Technical Publication

Liquid Level/Interface Monitoring in Flocculant/Sludge Control

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In municipal and industrial wastewater treatment plants, sludge clarifiers are utilized to separate solids from the water treatment effluent system by introducing air and flocculants. This process results in the sludge rising to the top of the pond or tank and spilling over a weir into a separate collection area. The amount of air and flocculants are controlled by measuring the liquid level interface between the sludge and water.

Flocculants are used in both the treatment of municipal sewage and industrial wastewater. There are many different types of flocculant chemicals and wastewater treatment systems. Flocculants cause the suspended solids in wastewater to float to the top or sink to the bottom where they can be removed. They also can be used in stormwater treatment systems and in drinking water filtration. In industrial applications, they efficiently remove oil, heavy metals, ink and other contaminants from water (Figure 1).

The Problem

Precisely measuring and controlling the mixture of wastewater effluent, flocculants and sludge is essential to efficient water treatment. The level/interface instruments that support the process liquid measurements must be capable of distinguishing between liquids with varying properties in order to detect the levels where the different liquids interface in the pond or tank. With this knowledge, the amount of air, effluent and flocculants is controlled to provide the optimum mix for treatment.

Such wastewater treatment systems operate under variable conditions that change with system and plant demand. In addition, seasonal temperatures rise and fall along with humidity levels that affect bacterial growth and the quantity of air and effluent required for proper operation. The instruments in the process loop also must have a rugged design in order to survive in dirty harsh operation conditions where methane and hydrogen sulfide are likely to be present.

A number of different liquid sensing technologies have been tried as level/interface sensors in wastewater treatment applications. Optical detectors, for example, have not been particularly successful because the sensors fail due to fouling in this dirty operating environment. When selecting a sensing a technology for liquid level/interface it is important to not only consider the process media and desired performance criteria, but the plant environment is important too.

The Solution

There are multiple technologies that can detect level/interface in liquids and foams. Each of them have their advantages and disadvantages. Thermal dispersion sensing is one example of a technology that works well in liquid level/interface switching applications.

Thermal dispersion technology places two thermowell protected platinum RTD temperature sensors in the process

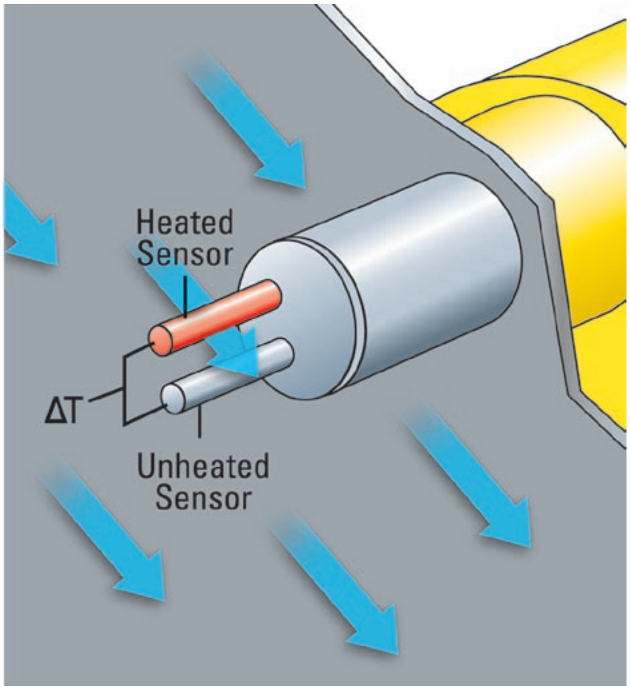

Figure 2. Thermal Mass Flow Sensing Theory of Operation

stream. One RTD is heated while the other senses the actual process temperature. The temperature difference between these two sensors is measured and is directly proportional to the flow rate of the liquid (Figure 2).

When a liquid-to-liquid interface change occurs, for example in oil to water, large changes in natural convection and thermal properties will cause substantial changes in the temperature. The liquid level/interface switch point may be factory pre-set by the manufacturer or field adjusted by the plant operator.

Similarly when clear liquid is present, the natural convection heat transfer is higher than when settled slurry such as a flocculent is present. Again a substantial and easily detectable temperature change occurs because natural convection is present and thus indicates clear liquid or a slurry is present, respectively.

For flocculant/sludge basin control in wastewater treatment, the FLT93S Flow/Level/Temperature Switch from Fluid Components International is an ideal solution. The FLT93S (Figure 3) performs monitoring, controlling and alarming of flow rates or levels of critical fluids such as flocculants/sludge, wastewater, foams, emulsion layers, other liquids and slurries. Its rugged industrial design and housing provide superior reliability and long service life under the harshest plant environments in wastewater treatment, chemical refining, nuclear power generation and other industries.

The FLT93S Switch is a dual-function insertion-style instrument that offers either flow/temperature sensing or level/temperature sensing in a single device. A single FLT measures and monitors flow or level and temperature simultaneously with excellent accuracy and reliability. Dual 6A relay outputs are standard and are assignable to flow, level or temperature.

Unlike density displacers, which are often used for level and interface control, the FLT93S Switch relies on the specific heat transfer properties of the media to identify the interface of different products. With its unique thermal dispersion sensing capability, the FLT93S monitors the interface of products with similar densities such as wastewater and flocculant/sludge for highly reliable control in basins or separation tanks and other vessels.

FCI's FLT93S can identify the interface between any type of media including flocculant/sludge, wastewater, foam, emulsion layers, other liquids and slurries. The FLT93S Switch's dual switch point option allows one instrument to control two different product interfaces. Two or more switches are used to control product discharge and intake at specified points.

The FLT Switch operates over a wide setpoint range in water from 0.01 FPS to 0.5 FPS (0.003 MPS to 0.9 MPS). Level/interface accuracy is ±0.25 inch (±6.4 mm), and measurement repeatability is ±0.125 inch (± 3.2 mm). The standard FLT93S withstands operating temperatures from -40 °F to 350 °F (-40 °C to 177 °C), and an optional configuration is available for temperatures from -100 °F to 850 °F (-73 °C to 454 °C).

Figure 3. FCI Model FLT93S

With its advanced thermal dispersion mass flow sensor, the FLT features built-in temperature compensation which ensures repeatable and reliable operation, even in dirty or extreme environments, such as those found in municipal and industrial wastewater treatment. This automatic compensation adjusts the instrument for changes in operating environment temperatures to ensure the trip points will remain accurate and will prevent false alarms or alarm failures to improve end-product quality, to maximize safety and to allow alarms to be set within a narrower set point range.

A wide selection of standard and custom process connections can be provided with the FLT93S Switch. The electronic control circuit can be integrally-mounted with the sensing element, or it can be located in a remote location. The standard enclosure is made from a coated aluminum alloy. It is suitable for use in ATEX locations and is rated for NEMA Type 4X (IP66) environments. Stainless steel or fiberglass enclosures also are available.

The FLT93S Switch also has been rated for Safety Integrity Level (SIL) 2 compliant service. FCI's SIL-2 compliance rating for the FLT93 Tank Level Switch has been documented in a failure analysis report with FMEDA techniques by the testing laboratory TUV NORD CERT GmbH. The FLT93 Tank Level Switch has been classified as a Type A subsystem in accordance to IEC 61508-1 with a hardware failure tolerance of 0. The Probability of Failure on Demand (PFD) meets SIL-2 capability standards.

Conclusions

In selecting a liquid level/interface switch for interface detection and control in wastewater treatment, it is important to look for a sensing technology that will provide accurate sensing and control in a rugged environment. This dirty, wet environment also is subject to wide variations in plant demand/throughput, as well as seasonal temperature swings. In addition, methane and H_2S will likely be present in most municipal and many industrial plant applications. These harsh substances require hardened instruments. Don't forget as well that frequent maintenance is totally undesirable in wastewater treatment environments, where the instruments are often in hard to reach locations – not to mention the technician cost and potential for system downtime. ■

Flocculant / Sludge Basin Control