WHEN IT COMES TO CONTINUOUS WATER ANALYSIS, ONE SIZE DOES NOT FIT ALL

Breaches of effluent discharge regulations have hit the news headlines many times over the last year. Julian Edwards of ABB Measurement & Analytics in the UK explains why when it comes to ensuring strict legislation is met, there is no "one size fits all" solution for managing wastewater quality.

pH and ORP sensors group

Growing urban populations, the effect of climate change on rivers and water courses and increased demand are influencing the way water is managed, treated and discharged to the environment.

Increasingly strict legislation is focusing attention on the quality of discharged effluent, placing added emphasis on the effective management and control of wastewater.

Continuous Water Analysis (CWA) systems are the best way to meet these demands as they give highly accurate, up to the minute information on process conditions. However, there is no 'one size fits all' approach as various conditions and legislative demands will determine what exact equipment and analysers are required.

The system and its components depend largely on the sources and makeup of the water entering the waste-water treatment works. Under the UK's Environmental Permitting Regulations or EPR, all industrial companies discharging $50m^3$ or more effluent per day to a watercourse or the sea must self-monitor their effluent flows. Some companies that discharge to a particularly sensitive aquatic life area may have to self-monitor their effluent flows even if they are discharging below $50m^3$ per day. In these cases, this would be specified in their PPC permit.

In some cases, factories will treat the water on site, particularly in the case of waste products that require specialist processes to render them suitable for discharge to a public water course or where the treatment would be prohibitively expensive for the water utility to treat.

In the final discharge from a water utility's treatment plant, some of the main parameters to monitor or control are ammonia, temperature, phosphate, pH, flow and turbidity/suspended solids.

Ammonia, a colourless, gaseous compound of hydrogen and nitrogen, is one of the major areas of concern. It is most often produced by industries and facilities such as power plants, commercial laundries, food and beverage factories and chemical production plants. In addition to ammonia being toxic, some of the by-products in nitrification process can produce nitrates which are a major plant nutrient that can cause excessive plant growth, producing oxygen starvation that can kill fish and other aquatic life. Ensuring that the ammonia and hence the nitrate level is kept to a minimum is an essential before discharging to the environment.

Ammonia can be removed from water using one of four main methods – aeration, ion-exchange, breakpoint chlorination and biological denitrification.

However, before treatment, levels of ammonia must be carefully monitored and measured. As it is colourless and odourless even in small amounts, the only way to detect it is through testing.

When controlling ammonia levels, access to real-time information through CWA allows immediate action to be taken if any issues occur.

A suitable instrument for this application is the ABB Aztec 600 ISE ammonia analyzer. This analyser offers reliable and accurate measurement of ammonia concentrations which can include monitoring of source water and the removal of nutrients from wastewater.

The Aztec 600 uses a robust gas sensing ammonia electrode to ensure continuous measurement of the total ammonia nitrogen (TAN) concentration, which is the sum of the ammonia gas (NH_3) and the ammonium cation (NH_{4+}).

Controlling phosphates

Another major measurement priority for wastewater treatment is phosphates which are commonly used in water treatment to correct problems resulting from inorganic contaminants, including iron, manganese and calcium. Phosphates can also be found in fertilizer run-off, sewage, industrial manufacturing waste and common household items like detergents

RVG200

However, excessive levels of phosphates released to the environment can have damaging effects, producing extra biomass that can lead to low oxygen levels in water courses.

Common methods of controlling phosphorous (P) rely on feedback control where phosphate (PO_4^{-3}) is measured at the outlet and fed back to the dosing system which adjusts the chemical dosing to maintain a consistent level.

Aztec 600

Although the feedback method has served well, AMP 7 now specifies very low levels of P in discharged water down to 0.25mg/l, typically from 1.0mg/l previously. Depending on the works design this can require adding a tertiary solids removal (TSR) stage coupled with a more precise control method that can prevent any excess P reaching the environment. To achieve this, water utilities are looking at closed loop control (feed forward / feedback), where P is tested before the TSR stage to help determine the level of chemical dosing needed and then the P level is tested again at discharge and used as part of the feedback control calculation.

Another challenge faced by facilities is the varying ability of the water course ways to absorb the amount of phosphorous being discharged. They often show a high P concentration during summer low flows and more diluted concentrations during winter storm events. Also, discharging phosphorus into large, fast flowing rivers such as the Thames will have a proportionately lower effect than discharging into a small, slow running stream.

The Aztec 600 phosphate analyzer from ABB meets all new consent levels and measures to the accuracy needed to meet AMP7 requirements. This instrument offers an accuracy down to 0.0016mg/l, helping utilities meet the prescribed level of 0.25mg/l

Cutting the cost of oxygen

Oxygen is one of the most important parameters in water quality management, from the treatment of waste at the aeration stage through to the point of final discharge. Dissolved oxygen levels

Combined txr & sensor pic - ROUGH

need to be maintained between 1.5ppm to 2ppm.

As aeration accounts for around 66 percent of energy use in wastewater treatment, failing to ensure tight control of dissolved oxygen greatly increases the risk of operators incurring excessive energy costs.

Continuously measuring dissolved oxygen levels with a CWA system allows variable speed drives to be used to provide the right level of aeration in the process and thus optimize energy use.

Continuous monitoring meets the challenges

Accurate, rapid assessment of the levels of these pollutants and parameters is vital if they are to be controlled to specified limits economically.

When evaluating pollutants, or dosing chemicals, a device offering continuous measurement offers several advantages over manual methods. With these, time lost between extraction of the sample and the subsequent testing often affects the value of the result. With online CWA systems, samples are automatically extracted and analysed in real-time.

Continuous monitoring also offers an up-to-date snapshot of process conditions as they exist. With manual testing methods, the results are only valid for the time when the test was conducted – the operator would not be able to evaluate current process conditions. Access to real-time information allows immediate action to be taken if any issues occur.

This was the basis of a system designed by ABB for Southern Water. Although intended for use on a potable water treatment works, the principles are the same. The system replaced an obsolete automatic coagulant dosing system that was reaching the end of its operational life. The customer also wanted improved control and instrumentation to cut OPEX by reducing dosing needs and maintenance effort.

ABB developed a continuous measurement and control system combining high and low-range UV organics (DOC) surrogate colour, turbidity and pH analysers with an RVG200 controller / recorder.

The system calculates the optimum amount of coagulant that will allow effective removal of particulates through sedimentation and filtration. Using real-time data from the analysers, the RVG200 uses a fully-configurable algorithm to adjust coagulant and account for seasonal fluctuations in raw water or physical changes to the process.

This produces values for the actual required dose (mg/l) and dose rate (ml/min), used to control coagulant dosing pumps, ensuring that the correct amount of coagulant is always administered.

The feedback control modifies the coagulant dose by maintaining colour for the clarified water within a set target band. This improved on the previous system that used only feed-forward control, with no feedback input.

Sensor-Cleaning-304

The use of a fully configurable algorithm means the system can be easily adjusted to handle any variations in upstream conditions, with any changes being able to be easily carried out using the RVG200 controller and with the use of an Ethernet connection, it enables the convenience of remote condition monitoring.

After a year of operation, Southern Water has seen 12 percent reduction in coagulant consumption, maintenance tasks decreased by more than half, and reliable control in line with raw water quality changes.

With the right instruments for the right job and an appropriate control system, Continuous Water Analysis can go a long way to meeting the requirements of the regulators while also keeping the cost of wastewater management under control.

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