Monitoring for Certainty

WATER/
Wastewater

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The water industry faces uncertainty in a changing legislative climate. Only the right monitoring systems can ensure that its operations comply with any future requirements, writes Jim Plumley, ABB Instrumentation.

ABB's turbidity monitoring equipment is suitable for use in raw water and effluent discharge applications

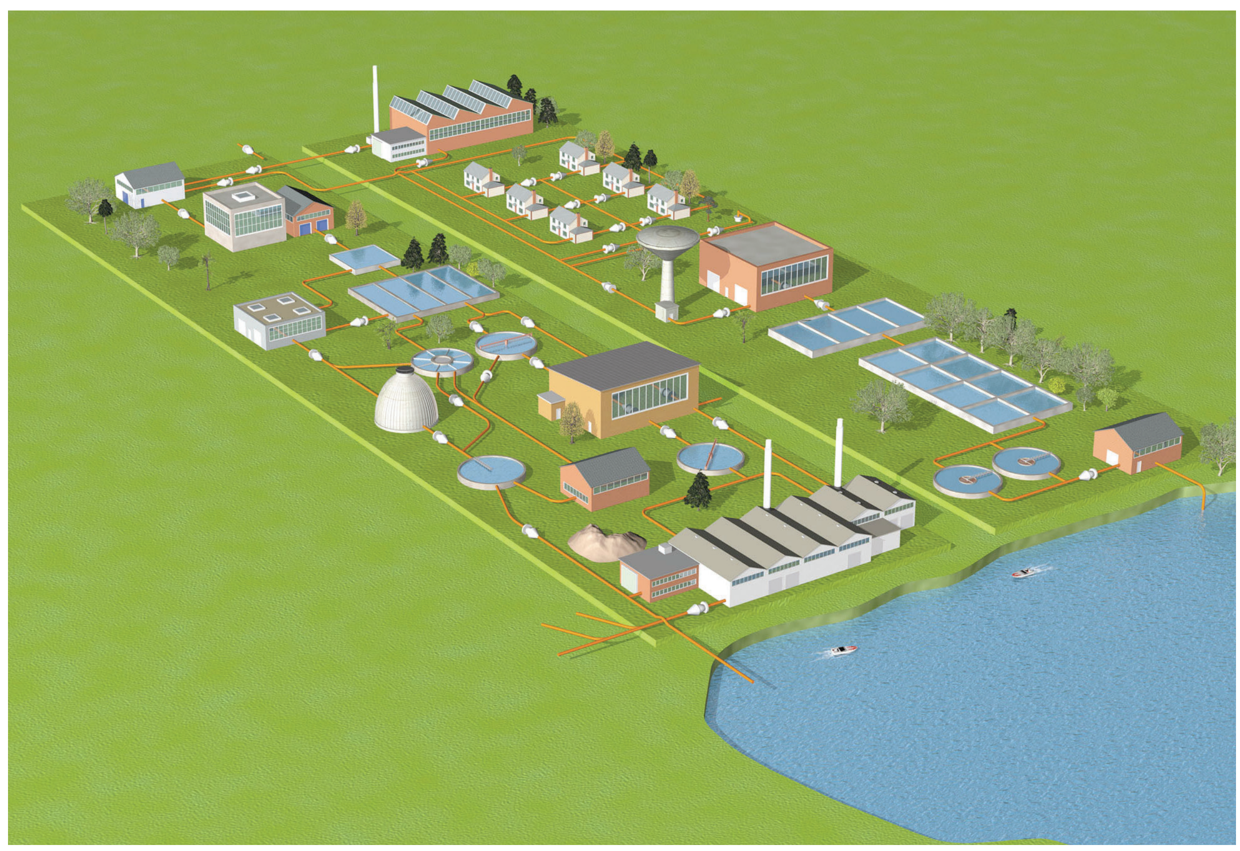

ABB supplies a host of instrumentation equipment for use around the water and waste water treatment cycle

The water industry has the potential to have a great impact on the environment. It supplies around 15 billion litres of water and disposes of over 10 million tonnes of waste water every day in England and Wales. To do this, the industry has over 350,000 kilometres of sewers, 6,000 discharges from sewage treatment works and 25,000 intermittent discharges. So it's hardly surprising that in 2003, water and sewerage companies were responsible for 198 of the most serious incidents of water pollution and 12.3% of the total number of pollution incidents in England and Wales, according to the Environment Agency.

Until now, the water industry has been largely regulated under the Water Resources Act, apart from certain sites which, for example, include new incinerators or other processes specifically bringing them under the Pollution Prevention and Control (PPC) regulations. But the situation is about to change for some sites. Although smaller sites will continue to fall under the Water Resources Act, larger and more complex sites will soon be governed by PPC.

Controlling emissions

Integrated Pollution Prevention and Control is all about taking tighter control of emissions to air, land and water, including waste. The Directive on IPPC (96/61/EC) is being introduced across Europe and will be fully implemented in all member states by October 2007.

Implementation of the PPC regulations, which apply the Directive in the UK, is well underway and has meant a busy time for regulators as the timetable for operators in different industrial sectors to apply for their PPC permits rolls out towards the 2007 deadline.

For the operators of the affected water industry sites, falling under PPC will mean taking on the responsibility of monitoring their own discharges to the environment. According to the Environment Agency, its agents have previously carried out most of the testing and monitoring in the water industry, but PPC instead shifts the regulator's efforts more towards checking that operators have effective systems in place to monitor themselves.

The situation for sites that do not fall under PPC remains unclear. On the one hand, sites under the Water Resources Act have been largely monitored by Agency staff and there is likely to be some pressure to keep them closely involved. This is partly because of the public perception that the agents will safeguard the environment more effectively than businesses. On the other hand, the arrival of PPC has marked a wider shift in the Agency towards a strategy of increasing operator self monitoring.

The best guess at the moment is that this change of emphasis will result in a phased programme to gradually bring most of the water industry into the self-monitoring camp over the next few years.

Self-monitoring

In 2001, the Environment Agency introduced a system known as the Operator Monitoring Assessment (OMA) to apply this self-monitoring approach to processes with significant emissions to air. OMA basically aims to measure how reliable the pollution monitoring equipment and management systems are on a given site.

Although the original OMA scheme does not deal with emissions to water, water companies would do well to familiarise themselves with the overall approach. The Environment Agency is currently in the process of drawing up a similar scheme for environmental, process and effluent monitoring in water and hopes to have it ready later in 2005.

The current OMA scheme has three broad aims and these will

The AV400 series UV analysers use UV light to accurately measure dissolved organic or nitrates levels

ABB's AC200 conductivity cell with in-built temperature sensor is ideal for water treatment applications.

remain the same for the forthcoming water scheme:

- To assess operators' self-monitoring (including monitoring undertaken on behalf of operators by contractors) using a consistent and transparent approach;
- To provide a driver for necessary improvements;
- To contribute to the targeting and prioritisation of the Agency's check monitoring programme.

In other words, it will pay an operator to score highly in an OMA audit, because the auditor will not have to check up on the site so often. Although OMA includes a points-based element, the Environment Agency stresses that the auditor's comments will carry as much weight as the numerical score. This is partly because the scheme must cope with such a wide variety of complex industrial processes that it would be impossible to achieve consistent, meaningful results using a 'tick box' approach.

An OMA audit covers five areas: management processes, the fitness for purpose of equipment, calibration, maintenance and quality systems. This clear auditing template is designed to guide both the auditor and the operator, who may well want to make improvements in the run up to an audit. After all, the Agency's job is to improve the environment, not catch companies out.

Although precise details of the likely self-monitoring requirements in the water industry are still emerging, what is certain that the legislative climate is changing. In its drive to modernise its own monitoring procedures, the Environment Agency's strategy of increased operator responsibility means that now is the time to start getting the systems and equipment in place to ensure compliance with any future regime.

The monitoring toolkit

Each discharge consent is specifically tailored to an operating site and depends on the likely contamination and the local environment. Although there may be other parameters included in a particular consent, there are certain key determinands that form the core of most monitoring requirements.

1. Dissolved Oxygen

Although not regarded as a polluting agent, dissolved oxygen is one of the most important parameters to be considered and can be a good indication of the level of pollution. It is the most critical factor affecting life in surface water. Micro-organisms utilise dissolved oxygen to undertake various biological processes which break down matter to simpler substances. To an extent, the degree of saturation affects these processes. If anaerobic conditions prevail in the watercourse, certain constituents, such as ammonia and hydrogen sulphide, are not broken down as they would be if dissolved oxygen in the water was plentiful.

2. Ammonia

Ammonia is gas comprising nitrogen and hydrogen, which is extremely soluble in water. It has a characteristic pungent smell and is very toxic to plant and animal life. It is formed by the natural product of the decay of organic nitrogen compounds. In aerobic conditions, ammonia is converted to nitrite (NO_2^-) which is

even more toxic than ammonia, and, if there is sufficient oxygen, it is further converted to nitrate (NO_3^-).

Under normal circumstances, this oxidising process is efficiently performed, maintaining the "balance" in the watercourse. However, should large-scale ammonia pollution be discharged into a river, then the cycle becomes overwhelmed. The dissolved oxygen content is then severely reduced, resulting in poisoning or complete death of the aquatic life in the river.

3. Nitrate

Nitrate is the ultimate product when ammonia is oxidised by bacteria in aerobic conditions. Nitrogen fertilisers used in agriculture are the other main source of nitrate found in rivers. Although nitrate is not directly toxic, it can promote weed growth and toxic blooms, creating anaerobic conditions and subsequent poisoning of the water. High levels of nitrate in river water becomes a problem when a potable water abstraction site is located further downstream.

Therefore ammonia and nitrate levels, taken in conjunction, can give an excellent indication of the "state of health" of surface waters, and are important parameters to be considered when contemplating river pollution monitoring.

4. Phosphate

Phosphate is a compound ion of the elements phosphorus and oxygen. It is used in many industrial processes, fertilisers in agriculture, and is used as a water softener in domestic detergents. Far from being toxic it is essential to all living matter. In a similar way to nitrate being a fertiliser, phosphate promotes weed growth and toxic blooms, creating anaerobic conditions and subsequent poisoning of the water.

5. BOD

BOD (Biological Oxygen Demand) is a measure of the quantity of dissolved oxygen consumed from a sample by micro-organisms in the course of their breakdown of organic material. A watercourse high in organic material has a high BOD value, and vice versa. These high BOD values may give rise to anaerobic conditions, producing toxic products and poor water quality.

The standard BOD test usually takes five days to complete. Dissolved oxygen is measured before and after incubation of the sample at 20°C. The difference gives the BOD value in mgl-1 dissolved oxygen. Typically, potable water has a BOD of less than 1, a good river less than 5, and a poor quality river 15 to 20 mg l-1. A sewage treatment plant inlet may be 200 to 400, with less than 25 at the outlet.

6. Acidity/Alkalinity

The typical pH of almost all natural waters is between 6 to 8pH. This is achieved by a fine balance between the aquatic environment and the atmosphere. Uncontrolled discharge of industrial wastes could wipe out this natural buffering effect. Since legislation now prohibits such discharges, the only circumstances that can cause waters to fall outside the natural conditions are accidental spillages of large volumes of strong acid and alkaline solutions.

7. Conductivity

This is a further measurement of river water that can help determine the level of pollution. Chemicals, discharged into a watercourse, may increase the conductivity above a known value, thereby indicating that a pollution incident has taken place. Conductivity measurements are usually taken in conjunction with other parameters.

8. Turbidity or Suspended Solids

These are caused by suspended and/or colloidal material in the water, and determine the clarity of the river. Much particulate organic matter contributes to the suspended solids content, although many other sources may also affect this, including industrial wastes and high river flows scouring the river bottom.

9. Temperature

In general, discharges from industry do not greatly affect the overall temperature of the river. However, some power generating stations can produce localised heating of the receiving surface water, which may affect the natural ecology. The limit in Europe is 30°C but warmer climates may have local restrictions on thermal pollution.

How can ABB help?

ABB manufactures and supplies a wide range of equipment for water monitoring, ranging from individual sensors and analysers through to complete packaged systems. This range is further supported by a host of other instrumentation products suitable for water industry applications, including recorders, actuators and positioners, controllers, flowmeters and equipment for measuring pressure and temperature. To find out more about ABB's range of instrumentation products, visit www.abb.com/instrumentation.