THICKENING OF BIO SLUDGE

The Process

UPM-Kymmene, Kajaani paper mill, produces 550,000 tonnes of newsprint and magazine papers a year. All process effluents are collected to the mill’s wastewater treatment plant where they are treated in an active sludge process capable of purifying about 21,000 m³ of effluent per day. Sludges from primary sedimentation and thickener 1, from barking water thickener and bio sludge thickener are processed together, primary sludge and bio sludge making up the greatest volume.
kajaaniMCAi consistency analyzer was put to measure biologically active excess sludge from the biological reactor. This sludge contains active microbial mass, and due to its low solids content it must be thickened before drying to make handling easier and to reduce the amount of water in the sludge treatment process. Bio sludge is relatively homogeneous in structure and reacts poorly to mechanical dewatering, as it contains plenty of intracellular water that can only be removed after the cellular structure has been broken. For this reason, bio sludge and primary sludge are treated together to achieve the best dewatering result. The amount of bio sludge in the thickening process varies, depending on the age of sludge in the biological process and the incoming solids load of the effluent treatment plant. The process involves many factors that may cause rapid, large swings in sludge quantity and quality, making process control a real challenge.

Situation before installation

Before kajaaniMCAi installation, the solids content of bio sludge was not measured continuously. Thickener operation was controlled on the basis of sludge scraper torque and two laboratory measurements per week. Apart from these measurements, process control had no data on system operation or sludge solids content. Additionally, the laboratory measurements introduce considerable uncertainty: depending on the moment of sampling, they might give either a truthful or vastly erroneous idea of the process situation. Scraper operation and the pumping of reject sludge also cause potential short term errors in sampling. As a result, the process could be run for several days based on a single, highly momentary solids content result.

The goal in thickening is to prevent the sludge from going anaerobic. Anaerobic state causes sludge fermentation and promotes stringy microbe growth and the formation of floating sludge. Microbe filaments and floating sludge significantly disturb the operation of thickening. They also indirectly complicate the biological reactions: harmful microbes may circulate in the sludge treatment process for a long time and require a lot of time and work before the process again reaches the normal operating status. In order to prevent anaerobic reactions, bio sludge is every now and then pumped to dewatering in too liquid form.

Measurement results

Figures 2 and 3 show examples of the measured solids content and the correlation between MCAi and laboratory.

Benefits of measurement

Solids content measurement by kajaaniMCAi can clearly improve the control of bio sludge thickening. Measurement of sludge solids content, combined with sedimentation rate data, enhances the management of thickener operation. The on-line measurement helps to increase the solids content of pumped sludge and to prevent anaerobic fermentation caused by too long time lags. In addition, good management of thickened sludge solids content helps to avoid disturbances in wastewater treatment.

Higher bio sludge consistency means that pumps have smaller volumes to handle. Better thickening also ensures that suspended substrates are more efficiently returned to the effluent treatment process with the thickening reject. Lower nutrient load in dewatered sludge helps to combat the sliming of belt presses and to reduce the frequency of cleaning.

Using the kajaaniMCAi measurement, bio sludge can be pumped to dewatering at a steady, controlled solids content load and optimum consistency. Thicker bio sludge means less hydraulic load, belt presses can be run at lower speeds and dewatering efficiency is improved. This will give a higher solids content, so the dewatered sludge is easier to incinerate and compensation for it is better.

Other possible installation points

The consistency analyzer can also be installed to measure the sludges pumped from primary sedimentation to mixing tank and from mixing tank to dewatering. Measuring the primary sludge could keep track of the amount of different sludges pumped to be dewatered, and this information could be used to control dewatering and polymer addition. In addition, the measurement helps to optimize the pumped primary sludge volume with regard to the overall load on the process and to control the amount of primary sludge generated, so that too fluid or too thick sludge is not pumped to be treated. The mixed sludge measurement complements the primary sludge and bio sludge measurements, but it could also be used alone in some situations, provided that the relative amounts of different sludges do not show large variations. Measuring the solids content of sludge prior to dewatering gives information of actual sludge consistency and can be used to control the amount of polymer added to the dewatering stage. Avoiding polymer overdosages, however, requires that the quality of sludge entering the dewatering stage is known with certainty.

The amount of solids in sludge treatment are easy to control with these measurements. Sludge volumes from primary sedimentation and biological reactor can be controlled separately, using the measurement before dewatering to complement the control. In this combination, the measurement prior to dewatering is mainly applied to control the ratio of different sludges in the total mixture, but also to adjust the entire pumped sludge volume over shorter periods of time.
Figure 2. Example of solids content variations in bio sludge from the scraper.

Figure 3. Correlation between kajaaniMCAi measurement and laboratory results.
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