Sampling in Water and Wastewater – Protecting our Environment

In recent years there have been active drives by the government to enforce companies throughout industry to implement measures to reduce waste and harmful discharges into the environment. As a valuable resource the importance of a safe water supply, efficient wastewater treatment and pure surface water should not be underestimated. This has contributed significantly to the rise in demand for correct water sampling to improve water quality by reducing the discharge of waste and harmful emissions into the environment.

Louise Snaith, Analytical Product Specialist at Endress+Hauser Ltd discusses the importance of regular sampling and analysis to achieve accurate and reliable samples whilst addressing how informed sampling can impart significant environmental and cost savings.

The various sampling methods are ultimately dependent upon the individual process. Reviewing the efficiency and control of water treatment plants in order to qualify losses in industrial processes is a common requirement, as is monitoring waste discharges. Sampling not only monitors the effluent discharge in industrial applications but also identifies any potential process issues by further analytical testing of the sample. From the results, a calculation is performed to charge the customer for the effluent or alternatively fine the customer if regulations have been breached.

Regulatory bodies and systems are in place to ensure that restrictions are upheld; one such system is the PPC (Pollution Prevention and Control). This is an environmental protection permit system, which is enforced and regulated in England and Wales by the Environmental Agency (EA) and in Scotland by the Scottish Environmental Protection Agency (SEPA). The PPC permit covers emissions to air, water and land, waste production, use of raw materials, energy efficiency, noise pollution, prevention of accidents and risk assessment. The PPC considers the effect of industries on the environment and raw material consumption (including water) to ensure adequate measures are taken to avoid pollution risks. The company is charged by the Environment Agency for discharging waste into the water system and is fined if the limits are breached. In order for companies to save money, accurate samples should be taken, so that a true representation of what is happening on-site is reported.

Sampling is a method employed by regulatory bodies to monitor the quality of effluents from agriculture and industry in order to determine the effects of specific discharges on the receiving water network and hence to highlight potential pollution sources.

The positioning of the sampler is integral to ensuring the results are fully representative of the water sample as a whole. Only a correctly collected sample can be monitored and analysed with accuracy. The automatic sampling device (either portable or stationary) draws liquid from the sampling point and distributes it into individually defined bottles. In order to avoid any biological changes in the sample after collection, the sample vessel is cooled to 4°C to prevent organisms from altering the composition.

There are three main sampling techniques:

- Flow proportional
- Time proportional
- Quantity proportional

The method employed is dependent upon both the individual application and legislative requirements. For example, in an industrial effluent treatment plant, the flow rate will change depending on production schedules and shift patterns.

Flow proportional sampling is based upon taking varying quantity samples at fixed time intervals. The sample size is dictated by the flow rate of the fluid at that particular point. This method gives an overall indication of the actual process discharges and inflows and can also be used to look at total loading into the water table.

The time proportional principle works by programming the sampler unit to take equal quantities at set time intervals. This method is used when the flow rate is constant as the consistent sample volume can only be guaranteed when the flow rate is consistent.

In quantity proportional sampling, set size samples are taken but at varying time intervals based on the flow rate of the process. The aim here is that more samples are taken at higher flow rates ensuring a representative overall sample is achieved.

There are various ways in which the sampler can be set up for distribution. Once a sample has been taken, it must be preserved and then either taken away for analysis or analysed on-site by various analytical techniques. One sample collection arrangement can consist of 24x1 bottles with a litre sample taken every day for 24 days. In this way, the most and least pollution occurrences can be calculated. Another method of collecting samples is by using a 30-litre composite container. Here, samples are placed into a large container and when they are full they are analysed as before. In this method, the times when the pollution is high are taken into account and balanced when the effluent is less potent. This is a considerable benefit as charges incurred by the plant can be calculated as an overall limit rather than for individual occurrences.

Once a sample has been taken and preserved, it must then be analysed for quality and pollutants. Typically in a wastewater treatment plant, the parameters measured are pH, temperature, redox potential, conductivity, dissolved oxygen, turbidity, total organic carbon (TOC), nitrate, chlorine, ammonia and phosphate. Some of these parameters require laboratory analysis, but others can be fitted into a sampling station to give a fully automated measurement station for continuous monitoring of the sample media. A complete measurement station in conjunction with the sampler construction can be designed depending on the required online parameters. The modular system consists of single units that can be specifically adapted to individual measurement tasks enabling a sampling station to collect and measure pH, temperature, redox, conductivity, dissolved oxygen and turbidity. Additionally, bespoke systems can be designed to include other parameters, for example ammonia, nitrate and so on. Once the measurements have been taken, the results can be sent back to a control system or stored on a database, so that compliance with discharge limits is traceable.

Some parameters are monitored more intensely than others as they can pose a serious threat to the environment. Ammonia is becoming increasingly important in effluent management as it has a detrimental effect if excess quantities are present. For a wastewater treatment plant to work efficiently, the amount of ammonia in any sample should be reduced to between10-12mg/litre of nitrogen. High levels of ammonia not only result in visible discolouration in rivers, streams and reservoirs but also when oxidised, produce nitrates and nitrites. These oxidised products can cause an algal bloom which creates poor water quality. This process is known as eutrophication and reduces the amount of oxygen content in the water thus considerably affecting aquatic life. By carrying out careful and informed sampling and monitoring, such

events can be avoided. Sampling will ensure that the levels of any configured parameters are known and allow prevention of inconsistent results ensuring the water quality is of a high standard. In order to achieve good, effective and accurate samples, it is important to ensure the correct position of the sampler, the configuration of the parameters and the most appropriate sampling method before analysis can be carried out. Taking time to consider these issues will have considerable environmental and cost implications.

One of the most important times in which to ensure accurate sampling is at the discharge point of an effluent treatment plant. One example is at an edible oils production facility, where effluent is treated with sulphuric acid to separate out the oil residue. The water is then decanted and caustic is added to correct the pH. Effluent at this site can be discharged at any pH level; however, in order to keep costs to a minimum, it is better to keep the pH around 8, as caustic is an expensive consumable. Regular sampling at this point can guarantee the correct pH level of the effluent leaving the site resulting in considerable financial benefits to the plant. This is actioned by taking a sample directly from the line, four times daily and placed into a sample bottle recording the date and time. This guarantees the security of the samples and ensures the plant complies with existing regulations. The company is therefore charged correctly for any discharge and in the most cost-effective way as use of caustic is monitored and kept to a minimum.

Whilst the choice of sampling equipment is determined by a variety of factors, the samplers can be tailor-made for each individual application. The factors are often determined by site conditions or the sampling regime required. However, selection of the most appropriate technique is important to achieve representative, useful and contamination-free samples.

In order to achieve good, effective and accurate samples, it is important to ensure the correct position of the sampler, the configuration of the parameters and the most appropriate sampling method before analysis can be carried out. Taking time to consider these issues will have considerable environmental and cost implications. We all have a responsibility to ensure a safe and clean environment and it is vital that we acknowledge the importance of regulations in place to preserve and protect it.

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