A Guide to Effective Measurement of Suspended Solids
DURING THE EFFLUENT TREATMENT PROCESS

Author Details

Tim Chettle
Solartron Mobrey
Tel: 01753 756600
Fax: 01753 823589
Email: timchettle@solartron.com

WATER/
Wastewater

Water companies are under increased pressure to run cost effective treatment facilities whilst also meeting stringent environmental legislation. This article aims to provide plant engineers and managers at water companies with an analysis of ultrasonic and optical technologies used in the measurement of suspended solids during the effluent treatment process. It outlines the applications during the primary to tertiary treatment stages where these technologies are used and gives an overview of the most appropriate solution for each environment.

By assessing the best technology for each stage of the process water companies are able to optimise plant efficiency and generate the data required in order to meet environmental legislation.

Environmental Guidelines

The Clean Water Act (US), the Water Resources Act (UK) and the European Urban Waste Water Treatment Directive (UWWTD), have been put in place to protect the environment from the adverse effects of untreated wastewater and effluent discharges. Each includes region-specific guidelines to the level of treatment that should be undertaken and outlines what data should be collected and available for review in order to prove these guidelines are being adhered to.

Details regarding the above legislation can be found at www.epa.gov/water (Clean Water Act), www.envirowise.gov.uk (Water Resources Act) and www.defra.gov.uk/environment/water (UWWTD).

Figure 1: In-pipe MSM400 Sensor

The Treatment Process

Effluent treatment is a multi-stage process that 'renovates' wastewater before it is re-used or re-enters the environment. The objective of the process is to reduce or remove organic matter, solids, nutrients, disease-causing organisms and other pollutants.

Measurement of suspended solids at key points throughout the process provides a range of immediate and long-term benefits to the operator.

First, it enables the automation of the processes that were previously manually operated, for example the pumping of sludge from settlement tanks to digestion. By only activating equipment when required, rather than operating them at timed intervals, running costs are reduced, plant efficiency is optimised and the life of the equipment is extended.

This increased efficiency not only saves money in the short term, but can also have a significant impact on long-term planning and investment decisions. As housing densities rise, treatment facilities may be able to increase capacity without having to undertake an expensive, large-scale upgrade.

Measurement can also be used to prevent costly incidents such as carry-over, using an integrated alarm and control system. And finally, the data collected can be used to meet the legislative requirements of the environmental agencies which require the processor to demonstrate compliance.

Ultrasonic Techniques

Ultrasonic instruments measure suspended solids by monitoring the attenuation of an ultrasonic signal transmitted through liquid or sludge. Able to provide proven reliable measurement in the dirty conditions of effluent treatment, these sensors are ideal for non-complex, predictable applications such as those required within the primary and secondary settlement tanks and the pipe work associated with sludge transfer between treatment stages.

Single Point (Goal Post) Sensors

In simple set-point control installations, single point sensors are suspended in the settlement vessel and measure the attenuation of the ultrasonic signal transmitted through the water to determine the amount of suspended solids present. When it reaches the pre-determined value the pumps are activated to transfer sludge, then turned off when the blanket drops to a lower level sensor. Alternatively, a solids density sensor positioned in a pipe section in the main outlet pipe (Fig 1.) can determine when the density of the sludge being pumped has reached a user defined trip point. These sensors are often installed in primary settlement tanks because of their ability to measure the higher percentage of suspended solids (typically up to 5% and greater) and operate at frequencies in the MHz range with sensor gap size being selected based on the percent solids range of the sludge.

With many areas of a treatment plant being enclosed to meet local odour control requirements, there is often a need for hazardous area ATEX certification. Such sensors are often ATEX intrinsically safe certified and provide a proven and cost-effective technology for reliable blanket level control and indication of suspended solids content.
As the sensors have no moving parts maintenance is minimal, only requiring a clean every few months. Some pipe section sensors also feature spray valves to allow automation of regular sensor cleaning, further reducing maintenance workloads.

Continuous Sludge Blanket Level Transmitters

Sludge blanket transmitters operate by sending sonic pulses from a submerged sensor through the supernatent, which are then reflected by the settling sludge blanket. The timing of the echo is processed and, using sophisticated echo processing routines, the blanket level is determined, with the control unit giving a local pictorial representation of the blanket level. Relays trigger when the blanket reaches a pre-determined level and pumps may be activated to transfer the sludge. The blanket level can also be relayed to the control room for monitoring by plant operators.

To prevent the submerged sensor becoming coated or fouled by the build up of algae, slime or sludge some products have self-cleaning capabilities. These can be activated at user-defined intervals, which enables the transmitter to function for longer periods between maintenance. Electro-mechanical cleaning systems are often used but can themselves require regular maintenance. More modern products use an air-purge cleaning system with no moving parts, further increasing maintenance intervals.

Most commonly mounted on secondary settlement tanks they are able to provide a reliable measurement of blanket level which can then be used to optimise pumping operations, avoid any costly or damaging incidents such as carry over and meet the requirements of the plant's water discharge consents.

Figure 2: Solartron Mobrey's MSM300 Range

Investment is higher than the single point sensors because of the sophistication of these systems and the analogue 4-20mA or Profibus digital output that allows the process to be optimised for maximum efficiency.

Optical

Optical sensors measure the suspended solids in the wastewater using infrared light, either in attenuative or back scatter configuration. Optics can measure much lower levels of suspended solids (between 0.005 and 2%) and are therefore ideal for the final stages of the wastewater treatment. Some models can also measure turbidity (i.e. the opaqueness of the liquid). The optical probes can be used in-tank or in pipework, and have an advantage over ultrasonic systems in that the measurement is unaffected by entrained gas, which is often present in return activated sludge (RAS) and mixed liquor suspended solids (MLSS) measurements.

The user should be aware that there are issues with maintenance of optical sensors because of the effect of the effluent. Optical sensors are more susceptible to build up and degradation of the signal so regular maintenance cycles are required. They are also a high cost technology compared with ultrasonic options.

One way to minimise the maintenance costs associated with optical technology is to assess whether it is supplied with a self-cleaning system (Figure 2, Solartron Mobrey MSM300). Usually electro-mechanical, these automatically wipe away deposit from the optics. To reduce contamination and permanent damage to a minimum, the best systems expose the optics to the effluent only when making the measurement at user defined intervals, retracting them into the body of the sensor when not being used.

Optical technologies are most commonly used for monitoring final effluent discharge to ensure compliance with EA regulations or in sludges where there is gas content, such as RAS.

Summary

Both ultrasonic and optical technologies can play an integral role in improving efficiency of plant processes and meeting environmental legislation. The key to finding the most cost-effective and reliable solution is to understand the requirements at each stage of the process and to select the most appropriate technology for each application.

Table 1.

Cost	Maintenance	Measurement Range (% solids)	Cost	Typical Application
Ultrasonic (single point)	Low	0.2% - 12%	Low	Primary and secondary settlement tanks
Ultrasonic (continuous) tank	Low	0.2% - 12%	High	Secondary settlement
Optical (Infra-red)	High	0.005%- 2% 50 mg/l – 20 g/l	High	Secondary and tertiary treatment, final effluent measurement