APPLICATION NOTE

MONITORING SUSPENDED SOLIDS IN BIOSOLIDS PROCESSING STAGES OF A WASTEWATER TREATMENT PLANT

Treating wastewater removes biosolids and cleanses the water before it is released from the plant. Various methods are used to separate the water from the solids, resulting in more concentrated biosolids. Specific disinfection processes destroy potentially harmful organisms in the biosolids before they can be safely returned to the environment.

Benefits of Monitoring Suspended Solids

Monitoring suspended solids in the biosolids processing stages of a wastewater treatment plant offers these benefits:

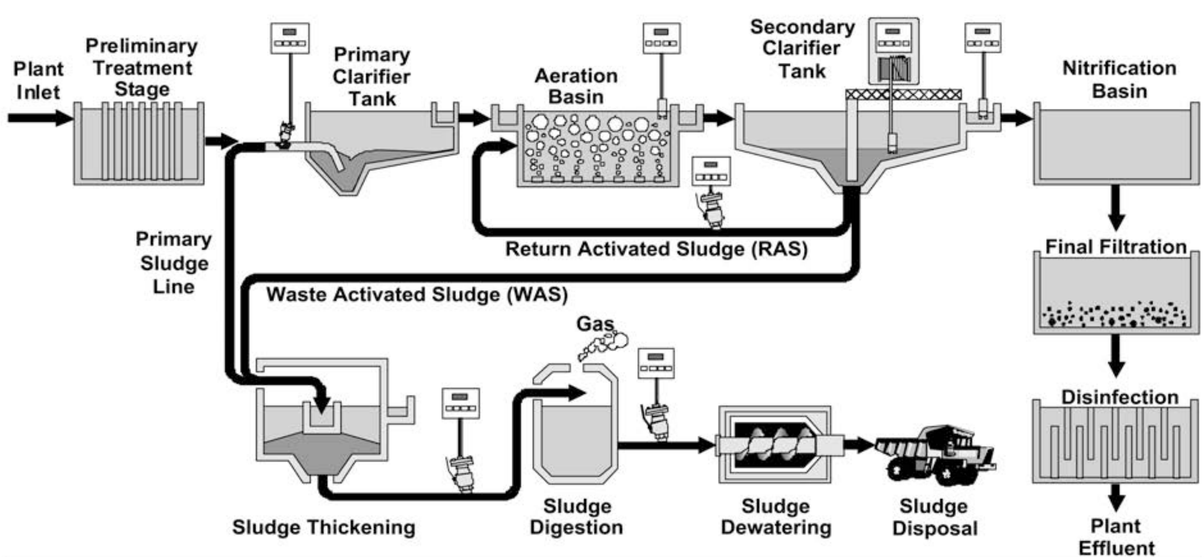
1. Increased plant efficiency based on improved dewatering performance
2. Accurate polymer addition due to real-time monitoring.
3. Reduced, time-consuming laboratory analysis.

Figure 1 shows the basic layout of a typical wastewater treatment plant.

The typical biosolids processing stages used in a wastewater treatment plant are:

- Sludge Thickening Stage
- Anaerobic Sludge Digestion
- Sludge Dewatering
- Sludge Disposal

Figure 1 Typical Wastewater Treatment Plant



Sludge Thickening Stage

Sludge is the watery mixture of biosolids that comes from the primary and secondary treatment stages, shown in Figure 1. The first step in treating these biosolids is removing the significant amount of water it contains, thereby reducing the amount of sludge that must be treated. There are various ways to thicken the sludge. Four of the most common methods are centrifugal thickening, gravity thickening, dissolved air flotation, and gravity belt thickening. Each method concentrates the biosolids differently, but they all make biosolids easier and less expensive to treat.

Centrifugal Thickening Product Application

A centrifuge exerts a force many times greater than gravity onto the sludge. Sometimes polymer is added to the centrifuge influent to help thicken the solids. The two most important factors affecting centrifuge performance are the incoming sludge volume and solids weight. The water removed from the centrifuge is called centrate. One way to determine centrifuge operating efficiency is by monitoring the concentration of solids in the centrate. Increasing the incoming sludge volume decreases the clarity of the centrate while increasing polymer consumption. Controlling the concentration of solids in the centrate enables the operator to optimize polymer addition.

Gravity Thickening Product Application

A gravity thickener operates similarly to a final settling tank. Sludge enters the tank and solids are allowed to settle and concentrate at the bottom. Weirs around the outer edge of the gravity thickener tank collect water overflow. If a gravity thickener is used with primary sludge, it is best to keep the incoming sludge as thin and fresh as possible. This might seem to be a contradiction, but septic solids do not settle as well as fresh solids. Therefore, pumping thin and fresh primary sludge is important. Controlling the incoming suspended solids concentration helps the operator maintain optimum settling conditions in the tank.

Dissolved Air Flotation (DAF) Product Application

The dissolved air flotation unit is the most useful with secondary solids. It can also be used with a mixture of primary and secondary sludges. In the dissolved air flotation unit, a mixture of water and air is pressurized between 40 and 70 psi. The pressurized air and water mixture is added to the sludge. Tiny bubbles attach to the solids, causing them to float. This thickens the sludge to a concentration ranging from 4 to 8% solids. Dissolved air flotation, like gravity thickening, requires the solids to be fresh. For this reason, thin and fresh sludge is preferred. The sludge may even be diluted if necessary. On the surface of the unit, a sludge float blanket is maintained with a thickness of anywhere from 8 to 24 inches (20 to 60 cm). Monitoring the incoming suspended solids concentration insures that the proper sludge float blanket is maintained.

Gravity Belt Thickening Product Application

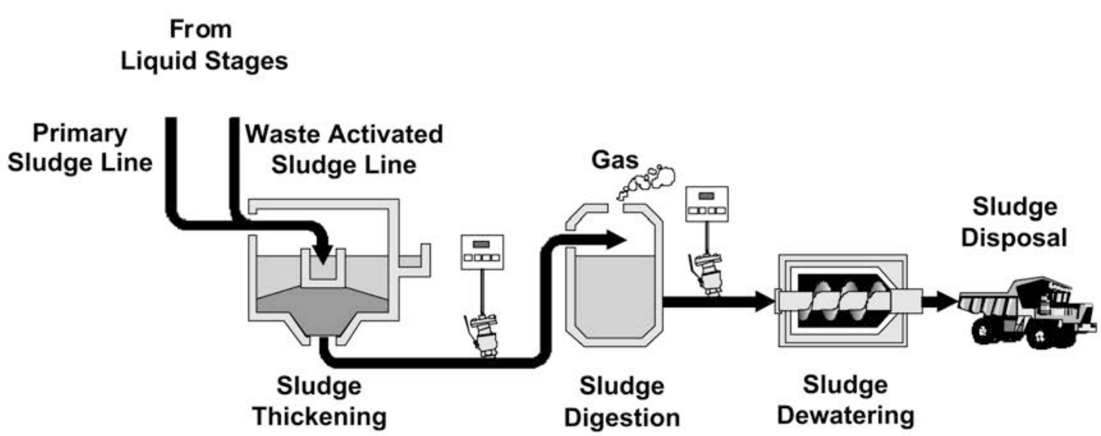
The gravity belt thickener uses polymer to make the sludge solids larger. After polymer is mixed with the sludge, the mixture is spread across a porous, horizontal belt to allow water to drain down by gravity. After water has drained through the belt, the residual solids block the pores to prevent more water from passing through. To remedy this problem, the belt is moved into stationary plows to scrape the solids from the belt surface, opening the pores for water drainage. The concentration and production of thickened sludge are affected by a number of factors. Polymer feed is important. The influent sludge must be thick enough to produce the required solids concentration of thickened sludge. Monitoring the incoming suspended solids concentration enables the operator to adjust for the optimum mixture of incoming sludge and polymer.

Anaerobic Sludge Digestion

The primary and secondary treatment processes remove the solids, food, and bugs from the water. This odiferous, watery mixture, known as sludge, has to be stabilized. Many treatment plants use the anaerobic digestion process to stabilize their sludge to a mixture that is easily dewatered and relatively odor free.

The anaerobic digestion process, shown in Figure 2, has two basic steps. The first step converts the organic materials to volatile acids. The second step changes the volatile acids to methane. Different microbiological organisms are used to perform each of these steps. The organisms used to convert the organic materials into volatile acids are called acid formers. The second group of organisms that change the volatile acids into methane are known as methanogenic organisms. The gas produced from a properly operating digester is a mixture of two primary gases: carbon dioxide (CO_2) and methane (CH_4).

Figure 2 Biosolids Stages of a Wastewater Treatment Plant



The gas mixture should be about 65% methane and 30% carbon dioxide. The conversion of organic material and the production of methane gas occur simultaneously within the same tank. The gas is drawn off the top of the tank and the digested sludge is moved to the sludge dewatering stage.

Product Application: Two important things to consider when operating a digester are how the raw sludge is added to the digester, and how the digested sludge is removed. Too much incoming raw sludge at one time increases the gas production, resulting in foaming and possible digester failure. Too much digested sludge removal at one time depletes the "seed" material needed to continue the process. Pumping raw sludge containing too much water into the digester can cause a hydraulic overload. The excess water also requires more heat energy to be consumed by the digester to insure proper treatment of the sludge. Monitoring the solids concentration of the incoming sludge helps the operator maintain digester efficiency and prevents hydraulic or organic overload from occurring.

Sludge Dewatering

At this point in the biosolids treatment process, the sludge has usually been pre-thickened to reduce most of the water. The remaining water is more difficult to remove. The objective of sludge dewatering is to remove as much water as possible from the sludge. The sludge is conditioned, and then usually dewatered by either air drying or some mechanical means.

Sludge conditioning typically involves adding a chemical to more easily remove the remaining water from the sludge. The added chemical reduces the electrical charges on the sludge particles. As with magnets, two negatively charged particles next to each other will repel each other. The sludge particles are usually negatively charged. The conditioning chemical electrochemically changes this negative charge. This first conditioning step in which the chemical changes these charges is called coagulation. Now that the sludge particles do not repel each other, the smaller sludge particles can be gently mixed to create larger particles. This second mixing step is called flocculation. One factor to consider is the size of the original sludge particles. The smaller the particles, the more charged particle ends there are to change, and the more chemical required to condition the sludge for dewatering.

Product Application: Several factors determine the efficiency of the dewatering process. The type and amount of flocculent used, the dry mass (flow multiplied by solids concentration), and the nature of the sludge itself. Since the flocculent dosage requirements are constantly changing, it is easy to see the advantage of continuously measuring the suspended solids entering this stage. Continuous measurement minimizes flocculent costs and saves energy by insuring that the sludge contains a minimum amount of water.

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