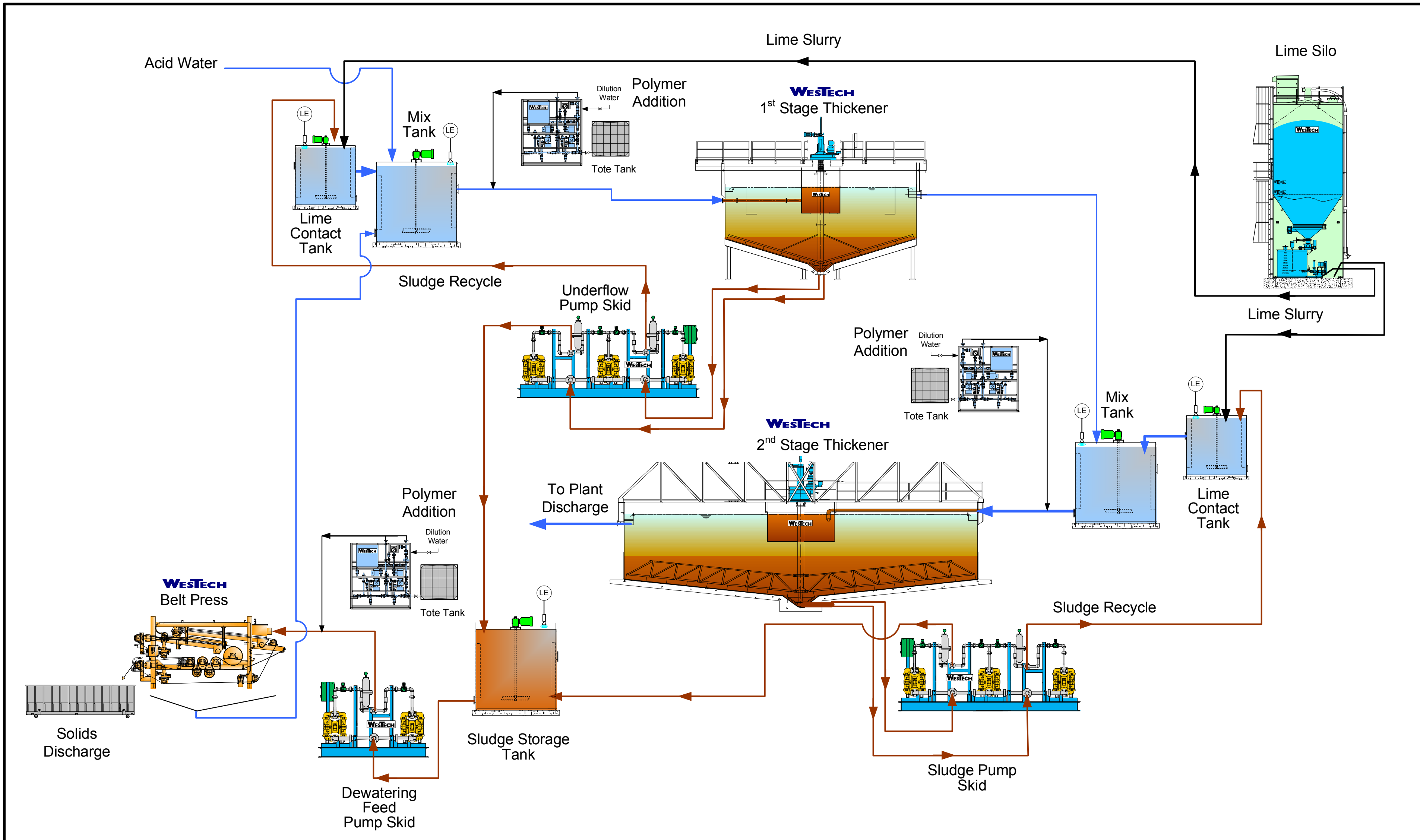

Two Stage Fluoride / Phosphate Removal From Gypsum Stack

WesTech

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.

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WesTech has experience in the phosphoric acid industry. From clarification to thickening and dewatering our engineering expertise and equipment continue to facilitate industry's plants and refineries.

Calcium fluoride and calcium phosphate slurries present specific challenges.

WesTech has experience at several plants with hydrofluoric 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.