Get **Equipped**

The process of flocculation is employed in wastewater treatment to separate suspended solids from water whenever the solid's natural subsidence rates are too slow to provide effective clarification. Water clarification, sludge thickening and dewatering depend on correct application of the theories of flocculation for their success. Flocs must be handled gently and with very low shear; otherwise, the process is rendered useless.

By David Heigl

Flocculation & Flotation Thickening

Wastewater from a food processing plant is an example where seepex PC pumps have been successful. Food processing plants get rid of their large solids through screening or settling. The dispersed solids that do not readily settle or are too small to screen are usually removed using the flocculation process by means of a dissolved-air flotation (DAF) thickener.

In the DAF process, the solids-laden slurry is supersaturated with pressurized air. The air is released inside the DAF tank as small bubbles. The bubbles attach to the suspended solids, increase their buoyancy and cause them to rise to the surface of the tank, where a concentrated sludge is formed. A high-molecular-weight polymer is also introduced as a flocculant at a point where the bubbles precipitate and contact the solids. The molecular structure of the flocculant helps gather the particles in a net or floc. Pumps are used to meter the polymers due to their low shear rate and metering accuracy.

Rakes gently move the accumulating floc sludge across the top of the DAF tank and into a hopper at the end. It is important not to pull apart or shear the floc. The flocculated sludge dewaters more quickly because of its less gelatinous structure.

When the hopper becomes full, the floc sludge is dewatered to a level determined by the solids-handling capability of a transfer pump. The pump sends the dewatered floc to a tanker truck for transport to land application or a rendering plant. The choice of pump at this stage has a large impact on dewatering costs and the quality of the floc sludge. With this in mind, there are several major advantages to using a seepex pump.

Using pumps with TSE dry-run protection and 6-L geometry for flocculation and sludge floc transfer

The "G" Factor

Fluid mechanics are crucial in the flocculation process. One of the most important variables in the process is shear rate, or the G factor, as it is referred to by some chemical suppliers. The flocculation process does not end in the DAF tank. The sludge must continue to concentrate and remain in a floc until the sludge reaches the final dewatering process at the rendering plant.

As mentioned earlier, flocculated sludge dewaters at a faster rate; therefore, a pump that shears the floc defeats the purpose of the process. Progressive cavity pumps must be employed due to their low shear rate of less than 100 inverse seconds per 100 rpm. To achieve even less shear, DAF sludge operators and engineers are using the seepex 6-L geometry that offers the lowest shear in the industry—20% less than conventional PC pumps.

Seepex cavity pumps offer the ability to handle a higher percentage of dewatered sludge. DAF operators are able to remove more water at the plant site, resulting in lower transportation costs and lower dewatering costs at the rendering plants. Replacing existing pumps with seepex has resulted in average moisture reductions of 25% at plants. Companies typically lower their moisture content from 80% to 60% when seepex pumps are introduced.

Advantages in Action

Take, for example, the pumps used at a poultry processing plant in Alabama. The plant's wastewater treatment facility uses two separate DAF clarifiers to remove suspended solids, fat and grease from the water. Air-operated double diaphragm pumps were used to transfer the flocculated sludge to the tanker trucks. At the time, moisture content levels were 80%.

Two constraints prohibited the company from obtaining an optimal moisture content of 60%. The first was retention time in the hopper. Due to incoming flow from the plant, the DAF sludge had a retention time limit in the hopper that did not allow it to reach moisture levels below 80%. The solution was to transfer the product to the tanker truck, where the sludge could be retained while being filled and for some time after that before leaving the plant. The theory was that the floc would continue to build and water could be drained from a valve at the bottom of the trailer. The second constraint—the air-operated double diaphragm pump—prevented this from occurring due to high shear rates from the pump. When the tanker valve was opened to drain the water, the sheared floc flowed out as well.

The company called upon a local seepex distributor to provide a solution to the problem. The distributor provided two model 17-6L seepex pumps with TSE dry-running protection. With progressive cavity design and 6-L geometry, the pumps were able to transfer the flocculated DAF sludge to the tanker truck with virtually no shear. The company was able to achieve extra dewatering retention time in the trailer. When the drain valve was opened to remove water, the indication was that the sludge remained in a floc inside the trailer.

The wastewater operators are now able to achieve 60% moisture content, and they are saving $4,000 per week in dehydrating charges from the rendering plant. The return on investment was less than one month.

There are also exclusive cost savings associated with maintenance. The TSE dry-running protection device is an important feature because in most plants, the DAF hoppers are emptied on a batch basis. Pumps face the possibility of running dry after batch transfer unless a level indicator is installed. Another benefit is that the 6-L geometry provides lower sliding velocities between the rotor and stator. The result is longer stator wear life. WWD

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