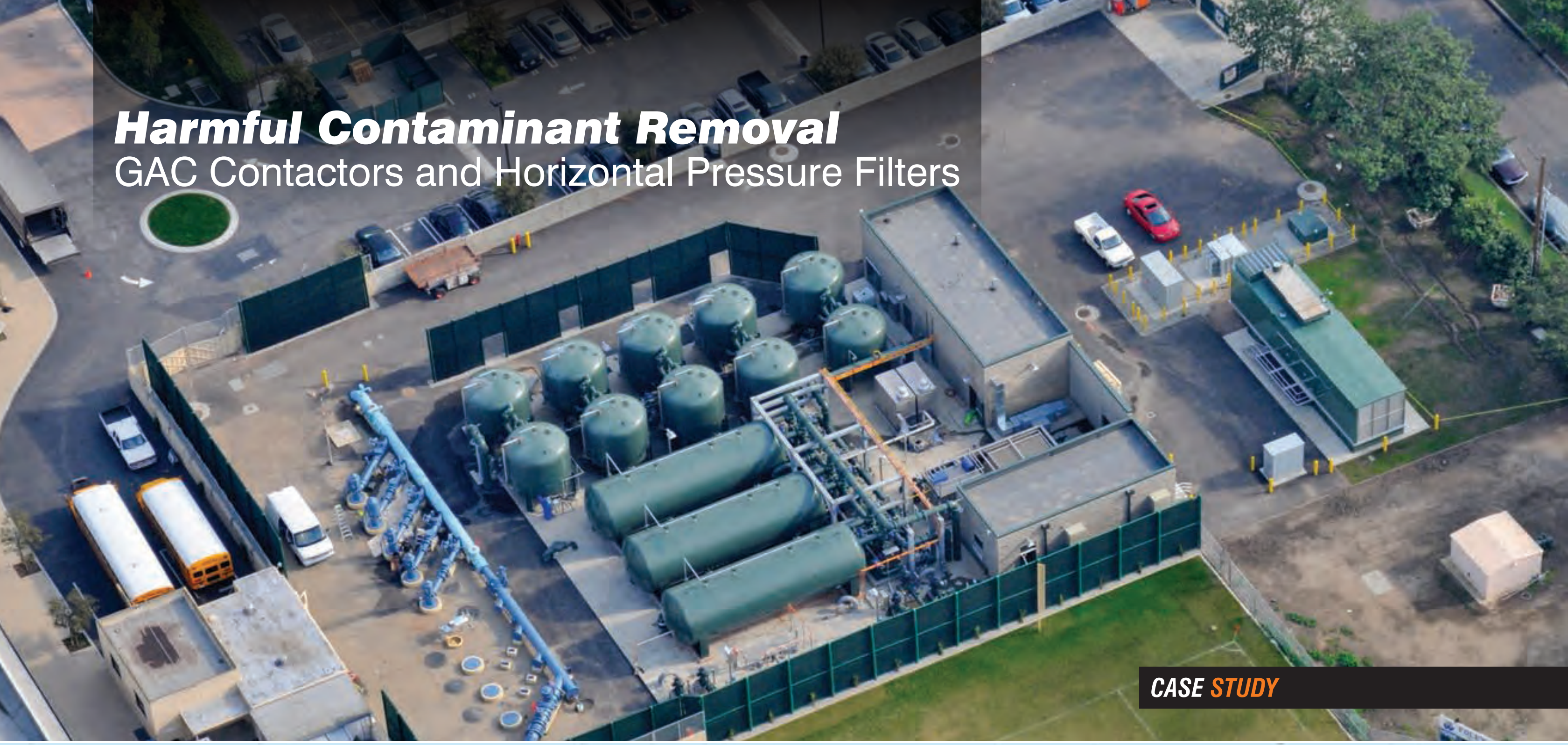
DVC1 – CAGE DRIVE
MODEL | SIZE | DVC1XX01 .25 x 4

3–93	DF	STB	MKD	NONE				
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

REVISION	BY	CHKD	DATE	LTR
CHANGED TO NEW STYLE DRIVE	DK		7–99	B
230/460 VOLTS WAS 360 VOLTS	RW	MDH	7–95	A

WESTECH | DRAWING NUMBER: DV805001 | PROJECT NUMBER: | REV.

SECTION FOUR – CASE STUDIES



Harmful Contaminant Removal
GAC Contactors and Horizontal Pressure Filters

CASE STUDY

Location: **Santa Monica, CA**
Owner: **City of Santa Monica**
Engineer: **Black & Veatch**
Contractor: **Black & Veatch Construction Inc.**

Expanding Service

The City of Santa Monica shut down the Charnock Well Field in 1996 after finding methyl tertiary-butyl ether (MTBE) and, later, trichloroethylene (TCE) and 1,1-Dichloroethene (1,1-DCE) in the water. These potential carcinogens spread rapidly through the environment, resulting in the shutdown of all five (5) Charnock wells. Approximately 50% of the city's residential water was supplied through these wells.

Removal of these contaminants is typically difficult and costly. As a result, the city purchased approximately 85% of its domestic water from the Metropolitan Water District. Following the goal of self-sustainability, and with the rising cost of purchasing water, the city opted to treat the polluted groundwater supply. Black and Veatch Contractors were hired to rehabilitate the Charnock wells through a design-build project.

Equipment Selection

To remove contaminants, WesTech supplied nine (9) horizontal pressure filters (12 ft diameter x 38 ft long) and ten (10) Granular Activated Carbon (GAC) contactor vessels (12 ft diameter). Each GAC vessel contains 20,000 lbs of Calgon Carbon coconut based activated carbon.

Horizontal Pressure Filter	
Quantity	9
Filter Area / unit	459 ft^2
Cells / unit	2
Design Filtration Rate	3.3 gpm/ft^2
Minimum Backwash Rate	11 gpm/ft^2
Backwash Flow	2,522 gpm/cell

WesTech's dual media horizontal pressure filters are an effective way to remove iron and manganese. If iron and manganese are not removed, GAC and reverse osmosis (RO) membranes will foul prematurely and require replacement. Greensand Plus™ media was installed in the pressure filters for the removal of dissolved manganese and to reduce contact times. The filter media depth was customized to match the water quality and remove the damaging contaminants.

Pressure Filter Media	
Anthracite Coal Media	
Depth	18 in
Effective Size	0.6-0.8 mm
Greensand Plus™ Media	
Depth	18 in
Effective Size	0.3-0.35 mm
Support Gravel Media	
Depth	12 in
Total Media Depth	***48 in***

Through a lead/lag configuration, GAC contactors were able to remove MTBE, TCE, and 1,1-DCE while providing redundancy. The lead/lag configuration consists of two vessels in series. After the GAC in the primary vessel needs replacement, flow is diverted to run through the secondary vessel first. By using the lead/lag configuration, WesTech has lengthened the usable life of the GAC.

GAC Contactors	
Design Flow per Train	750 gpm
Empty Bed Contact Time	6 min
Design Loading Rate	6.6 gpm/ft^2
Backwash Flow Rate	12 gpm/ft^2

Following the GAC contactors, water is sent to the Arcadia Water Treatment Plant where RO membrane softening is used to reduce the levels of hardness from 500 mg/L as $CaCO_3$ to 120 mg/L as $CaCO_3$. In addition, RO membranes act as a second barrier for MTBE removal.

Superior Service

As a result of extensive experience in pressure filter and contactor design, WesTech customized vessel quantity, diameter, and media type to remove harmful contaminants. One of the complexities of the Charnock Well Field project was fabricating and shipping a significant number of large diameter vessels while meeting strict project deadlines. WesTech's expertise in design, fabrication, and delivery scheduling allowed the project to run smoothly and be completed on time.

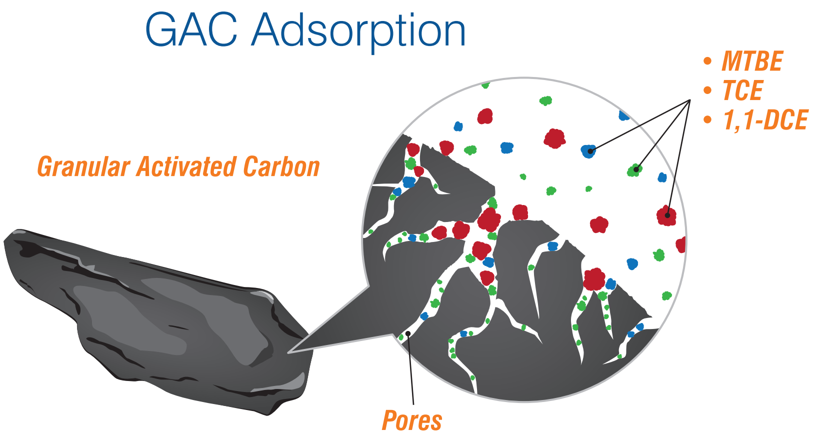
WesTech's dual media horizontal pressure filters and GAC contactors reduced high concentrations of contaminants to a non-detectable level. With the complete removal of these harmful contaminants in the Charnock well fields, the City of Santa Monica eliminated the need for imported water and has met the goal of self-sustainability.

Horizontal Pressure Filters at Bundy Well Site

Contaminant	Maximum Allowed Contaminant Level (µg/L)	Contaminant Level Prior to Treatment (µg/L)	Contaminant Level After Treatment (µg/L)
MTBE	5.0	610.0	Non-Detect
TCE	2.5	35.0	Non-Detect
1,1-DCE	3.0	12.0	Non-Detect

Vertical Pressure Filters at Westminster Well Site

Granular Activated Carbon: *Commonly used for adsorption applications, e.g., taste, odor, TOC, SOC removal.*



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WesTech INSTALLATION REPORT

Pressure Filters for Arsenic Removal

Location: Fallon, Nevada
Fallon WTP

Owner: City of Fallon

Engineer: Shepard Miller Inc.
Fort Collins, Colorado

Contractor: Western Summit Constructors, Inc.
Carlsbad, California

Reducing groundwater arsenic concentrations from 110 μg/L to less than 10 μg/L.

Located 60 miles east of Reno, the thriving farming community of Fallon Nevada was once described as being on a "Mount Everest of an arsenic problem". Several wells in the area draw water from an underlying basaltic aquifer that is high in naturally occurring arsenic. These wells, which supply drinking water to the City of Fallon and neighboring Fallon Naval Air Station, have arsenate concentrations as high as 110 μg/L.

In 2000, the City began pilot testing arsenic removal technologies, including ion exchange and enhanced coagulation followed by different filtration technologies. Based on the results of this study, enhanced coagulation followed by granular media filtration proved to be the most cost effective treatment for this source water. In 2002, construction began on a new $17 million ground water treatment plant.

This 10 MGD treatment plant utilizes enhanced coagulation followed by WesTech granular media pressure filters, to reduce treated water arsenic concentrations to less than the current MCL of 10 μg/L. The plant achieves this by reducing the pH of the raw water to 6.8 pH units using sulfuric acid, and then adding approximately 12 to 14 mg/L ferric sulfate. The water is filtered through sixteen, deep bed, vertical pressure filters, the pH is elevated with hydrated lime and is subsequently chlorinated and fed into the distribution system.

12' dia Vertical Pressure Filter

The sixteen (16) WesTech supplied vertical pressure filters are 12'0" dia x 15'-7" high and have 18" of 1.2 mm anthracite, 12" of 0.55 mm silica sand, and 6" of 0.22 mm garnet. The pressure filters are designed to automatically backwash based on headloss or time, but are currently preemptively backwashed manually once per day.

Sixteen Vertical Pressure Filters

Backwash wastewater is collected in a backwash waste equalization tank and then fed into two (2) WesTech IPS\\\™ high-rate inclined plate clarifiers. Supernatant from the clarifiers is fed back to the front of the plant and underflow is fed onto a filter press once per day. Dry solids are landfilled and filter press filtrate is sewered. This backwash recovery system allows the plant to be greater than 99% efficient.

Dry Ferric Sulfate Sludge

The Fallon Water Treatment Plant is greater than 99% efficient in terms of water recovery.

IPS\\\™, Backwash Recovery Clarifier

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an employee owned company

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Removing Arsenic to Non-Detect

Vertical Pressure Filters

Location: **Ione, Washington**
Owner: **City of Ione**
Engineer: **Esvelt Environmental Engineering**
Contractor: **TML Construction**

The Chippewa Water and Sewer District provides water distribution and sewer collection for the City of Ione, Washington. Raw water for the drinking water distribution system is supplied through two (2) production wells and is treated with chlorination.

This water complied with all primary drinking water standards but continually fell short of the EPA's secondary drinking water standards for iron and manganese. Seasonal peaks of iron and manganese clogged pipes and frequently produced aesthetic and odor issues, resulting in customer complaints.

In addition to iron and manganese, moderate levels of arsenic were also in the water. In 2003, Ione began planning for a new treatment plant to be in compliance with the anticipated requirement to increase arsenic removal. In 2006, EPA regulations for arsenic levels were reduced from 50 μg/L to 10 μg/L, compounding compliance issues.

Water Quality

	MCL	Well 1 Raw Water	Well 2 Raw Water
Iron	0.3 mg/L	0.63 mg/L	0.06 mg/L
Manganese	0.05 mg/L	0.32 mg/L	0.46 mg/L
Arsenic	10 μg/L	15-25 μg/L	15-25 μg/L

Equipment Selection

A comprehensive pilot study was completed to determine the best treatment method to remove arsenic, iron, and manganese. After comparing pressure filters to cartridge filters, bag filters, and other filtration methods, the engineer, in conjunction with the town council, selected a granular media pressure filtration system as the best available technology.

Vertical Pressure Filters

Quantity	3 filters
Size	10 ft diameter
Area per Filter	78.5 ft^2
Total Filtration Rate	3 gpm/ft^2
Backwash Flow Rate	9 gpm/ft^2

In 2008, WesTech was selected to provide three (3) 50% capacity vertical pressure filters, a complete chemical feed system, and a PLC control system.

WesTech's granular media vertical pressure filters effectively remove iron, manganese, and arsenic to meet primary and secondary standards. Individual, parallel operating vessels satisfy redundancy requirements and offer a design that is easily expanded to meet future needs.

To remove these contaminants most efficiently, WesTech customized the depth and type of granular media. The customized design allows Ione to improve water quality while keeping costs low.

Pressure Filter Media

Anthracite Coal Media	
Depth	18 in
Effective Size	0.6-0.8 mm
Greensand Plus™ Media	
Depth	18 in
Effective Size	0.3-0.35 mm
Support Gravel Media	
Depth	16 in
Total Media Depth	52 in

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Due to the levels of naturally occurring iron, both the iron and arsenic coprecipitate without the addition of an iron-based coagulant such as ferric chloride or ferric sulfate.

The plant was designed so that water can be pumped directly from the well, through the pressure filters, and have enough residual pressure to lift the treated water to the elevated storage tank. By doing this, repumping was not required after treatment.

Treated Water Quality	
Iron	0.15 mg/L
Manganese	0.01 mg/L
Arsenic	Non-Detect

Customer Satisfaction

Plant operators are impressed with the ease of operation provided by the WesTech PLC controls. Automatic backwashes can be controlled and plant adjustments made from the central control computer. Chris Chaney, the chief operator, said, "It's a complex plant, but the way WesTech's PLC is programed, it requires very little operator intervention."

Low maintenance and operator friendly features were important aspects of the treatment system selection since Chaney has many other responsibilities in addition to maintaining the treatment plant. Operators and residents alike were impressed with the inexpensive operation costs and the "perfect water" that was produced.

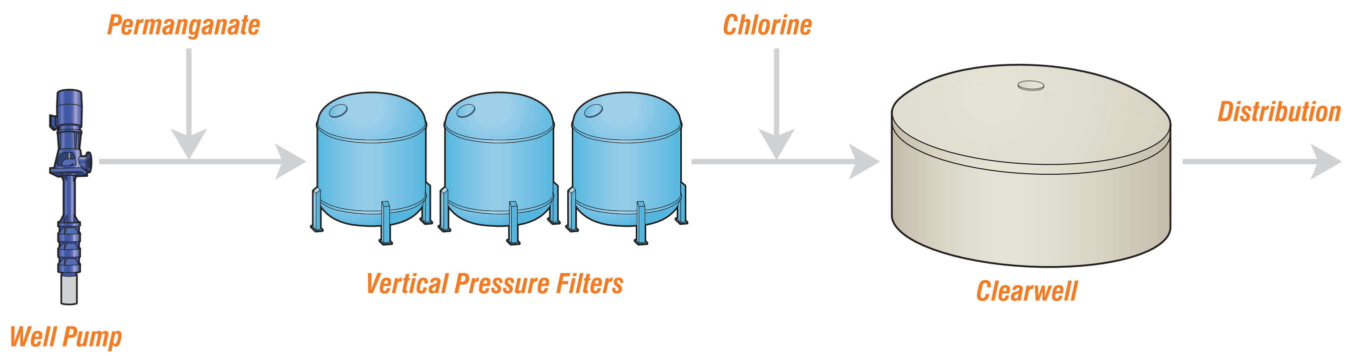
Before the new system was installed, the majority of homes used cartridge filters to reduce the negative aesthetic effects of the iron and manganese. Residents of Ione are pleased with the quality of water produced from the new treatment plant. They no longer need to worry about clogged pipes or brown laundry.

Since the installation of WesTech's pressure filters, maintenance and residents' individual treatment costs have been greatly reduced.

Pressure Vessels

Chris Chaney, Chief Plant Operator

Treatment Plant Flow Diagram



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Zero Liquid Discharge

Fill and Decant Backwash Clarifiers

Location: **Jamieson Canyon, Napa, California**
Owner: **City of Napa**
Engineer: **Kennedy/Jenks Consultants**
Contractor: **Overaa Construction**

Facility Upgrades

The Edward I. Barwick Jamieson Canyon Water Treatement Plant located in the City of Napa, California, treats water for domestic and winery use. With growing populations and an ageing plant, Napa needed to upgrade their treatment facility. The current system employs coagulation, flocculation, clarification, filtration, lagoons, and drying beds.

Napa is classified as a zero liquid discharge site. Due to this classification, no spent water can be released from the site, requiring onsite thickening and solar evaporation. To reduce the amount of water evaporating, increase capacity, and go green, the city decided to treat their backwash water. In 2009 Napa upgraded their water treatment plant and increased capacity from 14 MGD to 21 MGD.

Spent water from backwashes and clarifiers is typically between 16 – 21 times more concentrated with giardia and cryptosporidium than raw water. To ensure removal of these harmful contaminants, California State Law (under the Filter Backwash Recycling Rule) regulates spent filter backwash water quality. Backwash water used in filtration and clarifier underflow is treated to < 2 NTU and is pumped to the flocculators at the front of the plant.

Treatment Objectives

Treated Wastewater Return Flow	Up to 10% Total Plant Flow
Turbidity	< 2 NTU

When simple treatment technologies do not reduce turbidity below 2 NTU, spent water may be treated to match the raw influent quality. To prevent overloading the plant, up to 10% of total plant flow can be returned for recycling. With the current water demand, Napa sends 8% of their treated wash water to the front of their plant for reuse.

While many spent filter backwash water treatment technologies are available, the City of Napa decided to treat through thickening and clarification due to cost and required maintenance. To reduce the footprint, Napa explored the option of having a single basin for both thickening and clarification.
WesTech performed a series of laboratory tests on a backwash water sample in order to optimize the size of the basin, allowing for thickening and clarification to occur in the same basin.

Equipment Selection

Following the study, WesTech was contracted to supply two (2) 60 ft diameter Fill and Decant Backwash Clarifiers. The water depth in the clarifiers ranges from 8 ft to 29.5 ft depending on the backwash flow. The unique floating decant mechanism rises and falls with the water level as backwash volume changes. As backwash flow is not constant, but rather short surges of high flow, equalization is required prior to treatment.

Fill and Decant Clarifier

Quantity	2
Size	60 ft diameter
Solids Loading Rate	40 lbs/day/ft^2
Solids	**Peak:** 10,000 lbs/day **Avg:** 6,000 lbs/day
Total Working Volume	1.7 MGD

WesTech's Fill and Decant Clarifiers are an effective way to combine equalization and treatment of spent filter backwash in the same basin. The clarifier basin is designed with enough capacity to accom-

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modate the backwash surge volume, thus eliminating the need for separate equalization. After the backwash water fills the basin, the solids are allowed to settle and then the clarified supernatant is evenly drawn off by the floating decanter.

Water Quality		
Influent		
	Full Scale Operation	Bench Scale Study
Turbidity	65-90 NTU	79.3 NTU
Supernatant		
	Full Scale Operation	Bench Scale Study
Polymer Dose	0.0 mg/L	0.4 mg/L
Turbidity	< 2 NTU	0.7 NTU
Underflow Concentration		
	Full Scale Operation	Bench Scale Study
% Solids	3%	1.9%

Intelligent Solutions

Because of the effectiveness of the Fill and Decant Clarifier, California State requirements were met without the addition of a polymer into the clarifier. WesTech's research has shown that with the addition of a polymer, turbidity can be decreased to < 0.7 NTU. The chief operator, Paul Prewitt, said that they are "very happy with equipment and process" WesTech provided and water quality exceeds their expectations.

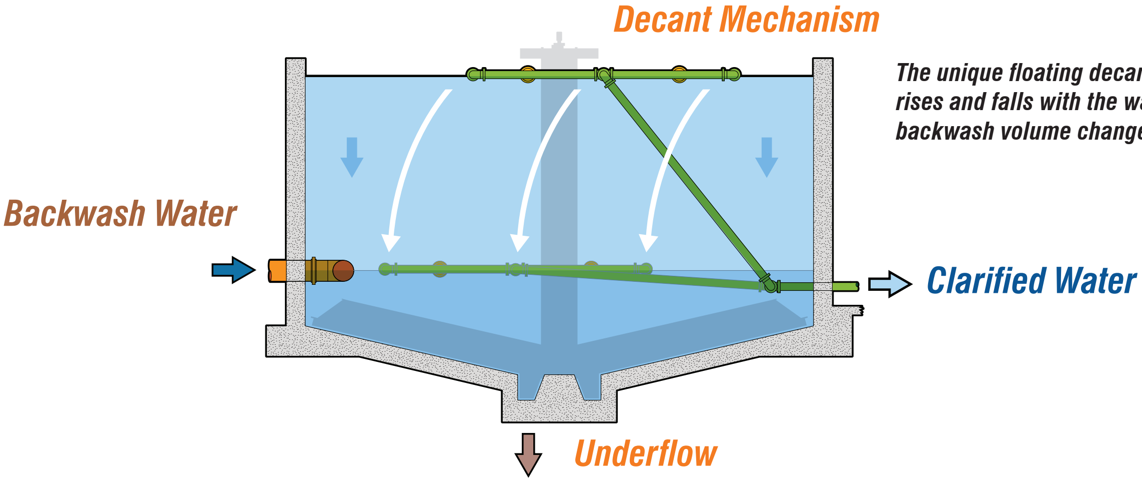
With the zero liquid discharge requirement, Napa treats the majority of its water with the Fill and Decant Clarifier to thicken solids and reclaim water. After the clarifier, water is sent to lagoons and the sludge is thickened in drying beds. With the new system, up to 98% of all water going through the plant is reclaimed and drying times have been reduced.

With the new WesTech equipment, the city's water reuse goals have been met and operations and maintenance have been simplified. "Operators that have been there for a number of years are very happy with this simplified system" said Prewitt. Things are "running smoothly and require only minor attention."

Fill and Decant Clarifier

Decant Mechanism

Decanter Operation



The unique floating decant mechanism rises and falls with the water level as backwash volume changes.

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Pilot Plant Study

Silver Eagle Refinery

BACKGROUND

North Salt Lake and West Bountiful are home to several large oil refineries. These large plants have several smoke stacks, open burning flares, and round storage tanks. Speeding by on the highway, people probably imagine that these industrial companies are shamelessly polluting our environment. To the contrary, Silver Eagle Refinery proactively worked with the South Davis Sewer District and WesTech Engineering, to find a treatment solution for the environmental pollutants that are generated at their facility.

BTEX

During the production of gasoline products, oil refineries generate a waste stream that contains petroleum by-products such as BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes). These volatile, monoaromatic hydrocarbons can be toxic to receiving streams with different populations of organisms. Until recently, Silver Eagle had discharged these harmful compounds to the South Davis Sewer District North Plant. At this wastewater plant, a trickling filter treatment process had been degrading these compounds biologically. But high levels of BTEX can upset the biological process and cause problems for a wastewater treatment plant. Silver Eagle Refinery and the South Davis Sewer District wanted to explore different methods of treating the BTEX before the wastewater plant would receive it.

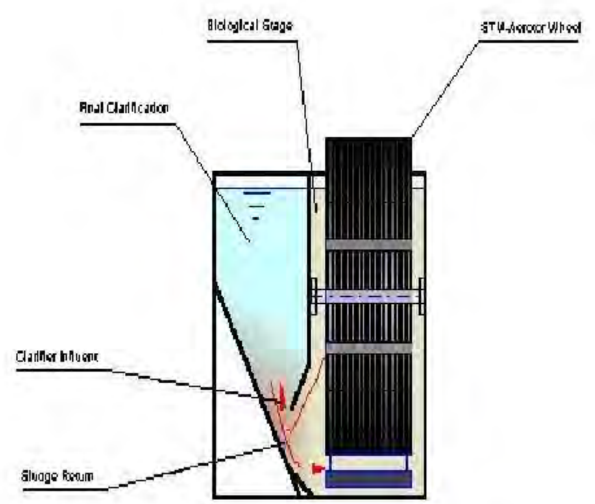
PRE-TREATMENT

To prevent any upsets at the wastewater plant, the South Davis Sewer District needed to limit the Silver Eagle Refinery discharge of BTEX to 5 ppm. As the treatment plant had proved, specific organisms could be employed to biologically remove BTEX . With these tighter restrictions, this refinery started to evaluate a pre-treatment program for their waste. Silver Eagle joined with local process company, WesTech Engineering, to conduct a pilot study. The goal was to find an efficient biological system that would significantly reduce their BTEX discharge in order to meet the limits required by South Davis.

Pilot Plant Study

Silver Eagle Refinery

PILOT PLANT EQUIPMENT



WesTech recommended their compact STM-Aerotor® Pilot Unit. It consists of a 10 foot long, 6 foot wide, and 8 foot tall container unit including a biological stage and an integral settling clarifier. The two-stage tank has an inlet feed into the biological stage, an effluent pipe in the clarification stage, and a drain used for wasting sludge. A baffle wall separates these two areas as seen in this picture. The STM-Aerotor® wheel contains several rows of unique plastic media, a strong structural cage, center shaft, roller chain, and a low HP drive unit. The plastic media has two main functions. First, the plastic media has a hollow interior, which captures atmospheric air, draws it down into the mixed liquor, and releases it for aeration. Second, the media provides a large surface area for the growth of fixed film organisms. The steel cage supports the rows of plastic media. Submerged up to 80%, the STM-Aerotor® wheel relies on a buoyant force to support a portion of its weight. The drive rotates the wheel with a single 1 HP motor via a steel roller chain. These components make the STM-Aerotor® a compact treatment unit.

PROCESS OBJECTIVE

The Silver Eagle Refinery needed to meet the 5 ppm BTEX limit on their discharge without building a large treatment facility that requires extensive operations and maintenance. Currently, the refinery has a holding tank that discharges a BTEX waste stream that varies from 60 to 15 ppm. WesTech provided the STM-Aerotor® pilot plant to receive a small portion of this waste stream to determine if this technology would effectively treat the BTEX. The chart below provides a summary of the influent and effluent characteristics for the pilot plant.

Pilot Plant Study

Silver Eagle Refinery

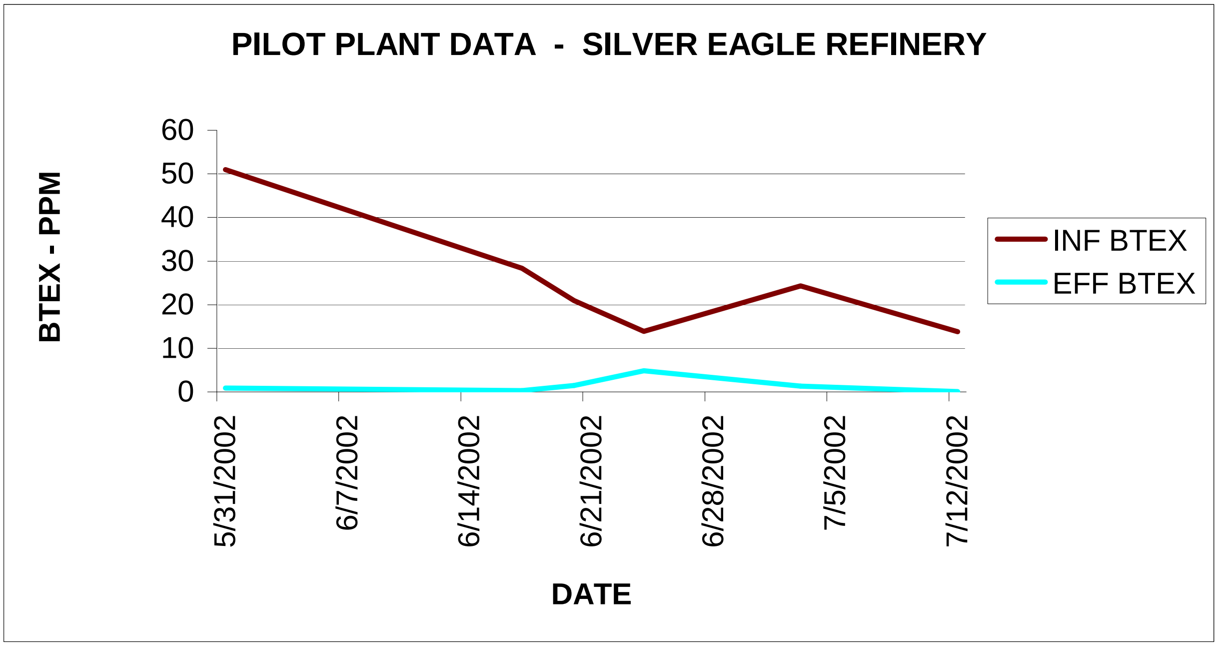


FIGURE 1. Pilot plant performance data

RESULTS

The effluent data shows that the STM-Aerotor® successfully met the 5 ppm limit. The organisms in the pilot plant tank successfully oxidized the influent BTEX. Throughout this study, the influent BTEX varied considerably, but the effluent BTEX remained around 1 ppm. During a stress test, the pilot unit received flow rates well above its design. Even during these high flows, the pilot plant removed the BTEX below the 5 ppm limit.

CURRENT STATUS

After this pilot test, the Silver Eagle Refinery decided to install a full-scale STM-Aerotor® plant to treat their effluent. The full-scale plant has been operational since January 31, 2003. Currently, Silver Eagle has operated the STM-Aerotor plant without a settling clarifier. Therefore, the treatment mainly comes from the fixed film organisms instead of a suspended growth population of organisms. In the future, Silver Eagle plans to add a settling clarifier so that a portion of the suspended growth organisms can be recycled from the clarifier back to the STM-Aerotor basin. The South Davis Sewer District has been sampling the effluent of the new pre-treatment plant. So far, Lyndon Tan of South Davis reports that the Silver Eagle Refinery has met the 5 ppm limit during every test. The Silver Eagle Refinery Operations Manager, Gil Higham, enjoys the ease of operation and lack of extensive maintenance. When asked about the routine maintenance, Gil reported that they clean the dissolved oxygen probe once per week because of the biological growth in the basin.

Harmful Contaminants, Innovative Solution

GAC Contactors

CASE STUDY

Location: **Magna, Utah**

Owner: **Magna Water District**

Engineer: **Carollo Engineers**

Contractor: **Alder Construction**

Perchlorate Contamination

The Magna Water District provides drinking water and wastewater treatment for the City of Magna, Utah. Drinking water was drawn from wells where dissolved solids, minerals and salts, and naturally occurring arsenic were persistent problems.

During routine testing in 1997, trace elements of perchlorate were found in one well at the Barton Wellfield. A plume from the defense industry had contaminated the groundwater with perchlorate. Because of the rapid moving nature of plumes, the entire Barton Wellfield was shut down for fear of further contamination.

Naturally occurring arsenic levels at the Barton Well Field were between 8 and 18 μg/L. In 2001, the EPA adopted a new arsenic standard of 10μg/L, replacing the old standard of 50 μg/L, and requiring compliance by January, 2006. While the EPA had not made a final regulatory determination by setting a maximum contaminant level (MCL) for perchlorate, the Magna Water District took a proactive approach and began looking for a solution for perchlorate remediation that could also provide arsenic removal (the EPA most recently declared an interim health advisory of 15 μg/L in January 2009).

A series of studies were conducted over the course of the next several years to evaluate processes for simultaneous arsenic and perchlorate removal. Following the studies, the engineer concluded that electrodialysis reversal (EDR) was the most cost effective contaminant removal system. Typically EDR systems are used for desalination and to remove charged particles (lead, copper, chromium, and nitrates). Magna installed the first EDR for arsenic and perchlorate removal.

Equipment Selection

After the removal of perchlorate and other contaminants from the drinking water, the concentrated waste stream required disposal. If perchlorate is not destroyed, it will continue to pollute the environment and drinking water supplies. Magna, in conjunction with Carollo Engineers, developed a biological process to destroy perchlorate. The concentrated reject stream from the EDR was combined at a 1.5:1 ratio with screened wastewater and allowed to react anaerobically. Vertical pressure filters were the best treatment housing equipment option to provide this anaerobic reaction. In 2007, WesTech was contracted to supply six (6) 12 ft diameter x 9.5 ft high vertical pressure vessels for digestion.

GAC Contactors	
Quantity	6
Size	12 ft diameter
Area per Filter	113 ft²
Design Flow	2604 gpm
Filtration Rate	**Nominal:** 3.34 gpm/ft² (377 gpm) **Maximum:** 4.6 gpm/ft² (520 gpm)
Backwash Flow Rate	26 gpm/ft² (2940 gpm)
Empty Bed Contact Time	7.3 min

WesTech's vertical pressure filters were filled with 54 inches of granular activated carbon (GAC) media. Because of the media depth, the underdrain design needed to be modified for the system. The unique header and lateral underdrain design developed by WesTech, in collaboration with Carollo, ensured uniform distribution of flow in the vessels. With WesTech's extensive experience in designing and constructing pressure filters, the large

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EDR Contaminant Removal

Contaminant	MCL	Feed Water	Filtered Water
Perchlorate (2 Step Process)	10 µg/L (treatment goal)	10-25 µg/L	< 4 µg/L
Perchlorate (4 Step Process)	10 µg/L (treatment goal)	50-60 µg/L	< 4 µg/L
Arsenic	10 µg/L	8-18 µg/L	**Range:** Non-Detect-7.3 µg/L **Avg:** 1.6 µg/L
TDS	2000 mg/L	770-1350 mg/L	**Range:** 10-390 mg/L **Avg:** 231 mg/L
Silica	Unregulated	11.7 mg/L	11.5 mg/L

diameter vessels and media depth were customized to match the water quality and remove perchlorate.

Biological Perchlorate Removal

	BIOBROx®	Alternate Biological Processes
Contact Time	10 min	6-24 hrs

Due to its porous nature, GAC was an optimal growth media where the wastewater developed a biofilm around the media. When perchlorate-contaminated water passed over the media, the oxygen-starved bacteria consumed the oxygen in the perchlorate, breaking the O-Cl bonds and destroying the perchlorate.

The biodestruction of blended residual oxidants (BIOBROx®) process provided sustained perchlorate and arsenic removal below detection with much shorter detention times than traditional methods.

In addition, BIOBROx® is lower in cost due to lack of aeration requirement and the fact that it is contained within a smaller footprint than traditional biological processes.

Customer Satisfaction

As perchlorate is difficult and costly to track, nitrate levels are routinely monitored. In a pilot study completed before plant operation began, when nitrate levels were below 0.05 mg/L, perchlorate levels were non-detectable.

The Magna Water District has received recognition for its forward thinking and role in advancing water treatment technology. By destroying perchlorate, Magna created an environmentally friendly treatment process. In a letter to the water district, Senator Orrin Hatch said, "It is exciting to know that the project continues to be an efficient and cost effective solution to the problem."

GAC Contactors for Arsenic and Perchlorate Removal

Installation of Vertical Pressure Filters for BIOBROx® Process

Magna Water Treatment Plant in Operation

"The simultaneous removal of arsenic, perchlorate, and TDS by EDR, followed by the bio-destruction of perchlorate in the concentrate represents a unique approach to a complex water quality problem."

AWWA and Cummings, Michelle et. al June 2007

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STP Cheese Production Plant

Valliéres

The STP Cheese Plant in Valliéres, France produces approximately 11,000 Emmentaler cheeses per year. This involves processing 2,900,000 gallons of milk per year, with 11,000 gallons per day in the peak season.

Wastewater from the cheesemaking operation, amounting to approx. 29,000 gal/day, is treated in a small onsite treatment plant. The plant includes a small screen, a 32,000 gal. pre-aerated buffer tank, a small upflow final clarifier, recycle pumps, and a small sludge thickener. Biological treatment is accomplished using the STM-Aerotor™ process, with two model STM-P units, 4.3m dia. x 5m long.

Wastewater Characteristics		**Effluent Characteristics**	
BOD_5:	2600-4300 mg/L	BOD_5:	$\leq$ 14 mg/L
COD:	4200-6000 mg/L	COD:	$\leq$ 107 mg/L
Susp. Solids	900 mg/L	Susp. Solids	$\leq$ 22 mg/L
TKN:	77 mg/L	TKN:	$\leq$ 6.2 mg/L
Total Phosphorus:	15.5 mg/L	Total Phosphorus:	$\leq$ 4.1mg/L

Sludge		**Energy Consumption**	
Concentration (after thickening)	2%	Total Plant:	approx. 200 kWh/day
Waste Sludge production	250 - 300 gal/d	Or 18.2 watts per gallon of milk processed	

Removal of Iron and Manganese

Horizontal Pressure Filters using TechnaGreen™ Media

CASE STUDY

Location: **Belvue, Kansas**
Owner: **Rural Water District No. 4**
Engineer: **Bartlett & West, Inc.**
Contractor: **Walters Morgan Construction**

A Need for Cost Savings

Pottawatomie County Water Treatment Plant provides drinking water for Kansas Rural Water District No. 4. Two (2) wells supply the majority of the county's water.

To meet the secondary MCL for iron and manganese, Pottawatomie used cartridge filters followed by reverse osmosis (RO) for softening. Because of influent water quality, the cartridge filters needed to be replaced every other day, resulting in large operating costs and demanding significant operator attention.

The treatment plant was falling short of the secondary standards and set a goal of 0.05 mg/L for both iron and manganese.

Equipment Selection

In order to meet this standard, the engineer decided that a granular media filtration system would more efficiently serve the residents of Pottawatomie County and reduce maintenance hassles. Compared to cartridge filters, granular media filters resulted in better water quality, lower operating costs, and reduced fouling of the RO membrane.

In 2011, Pottawatomie installed one (1) WesTech Horizontal Pressure Filter with TechnaGreen™ media to remove iron and manganese. TechnaGreen™ media catalytically removes soluble manganese and particulate iron from water in the exact same manner as manganese greensand.

At start up, WesTech conditions its iron and manganese removal media with the TechnaGreen™ process after it has been placed in the filter. This conditioning consists of soaking the media for 24 hours in a solution of potassium permanganate and manganese sulfate. The media is then continuously fed with an oxidant to provide permanent regeneration. In a pilot study completed at the Pottawatomie Water Treatment Facility, TechnaGreen™ was proven to be as effective and efficient as the leading manufactured manganese greensand, Greensand Plus™. This efficiency can be seen in comparable effluent qualities between TechnaGreen™ and Greensand Plus™, when supplied with similar influent water qualities.

Water Quality

	Secondary MCL	Treatment Objective	Well 1 Raw Water	Well 2 Raw Water
Iron	0.3 mg/L	0.05 mg/L	0.32 mg/L	0.62 mg/L
Manganese	0.05 mg/L	0.05 mg/L	0.04 mg/L	0.05 mg/L

Pilot Study

	TechnaGreen™	Greensand Plus™
Hydraulic Loading Rate	6 gpm	6 gpm
Backwash	8 gpm 9 min	4 gpm 17 min
Total Backwash Volume	72 gallons	68 gallons
Media Size	0.45-0.55 mm	0.3 - 0.35 mm
Iron Influent	0.620 mg/L	0.620 mg/L
Iron Effluent	0.080 mg/L	0.092 mg/L
Manganese Influent	0.0534 mg/L	0.0534 mg/L
Manganese Effluent	0.006 mg/L	0.010 mg/L

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Customer Satisfaction

Pressure filters with TechnaGreen™ produce high quality water at a fraction of the media cost. TechnaGreen™ media is conditioned on site, which means costs solely include granular media and chemical treatment. TechnaGreen™ has many other advantages over Greensand Plus™, including: media sizes can be matched to water quality, media is easily recoated in place if needed, and materials are readily available.

Because of the ability to treat various grain sizes, WesTech is able to customize the media size to meet multiple hydraulic loading and backwash rates. With this versatility, media is less likely to wash out or migrate into supporting gravel layers.

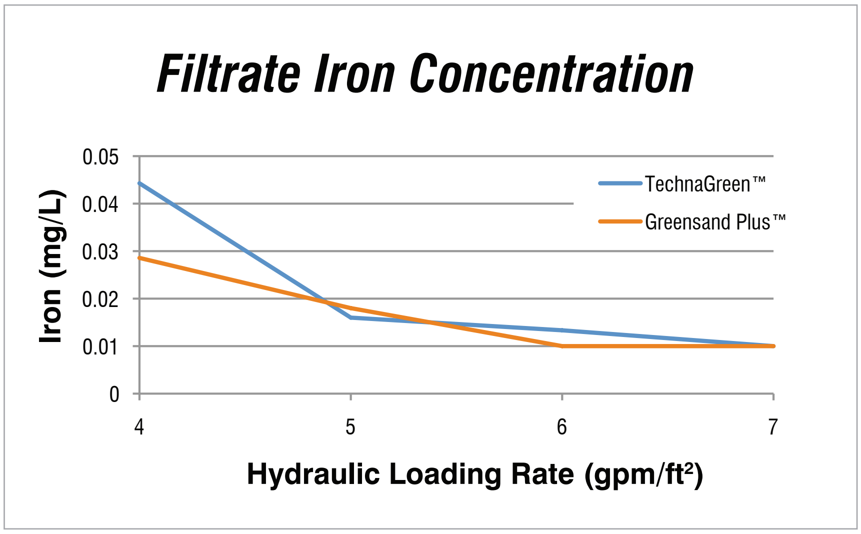
By replacing inefficient cartridge filters with a horizontal pressure filter, Pottawatomie County saved money and has reduced operator hassle. To increase money savings even further, TechnaGreen™ filter media was used. Capital costs of this media are initially lower. Additional savings are also seen as media requires replacement.

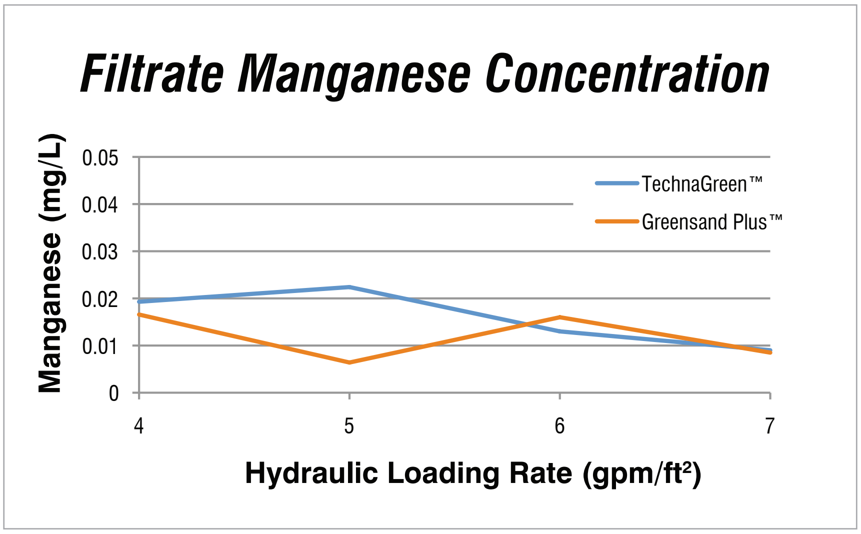
TechnaGreen™ has been proven to produce high quality water and provide significant savings over the life of the plant.

Fully Automated Horizontal Pressure Filter

Filter Media Comparison

	TechnaGreen™	Greensand Plus™	Naturally Occurring Greensand
Price	$10/ft³	$66/ft³	$85/ft³
Effective Size	Variable	0.3-0.35 mm	0.3-0.35 mm
Availability	Non-Proprietary	Proprietary	Proprietary
Expected Media Life	Restorable Coating	Restorable Coating	4-8 years





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Landfill Leachate Treatment

Hengelo, Netherlands

The sanitary landfill in Hengelo produces a maximum of 76,000 gallons per day of leachate. In order to allow the leachate to be discharged to the local municipality, the elevated levels of BOD and ammonia would need to be significantly decreased. In 1995, the City of Hengelo conducted a pilot study of the STM-Aerotor^{TM} process in efforts to find a process that would reduce the leachate concentration to acceptable levels.

The pilot study was conducted over an eight month period. The average influent and removal efficiencies of the pilot study were:

	COD (mg/l)	NH4-N (mg/l)	TKN (mg/l)
Influent	3,578	1,131	1,472
Removal	67%	96.1%	92.3%

The pilot study results produced treatment levels greater than expected and shortly after, a full STM-Aerotor process was purchased to treat the leachate.

The Helgelo, Netherlands plant is equipped with six model STM46B STM-Aerotor units installed in three adjacent basins. The process has a total basin volume of 317,000 gallons with a 15 ft side water depth. The modular design of the process allows for common wall construction, saving in land area and capital costs.

Scouting for Clean Water in a Remote Location

CASE STUDY

Location: **Camp Steiner, Utah**
Owner: **Boy Scouts of America**

Seasonal Water Treatment

Located at 10,000 ft above sea level, Camp Steiner in the high Uintah Mountains of Utah is home to the highest Boy Scout camp in the United States. For water treatment, the Great Salt Lake Council (GSLC) of the Boy Scouts of America used 0.5 and 3.0 μm bag and cartridge filtration. After every 300 to 400 gallons of treatment, fouling would cause the bag filters to blind off. This cost the GSLC $60,000 each summer in bag filter replacements, in addition to the considerable labor required to operate and maintain the system.

Through a comprehensive study, an ultrafiltration membrane system was determined to be the best option to replace the bag and cartridge system. Membrane filtration was an ideal solution for Camp Steiner due to its small footprint, low cost, and ease of operation.

Equipment Selection

WesTech worked directly with the GSLC to provide one (1) AltaPac™ AP-II for Camp Steiner in July 2008. The AltaPac AP-II is designed as an economical membrane treatment system that is both easy to use and simple to install. The fully functional, self-contained skids allow for an all-inclusive treatment system within a small footprint.

WesTech's AltaPac AP-II Ultrafiltration Membranes as provided by Polymem, have a pore size of 0.01μm, providing the highest level of pathogen and particulate matter removal available for low pressure membrane filters. The AltaPac also consistently produces the highest possible quality filtrate, with greater than 6 log removal of bacteria, Cryptosporidium and Giardia.

AltaPac™ Ultrafiltration Modules

AltaPac™ Membrane Filtration	
Number of Membrane Modules	2
Module Filtration Area	1,227 ft^2
System Filtration Area	2,454 ft^2
Normalized Design Flux	27 GFD
Net Permeate Flow	30 gpm
Backwash Frequency	90 min
Recovery	>90%

Throughout the summer, the system treated water from both Scout Lake and a nearby spring with raw water turbidities up to 5 NTU. Filtrate averaged 0.02 NTU and the ultrafiltration membrane removed all coliforms that were present in the raw water. It also reduced the heterotrophic plate count from 470 CFU/mL to the detection limit of 0 CFU/mL.

From the filtered water tank of the AltaPac, a submersible transfer pump was used to pump the water to a 16,000 gallon storage tank. The system demonstrated a permeate production rate of 30 to 70 gpm, was backwashed every 90 minutes, and did not require a chemical clean throughout the summer.

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Water Quality

	Raw Water	Filtrate
Turbidity	**Max:** 5 NTU **Avg:** 2.1 NTU	**Max:** 0.04 NTU **Avg:** 0.02 NTU
Total Coliform (Organisms/100 mL)	Present	Absent
Heterotropic Plate Count	470 CFU/mL	0 CFU/mL

To accommodate, WesTech modified a short flatbed trailer to provide the extra clearance and heavy duty load capacity needed for transport to the camp. As there was not an existing building on site, the AltaPac remains on the trailer for the summer with a tent for protection from the elements.

Fully Automated System

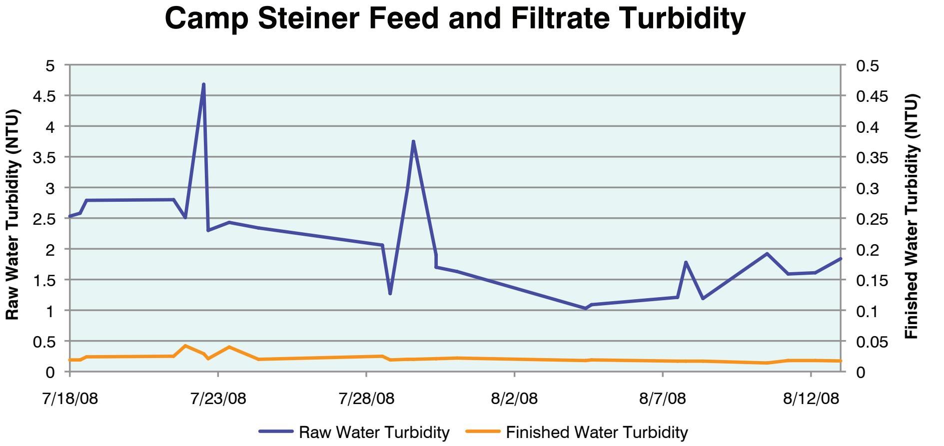
Customer Satisfaction

Scott Bradbury, the plant operator, commented, "With its easy installation and automatic operation, the WesTech AltaPac™ AP-II was the perfect choice to replace our bag and cartridge filtration system at our remote camping area. It improved the water quality and we saved over $60,000 in filter replacements in the first year".

Because of the remote location, special considerations had to be made for transportation and operation of the AltaPac. The unmaintained dirt road leading to Camp Steiner is full of switchbacks, ruts, and rocks making standard shipping difficult.

WesTech provides a service and maintenance contract with the GSLC to transport the AltaPac to Camp Steiner at the beginning of each summer and perform start-up and operation services. At the end of the camp season, WesTech transports the unit back to the manufacturing facilities in Salt Lake City, performs a chemical clean and any system maintenance, and stores the unit for the winter season. With unmatched customer service, WesTech provided Camp Steiner with a high quality, worry free system.

Compact Footprint AltaPac™ Trailer Installation



"*The Altapac* improved the water quality and we saved over $60,000 in filter replacements in the first year"

- Scott Bradbury
Plant Operator

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Keeping P Out of the Nashua

SuperDisc™ Pilot Filtration System

CASE STUDY

Location: **Clinton, Massachusetts**
Owner: **Massachusetts Water Resources Authority**
Engineer: **Fay, Spofford, & Thorndike**
Pilot Testing Period: **Mar 28 - Apr 29, 2011**

New Treatment Goals

The Clinton Wastewater Treatment Plant provides advanced wastewater treatment, including nutrient removal, for the towns of Clinton and Lancaster, Massachusetts. With an average daily flow of 3 MGD, Clinton removes phosphorus through a conventional activated sludge system followed by chemical coagulation. Discharged phosphorus can reduce oxygen levels in water bodies as a result of eutrophication. It can also decrease aquatic life.

The current regulation for the Clinton Wastewater Treatment Plant states that 1.0 mg/L of total phosphorous (TP) can be discharged into the Nashua River. The Massachusetts Department of Environmental Protection released a draft National Pollutant Discharge Elimination System (NPDES) permit stipulating phosphorus regulation changes beginning in 2014. The permit requires that the facility discharge less than 0.15 mg/L of TP from April through October, and less than 1.0 mg/L between November and March. For a safety margin and to improve environmental quality, Clinton set a treatment goal of < 0.1 mg/L phosphorus year-round.

Phosphorus Discharge Requirements

	April to October	November to March
Current Discharge Requirements	1.0 mg/L	1.0 mg/L
2014 Discharge Requirements	0.15 mg/L	1.0 mg/L
Treatment Goal	0.1 mg/L	0.1 mg/L

Pilot Studies

With the change in phosphorus regulations, Clinton needs to upgrade their system and increase phosphorus removal. After Clinton's decision to use small footprint disc filters, a series of pilot studies were completed to find the most cost effective and efficient phosphorous removal filter.

Plant Conditions

Average Daily Flow	3.0 MGD
Maximum Daily Flow	8.0 MGD
Peak Hourly Flow	12.0 MGD

The WesTech SuperDisc rotating disc filter was used to complete a pilot study between March and April 2011 for phosphorus removal at the wastewater treatment plant. The study was conducted using a pilot scale SuperDisc with a 10μm polyester cloth filter. Water was diverted from the secondary clarifiers to a chemical feed skid for conditioning to ensure maximum phosphorus removal. Following chemical conditioning, phosphorus was filtered using the SuperDisc. WesTech's disc filter design provided high quality water with many significant advantages.

SuperDisc Filter Cassettes

The SuperDisc filter cassettes are made of a reinforced polyester composite frame resulting in a lighter, stronger cassette, and reducing installation and maintenance difficulties. These cassettes were also specifically designed to eliminate the potential for perimeter leakage by removing perimeter gaskets all together, as gaskets are typically weak points for possible leakage or failure.

WesTech's inside-out filtration design uses an oscillating backwash arm to increase the usable life of the filter cloth. Outside-in filtration systems require a liquid suc-

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tion backwash shoe which scrapes against the media. With a pressurized backwash spray in lieu of liquid suction, filter media is not mechanically scraped, doubling the usable life and decreasing replacement costs. Another advantage of the inside-out design is the low hydraulic profile use, which allows SuperDisc filters to be easily retrofitted into existing shallow basins.

Ease of Operation and Maintenance

The partially submerged design simplifies all routine operation and maintenance without draining the basin. By combining intelligent engineering and superior technology, the SuperDisc filter offers the distinct advantages of lightweight cassettes, increased filter media life, continuous operation during backwash and the highest quality filtrate.

Pilot Results

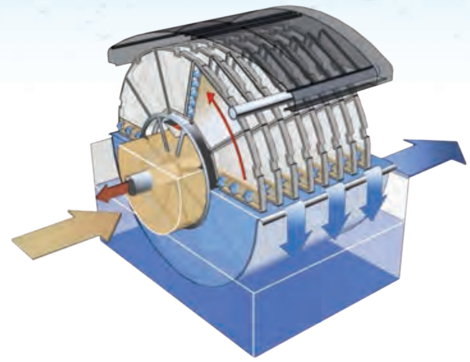
To optimize filtrate quality and chemical dose, multiple dosing rates of alum, ferric chloride, and various polymers were tested in the WesTech SuperDisc pilot study. Results showed that with the addition of a cationic polymer and ferric chloride, phosphorus levels were minimized and consistently below the goal of 0.1 mg/L TP under all plant conditions while operating between 95-97% efficiency.

Flow Rate (gpm)	Coagulant Dose (mg/L)	% Backwash Water
40	25	3.82%
45	27	4.39%
46	22	3.51%
68	27	4.86%

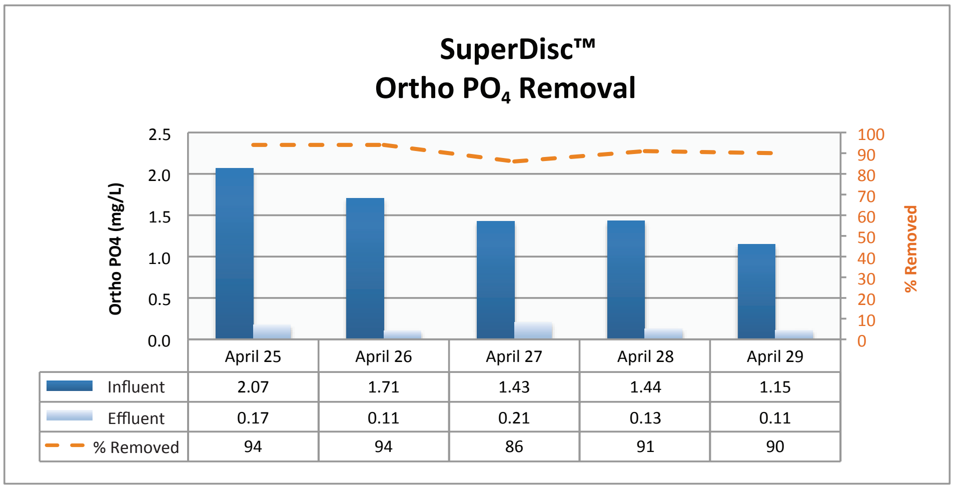
Through the range of loading rates tested, elevated hydraulic loading rate did not show any significant impact on phosphorus removal levels. As a result of this pilot study, WesTech verified that the SuperDisc can effectively and efficiently remove total phosphorus.

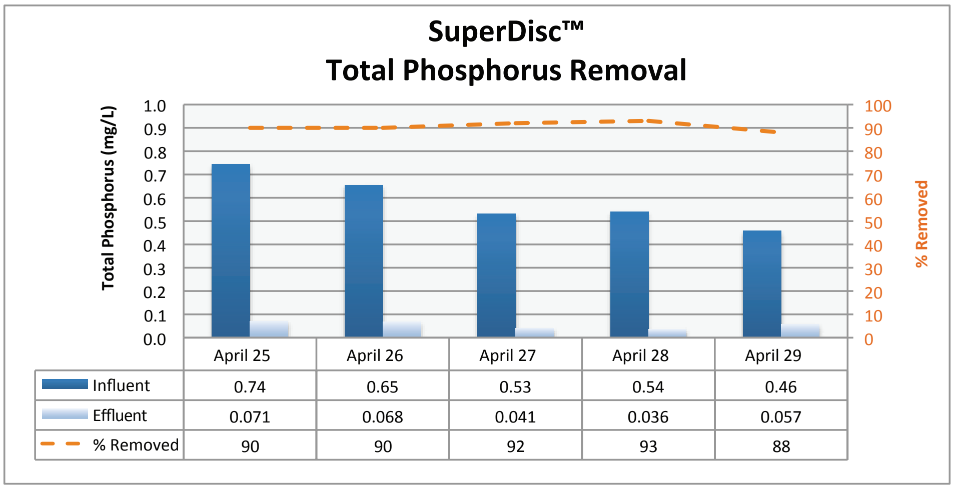
Pilot Study Results

Flow Rate	24-68 gpm
Hydraulic Loading Rate	1.3-3.6 gpm/ft2
Influent Total Phosphorus	0.45-0.83 mg/L
Effluent Total Phosphorus	0.024-0.076 mg/L
% TP Removal	88%-93%
Ferric Chloride Coagulant Dose	22-28 mg/L
Cationic Polymer Dose	0.28-0.36 mg/L



Water is fed into the system and flows by gravity into the filter discs where the suspended solids are then separated and accumulate on the surface of the filter fabric.





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WesTech INSTALLATION REPORT

Claricell-B™ Package Water Treatment Plants

Location: Cross Lake, Manitoba, Canada

Owner: Cross Lake First Nation

Engineer: SEG Engineering
Winnipeg, Manitoba, Canada

Contractor: Wescan Mechanical Services

Reducing surface water turbidity from 9-12 NTU to less than 0.1 NTU and raw water color units from 127 CU to less than 4 CU.

In 2003, SEG Engineering was contracted to design a new water treatment plant for the Cross Lake First Nation. Located approximately 370 miles north of Winnipeg, this thriving community of 4,000 people is only accessible by air or during the cold winter months by ice roads. Inaccessibility, cold weather and high raw water color were only a few of the design challenges that SEG Engineering faced for this new water treatment plant. After much evaluation, SEG Engineering concluded that a packaged water treatment plant utilizing two stage filtration was the best available technology for the project.

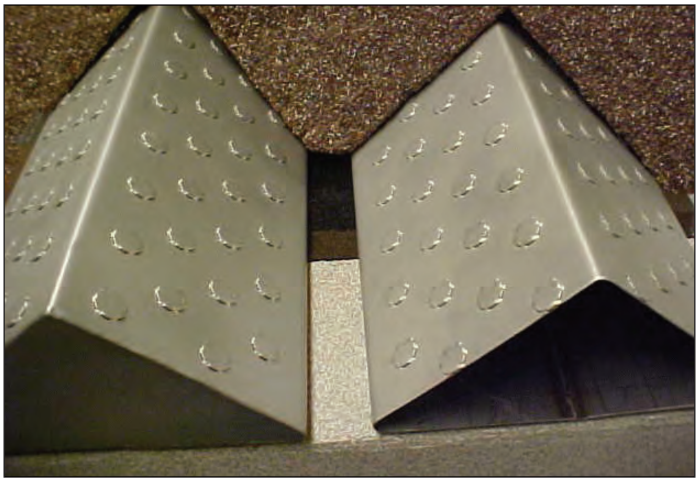
Based on this evaluation, SEG Engineering developed a detailed equipment specification that included minimum outlet performance requirements. These performance specifications required outlet turbidities of less than 0.1 NTU, color less than 5 Pt-Co units, and Trihalomethanes less than 60 µg/L.

Raw water from Cross Lake has turbidities ranging from 9-12 NTU and raw water color as high as 126 Pt-Co units.

In the fall of 2004, WesTech Engineering was contracted to supply a 350 gpm ClariCell-BTM Package Treatment Plant. The ClariCell-BTM is a skid mounted treatment unit that utilizes a buoyant, up-flow, coarse media roughing filter followed by a downflow, fine media polishing filter.

Water enters the ClariCell-BTM treatment unit and flows up through 48” of 3-5 mm polyethylene media where approximately 85% of the raw water turbidity and color is removed. The buoyant media is retained in the roughing filter by a stainless steel screen. The flow is then fed onto the polishing filter which has 18” of 1.1 mm anthracite, 9” of 0.55 mm silica sand and 3” of 0.40 mm garnet. The polishing filter media is supported by the

Pyramed™ Underdrain, an all stainless steel direct retention underdrain. The ClariCell-B™ is fabricated from marine grade aluminum, eliminating the need for coating maintenance associated with epoxy coated carbon steel.



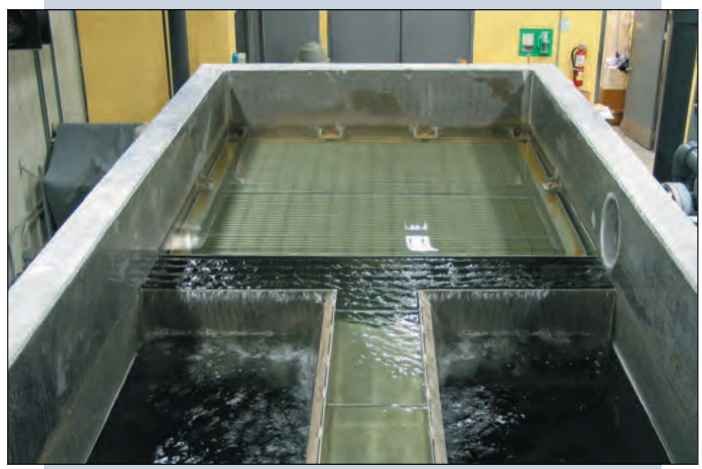
Pyramed™ Underdrain

The WesTech provided PLC controls allow for automatic operation of the treatment unit and chemical feed system and automated backwashing of the filters. Backwash of the roughing filter is done using untreated raw water where as the polishing filter is periodically backwashed with treated water.

In May of 2005, during a 7 day performance test, WesTech successfully demonstrated that the ClariCell-B™ could meet or exceed all of the performance criteria required and the plant was turned over to the Cross Lake First Nation.

PLC control

WesTech successfully demonstrated that the ClariCell-B™ could meet or exceed all of the performance criteria required



Claricell-B™ Package Tratement Plant

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Reduced Chemical Dose, Improved Water Quality

Solids CONTACT CLARIFIER™ with Tube Settlers

CASE STUDY

Location: **Fort Payne, Alabama**
Owner: **Fort Payne Water District**
Engineer: **ADL-Constantine Group**
Contractor: **Lambert Construction**

New Water Source Challenge

The Fort Payne Water District provides water for the City of Fort Payne and acts as a wholesaler to neighboring water districts. Treating 9 MGD, the trapezoidal concrete sedimentation basins built in 1968 were deteriorating, requiring an upgrade or replacement.

In addition to failing concrete, the basins experienced severe hydraulic short-circuiting and sludge removal issues. The traveling hydraulic vacuum sludge removal system would often get stuck in the sludge, requiring the basins to be drained and hosed out. At times, air pockets would develop in the vacuum hose, depriming the siphon and breaking the sludge vacuum.

In 2009, Fort Payne began working with Constantine Engineering to replace the sedimentation basins to improve filter run times and filtrate quality.

When selecting the equipment for the new system, the operators wanted to correct the issues associated with the old system. The previous system was mechanical with many moving parts, resulting in frequent maintenance. Many flocculation and clarification technologies were considered, including solids contact clarifiers, because they have very few moving parts and are housed within a compact footprint.

WesTech's Solids CONTACT CLARIFIER™ provides flocculation and clarification within the same basin, eliminating the need for separate flocculation basins and also reducing clarification basin size. Operators were impressed with the compact nature and quality of water produced by WesTech's Solids CONTACT CLARIFIER.

The Fort Payne Water District decided to use solids contact clarifiers for sedimentation and in 2011 installed two (2) WesTech Solids CONTACT CLARIFIERS. As an enhanced flocculation device, the Solids CONTACT CLARIFIER provides high volume internal solids recirculation combined with gentle mixing. The internal solids recirculation results in enhanced flocculation and improved water quality.

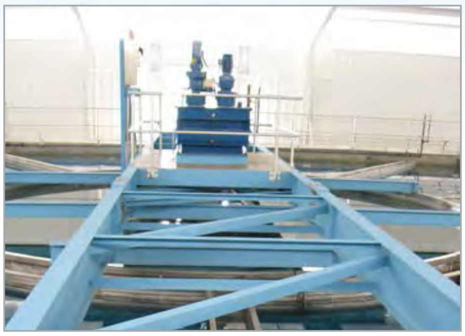
To further improve settling efficiency, tube settlers were installed. Tube settlers allow small floc particles to come in contact with each other, creating a faster settling particle and better clarified water. Through the superior design of the Solids CONTACT CLARIFIER and the use of tube settlers, Fort Payne reduced clarified

Solids CONTACT CLARIFIER™	
Quantity	2
Flow Rate	3125 gpm/unit
Dimensions	65 ft square
Side Water Depth	18 ft
Hydraulic Loading Rate	0.9 gpm/ft^2
Internal Recirculation Rate	18,750 gpm
Flocculation Well Detention Time	30 min
Total Detention Time	180 min
Motor HP	Rake Arm Drive: 0.5 HP Impeller Drive: 5 HP

Tube Settlers	
Material	PVC
Angle from Horizontal	60˚
Vertical Height	36 in
Plan Area	3500 ft^2

Fort Payne Water Treatment System Comparison

	Raw Water	1968 System	2011 WesTech Upgrade
Water Quality			
Turbidity	12.9 NTU	1.25 NTU	0.4 NTU
TOC	3.61 mg/L	2.38 mg/L	1.82mg/L
Color	6.85 Pt-Co	0.16 Pt-Co	0.0 Pt-Co
Chemical Dosing			
Coagulant Dose	-	25-31 ppm	13-15 ppm
Filter Run Time	-	40-50 hrs	More than 100 hrs



Solids CONTACT CLARIFIER™

effluent turbidity by 70% over their previous clarifiers.

Brandon Light, the Fort Payne treatment plant manager, said that, "Turbidity has gone dramatically down and we were able to cut our coagulant dose in half." Fort Payne plant operators believe this is the highest quality water they have seen in years from the clarification process, even with the reduced coagulant dose.

Before the Solids CONTACT CLARIFIERS were installed, the water clarity onto the subsequent multimedia filters was so poor that the filter media could not be seen and backwash cycles were frequent. With the new clarifiers, filter media is clearly visible and filter run times have been doubled. These filters can now run more than 100 hours before needing to be backwashed.

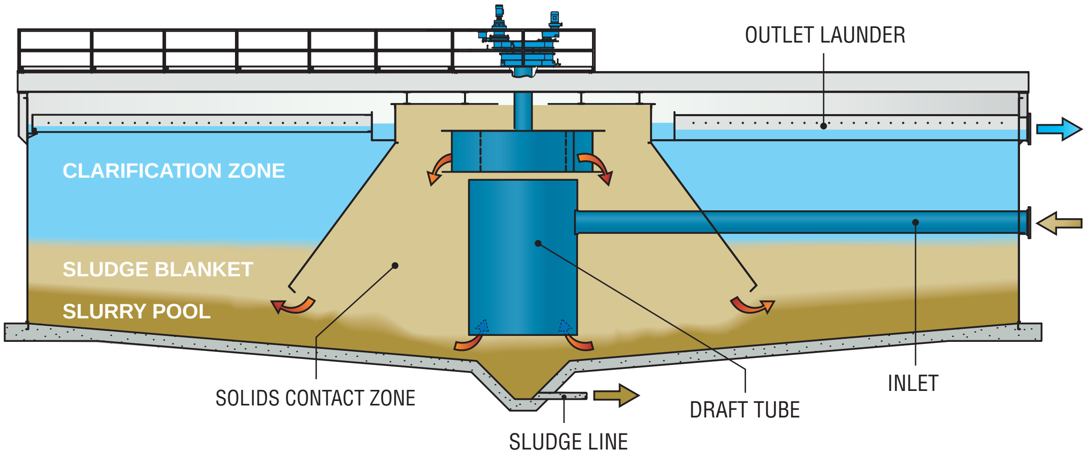
The Solids CONTACT CLARIFIERS have increased water quality while decreasing costs through reduced coagulant dosage and longer filter run times. To eliminate recoating, stainless steel was installed at the air/water interface. Operation and maintenance have been simplified through WesTech's robust, stationary equipment. The operators at Fort Payne are pleased with the small footprint and ease of operation.

Paul Nail, General Manager (L) and Brandon Light, (R) Plant Manager, Fort Payne Water District

"Turbidity has gone dramatically down and we were able to cut our coagulant dose in half."

Brandon Light
Plant Manager

The internal solids recirculation resulted in enhanced flocculation and improved water quality.



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WESTECH INSTALLATION REPORT

Ultrafiltration for Reverse Osmosis Pretreatment

Location: Lebec, California

Owner: Pastoria Energy,
Pastoria Power
Generation Facility

Design Build Contractor:
Calpine Operating Services Co., Inc.
Folsom, California

The filtered water quality was consistently very low in turbidity and less than 2 SDI (Silt Density Index).

Calpine Corporation, an industry leader in U.S. power generation, recently finished a new four turbine power plant in south-central California. This steam turbine generating plant has large water needs, including high purity water boiler feed and cooling tower water. A key part of their complex and efficient water treatment flow scheme is their reverse osmosis (R.O.) system.

Approximately six months after final commissioning of the plant, WesTech received an urgent call from the engineers at Calpine. It became apparent that the existing granular media filters on the project, upstream of the R.O. system, were not treating to sufficient filtered water quality levels. Suspended solids feeding the R.O. membrane were high in iron species and would spike with turbidities up to 30 NTU. R.O. membrane fouling occurred in less than a day! After fouling two sets of R.O. membranes, it was realized that a WesTech membrane treatment system was needed fast!

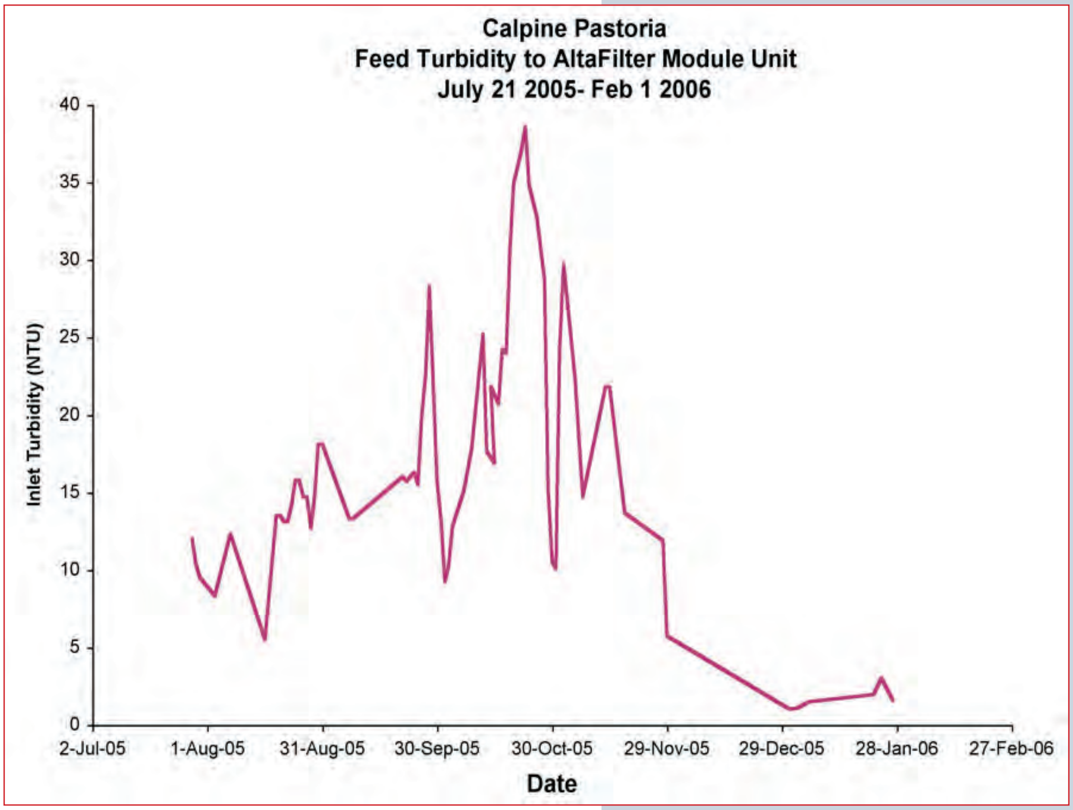
In less than four days, WesTech responded by delivering a fully automated AltaFilter™ membrane system. This ultrafilter system utilizes 18 membrane modules manufactured by Polymem of Toulouse, France as the heart of the filtration unit.

Within seven days the system was unloaded, piped up, wired up and began producing treated water. The filtered water quality was consistently very low in turbidity and less than 2 SDI (Silt Density Index). As a result, the R.O. membrane's

AltaFilter™ Ultrafiltration Membrane System performance has improved significantly and has operated since July, 2005 with few, if any, problems.

During its extended services, the AltaFilter™ has required chemical cleaning only once every three months despite widely varying feed turbidities, as shown on the following graph. ■

Set up for temporary AltaFilter™ rental



Despite widely varying feed turbidity, SDI's were always less than 2

Bill Moore, Calpine's Senior Water Treatment Specialist said: "*WesTech is a great company to work with. They produce good systems with excellent support and service to back it up.*"

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an employee-owned company

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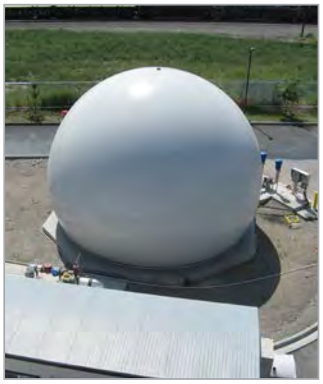
SECTION FIVE – EQUIPMENT PHOTOS

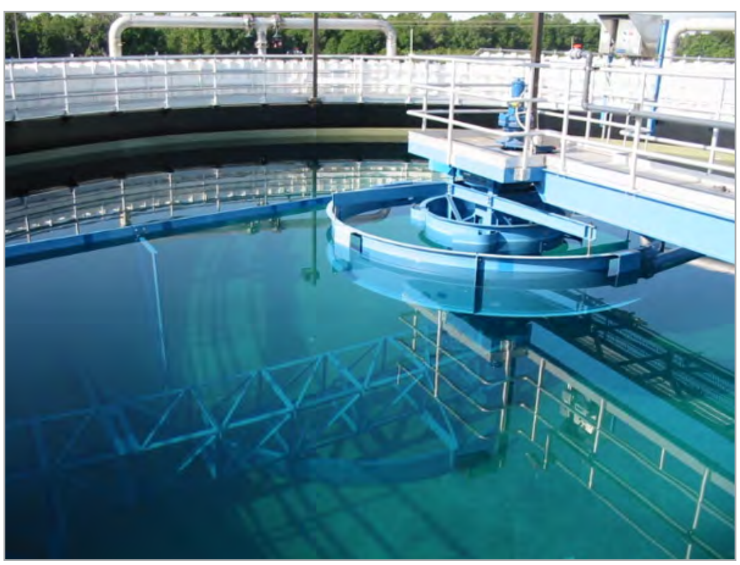
Aerators

AltaFilter™ Ultrafiltration

Anaerobic Digestion

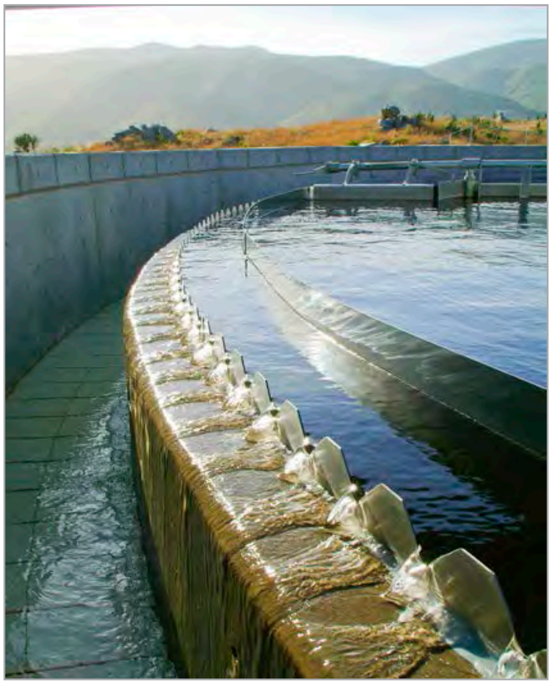


BioTreaters



Conventional Clarifiers

COP™ Clarifiers



DAF/DGF Circular/Rectangular Units

Granular Activated Carbon Units

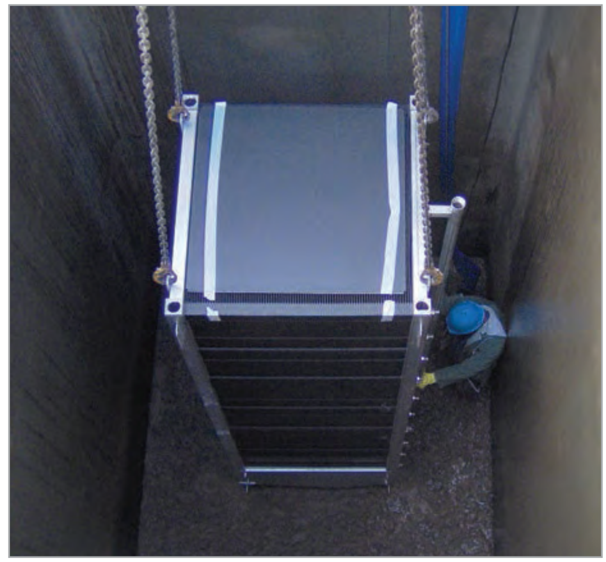
Gravity Filters

HiFlo™ Thickeners

Horizontal Belt Filters

Industrial Drive Units

Membrane Bioreactors



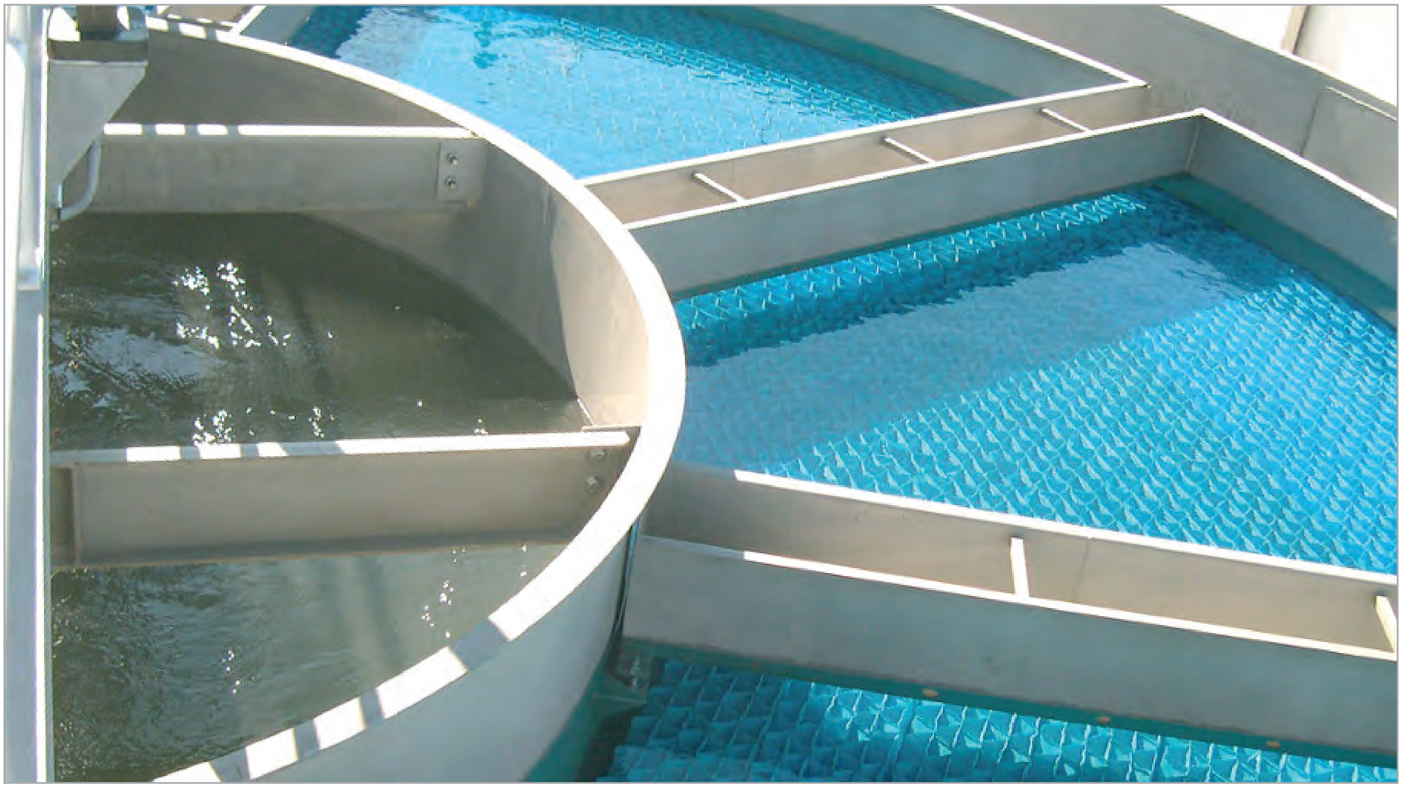
Oil/Water Separators

Paste Thickeners

Pressure Filters

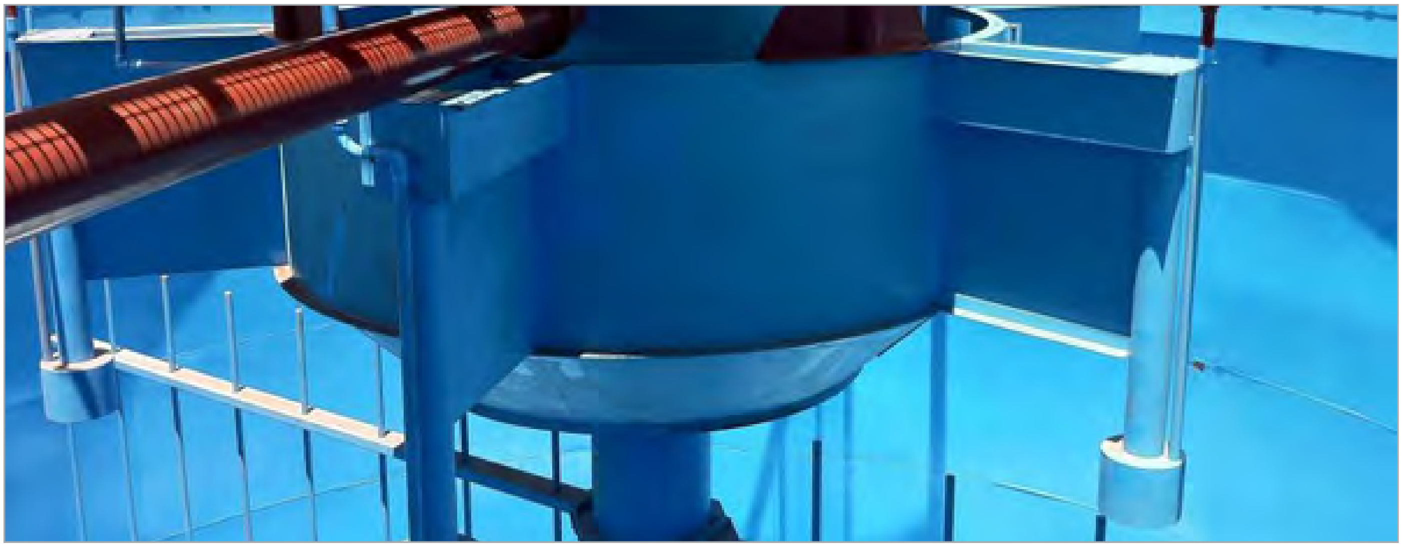
Screens

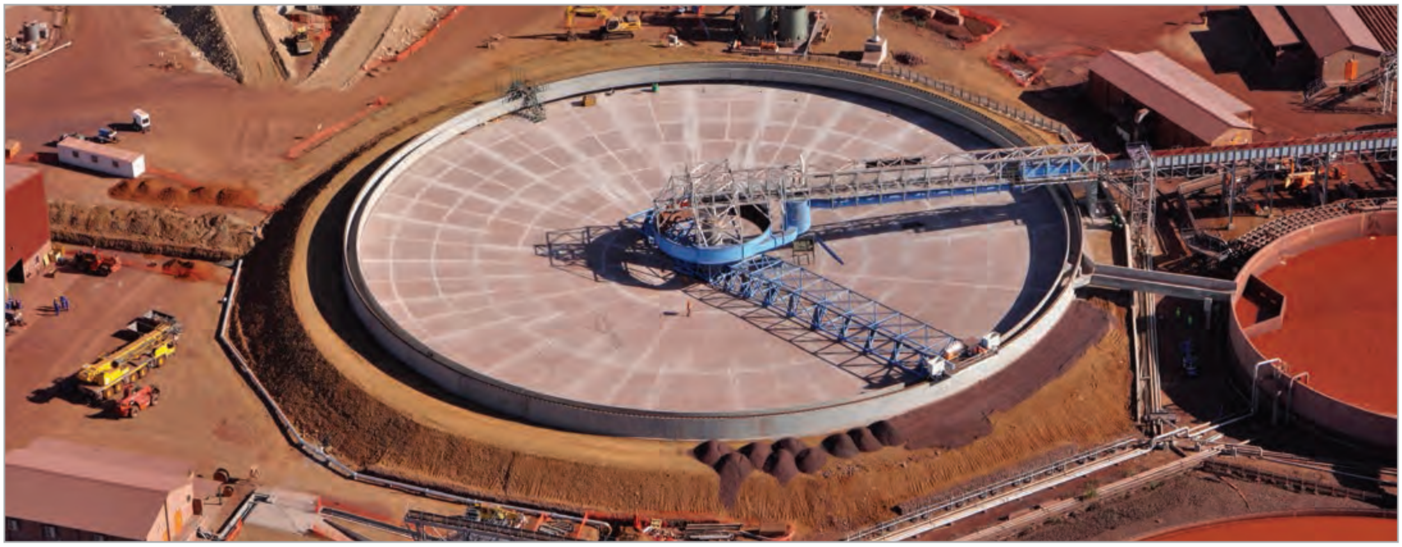
solids Contact Clarifiers™



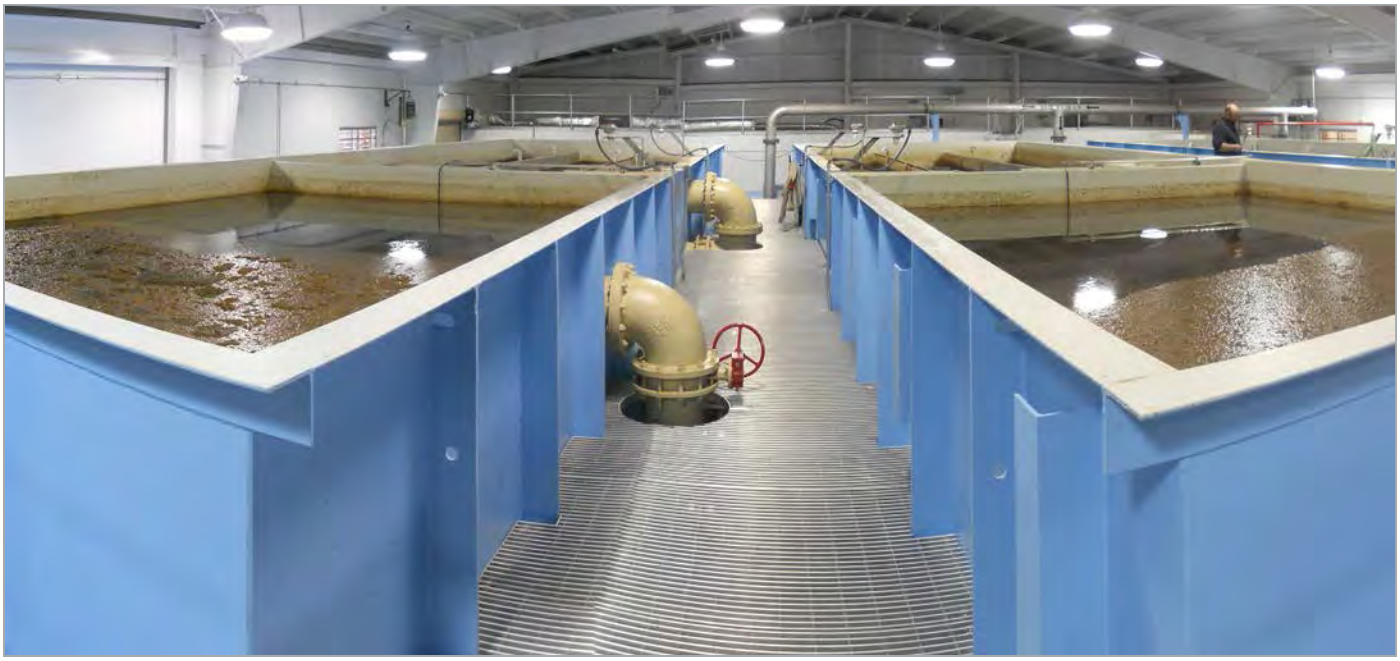
STM-Aerotors™

TOP™ Thickeners





Trident® HS



Vacuum Drum Filters