Advanced online instrumentation helps DAF systems lower costs

Introduction

Advanced on-line instrumentation provides continuous, real time suspended solids measurement in "Dissolved Air Flotation" (DAF) operations, which automates and optimises polymer and coagulant feed regardless of wide load variations. The result: potential polymer savings of 20 to 30%.

Background

Dissolved air flotation (DAF) is used to remove fats, oils and grease (FOG) and suspended solids from wastewater streams. DAF systems therefore gained widespread use to provide wastewater pretreatment and thickening of biological solids in industries ranging from food processing to pulp and paper to petrochemicals.

In DAF operations, chemical coagulant and flocculant additions are often required, and dosage rates are typically kept on the high side because of the wide, sudden variations in influent water quality that are characteristic of those processing facilities. Because periodic jar tests can provide a snapshot of loadings current only at the time the sample was pulled, operators typically overfeed coagulant and flocculant to play it safe. This can be an expensive procedure, however.

Advanced online instrumentation in DAF operations provides the capability of optimising system performance while significantly lowering chemical usage. The continuous, real time measurements can provide for automated and optimised chemical feed regardless of wide load variations.

Dissolved Air Flotation (DAF)

In DAF, wastewater first enters a coagulation tube where coagulants and flocculants may be introduced to increase the particle size along with whitewater (a mixture of a portion of the DAF effluent which has been saturated with atmospheric air). The wastewater then enters the vessel across the length of the system, where the water velocity is significantly reduced to maximise separation potential.

The micro-bubbles inside the vessel attach to the particle surface, affecting particle density and causing the suspended solids to float to the surface where they are skimmed off. Heavy particles settle to the bottom and are removed. Clarified liquid is continuously removed from several points in the DAF vessel.

Generally, flotation separation systems such as DAFs can process feed with up to 300 ppm oil content. Without chemical addition, they can remove particles larger than 25 microns. With chemical addition to coagulate oil and solids, particles less than 10 microns can be removed. The effectiveness of the process depends upon a number of factors, including the adherence of the bubbles to the oil, interaction of the oil and gas, the size of the floc and the amount of gas in the floc.

The addition of polymers and coagulants can significantly enhance the performance of DAF units. Commonly used chemicals include trivalent metallic salts of iron or aluminium. Organic and inorganic polymers (cationic or anionic) are often used to enhance the DAF process. The polyacrylamides are the inorganic polymers most commonly used. When using ferric compounds, pH should typically be adjusted to between 4.5 and 5.5, or between 5.5 and 6.5 for aluminum compounds using an acid such as H_2SO_4 or a base, such as NaOH.

Considerable effort has been directed by operators to optimise the performance of DAFs, and polymer use has received significant attention due to its high cost. Concentrations of chemical flocculants used normally range from 100 to 500 mg/L. If the daily flow is 4,000 m^3 per day, for example, and chemical feed is 40 ppm, the amount of chemical fed per day is 160 kg. Based on the cost of the chemical being 3 €/kg, the cost of this treatment is 175,500 € per year. A reduction in usage by only a few percentage points can significantly lower costs.

Accurate chemical dosage control can be difficult

Although systems that monitor pH and adjust it by controlling acid or base dosing pumps are commonly used, polymer and coagulant dosage control has typically been a manual operation, based on periodic jar test results and flow pacing. It has been difficult for operators to find reliable systems for automatically adjusting dosage of coagulants and flocculants for DAF due to influent loadings that can change within minutes.

Because of this, dosage rates are typically set high to ensure high influent loadings are sufficiently treated. When influent water has a low organic load, these chemicals are overfed, often wasting a significant amount of money.

Automatic dosage control

Although most DAF operations have long relied on jar testing to obtain suspended solids readings, new online sensors now provide accurate, real-time suspended solids measurements, thereby reducing the reliance on intermittent and time-consuming analysis.

DAF operators can utilize the suspended solids sensor SOLITAX sc or TSS sc with SC 200 controllers to precisely monitor suspended solids levels in DAF influent and use these ongoing readings to automatically control chemical feed dosage. The signal from the sensor is linked to the plant's DCS or SCADA system using a full-scale 4–20 mA output from the sensor's controller or a Profibus communication. With real-time flow rate, sensor value, and polymer flow and concentration, the DCS/SCADA system calculates and adjusts the polymer or coagulant flow rate to consistently meet the set point of kg of active polymer to dry ton of mixed sludge.

The goal: reduced chemical consumption

In most DAF units, flocculant and coagulant are dosed via operator adjustments and are typically overdosed to ensure proper treatment during high load swings. Overdosing these chemicals does not improve DAF performance and is costly. Through continuous, reliable suspended solids measurement, processors can take a more proactive approach to DAF polymer and coagulant dosing to optimise these operations and reduce costs. The bottom line reflects the value in reliable monitoring. This more effective dosing program can result in savings from 20 to 30 % in chemical consumption.

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