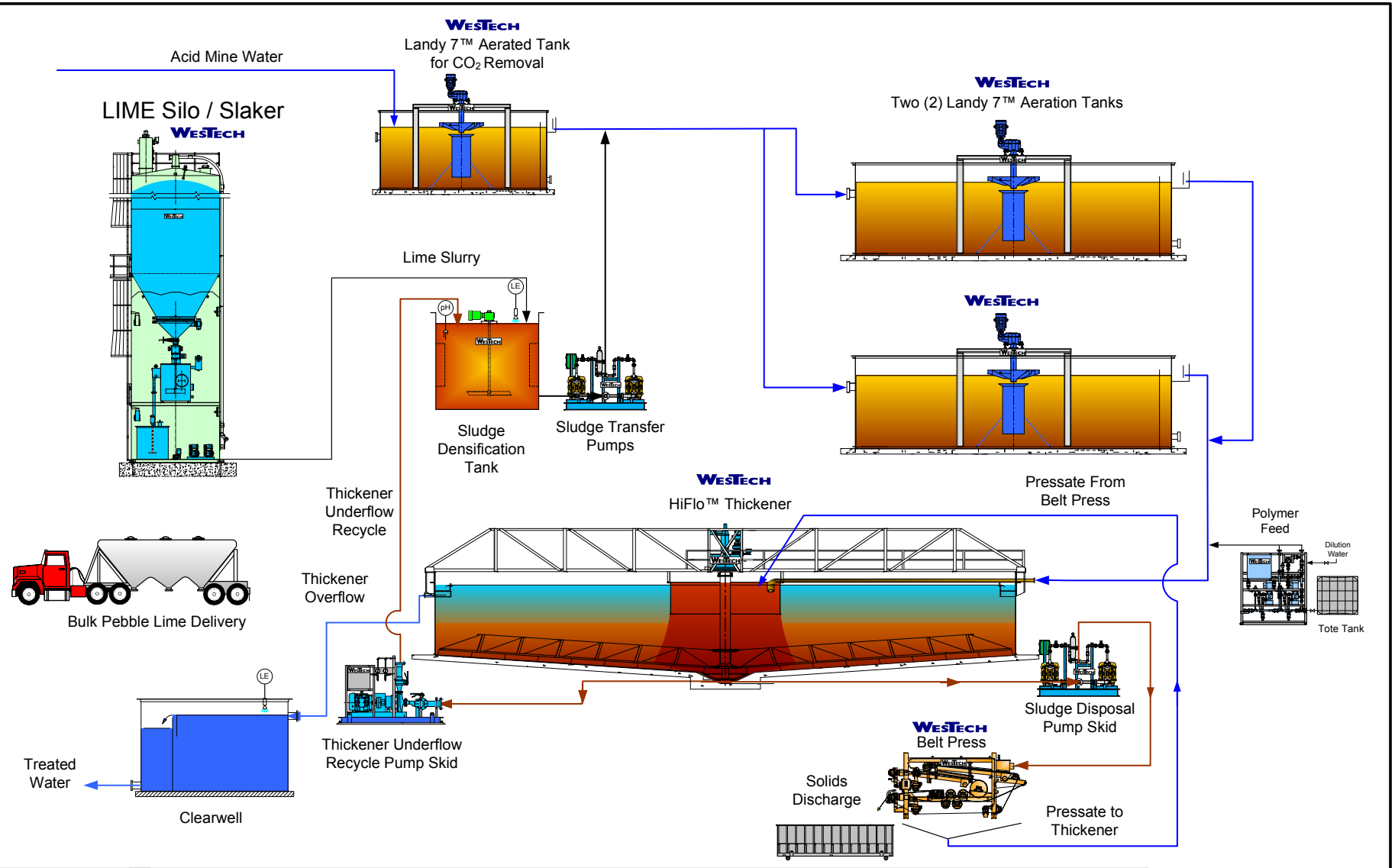

Acid Mine Drainage

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.