Minimising costs through process optimisation

The control of industrial processes can be a complex operation involving multiple valves, sensors and controllers which means there are many considerations when looking for opportunities for process optimisation. Using best practice and ensuring control protocols are updated when process changes are implemented however, ensures the process remains efficient and effective.

Greg Wainhouse, UK Water Segment Manager at Bürkert, looks at some examples from different industries, where process optimisation can deliver significant improvements and reduce costs.

Process control engineers are constantly aiming for perfection while all the time tackling the challenges that stand in their way. From variable inputs to changing conditions and complex infrastructure, there is always another obstacle to overcome, but by taking advantage of expertise within the industry, it is possible to make significant practical improvements.

Waste water processing

One of the major challenges in the water treatment sector involves the sludge dewatering process, which in many cases involves high speed centrifuges that separate the solid and liquid fractions. To assist this process, a polymer is added to the sludge to help bind the solid particles together. The goal is to produce a final product that has the right consistency that makes transport efficient, without moving excess water to the fields, where it is spread as agricultural soil enhancer.

The process has a number of variables, including the percentage solids of the raw sludge, the flowrate of the sludge, the amount of polymer being added and the speed of the centrifuge. Of these, the solid content of the sludge is crucial to determine the settings for the rest of the process.

There are several ways in which this can be determined, including a process where a sludge sample is placed in a petri dish, and the water is evaporated off to obtain the mass of the solids. This is not a very efficient process and can take 45 minutes to complete. Once the results are available, the centrifuge and polymer settings can be adjusted and an improvement in the consistency of the dewatered sludge should be apparent.

However, changes in the solids content can occur frequently, which makes this process quite ineffective and labour intensive. In addition, it is a reactive process, more often used when the consistency of the dried sludge doesn't meet expectations. During the time taken to observe the change, complete the test and alter the settings, the centrifuge has continued to discharge a sub-standard end product.

Dealing with solids in suspension

In the first instance, assessing the percentage of solids using a turbidity sensor located on the intake to the centrifuge will significantly increase the response time to any changes. These sensors look at refracted light to provide an approximation of the solids loading of the incoming sludge, but they can suffer from fouling problems, and the calibration process can be interpreted differently by various operators.

By constantly monitoring the inlet of the process, adjustments can be made quickly and the amount of processed sludge that falls below the required standard is minimised. Further improvements can be made by adding a flowmeter, or better still a device that provides a mass flow measurement.

By creating a pro-active system that makes adjustments based on data from the inlet, as opposed to a reactive system that observes the results before implementing a change, process engineers will be following best practice. Furthermore, this setup reduces the amount of operator intervention and delivers a more stable output.

Brewing perfection

An important part of the brewing process is adding oxygen to the wort to allow the yeast to thrive and create the alcohol and carbon dioxide. After the boiled wort has been chilled to fermentation temperature, oxygen is used to start the fermentation process.

If air, which contains 20% oxygen, is added, then the process can only achieve an O2 concentration of eight parts per million (ppm). For higher levels, around 10 ppm, typically used by commercial breweries for higher strength beers, pure oxygen is required.

However, the ability of the wort to absorb oxygen is affected by its specific gravity, which is measured on the Plato gravity scale. This measures the concentration of dissolved solids in the wort. Furthermore, each yeast strain has an optimum oxygen level and if this is not achieved precisely, the optimum fermentation rate will not be achieved.

Mass flow accuracy for gasses

Some of the most important flavour contributors to beer are fermentation products such as esters, higher alcohols and sulphur compounds. The concentrations of these flavour compounds will be altered if the growth characteristics of the yeast are less than perfect.

Achieving the optimum O2 level in the wort for each beer therefore is very important in terms of product quality, so an effective process to control the oxygen levels is essential. Using a mass flow sensor to establish the concentration of dissolved solids, and total volume, coupled with a mass flow controller to deliver the gas, is an efficient starting point.

To improve the accuracy of the system even more, the signal from a dissolved oxygen (DO) probe in the fermenter vessel can provide feedback to adjust the setpoint and obtain the exact level of dissolved oxygen required. This offers the opportunity to maintain precise levels of dissolved oxygen which have a major impact on the quality of the final product.

pH in water

Carbon dioxide (CO) is used to reduce the pH of the water for a number of reasons. Primarily, it is a gas that is easy to handle, non-corrosive and its most appealing feature is that it will not lower the pH of water below 7.0. In addition, the only maintenance required for the dosing system is to replenish the gas cylinders periodically.

The control structure for this dosing system needs to cope with variable flow as well as decreasing gas pressure as the volume in the cylinders deceases. Using a mass flow controller that is calibrated for the gas and delivers accurate measurements independent of temperature and pressure, is very important.

Many will use a pH sensor after the dosing point and use this information to adjust the gas flow rate. This reactive process can be optimised by adding a pH sensor to the input side and using the readings from this sensor to set the CO2 dosing rate. The second sensor then acts as validation of the process setting. This offers a quicker response to changes in the pH levels at the input.

Optimised cleaning

For those working in hygienic applications, clean-in-place (CIP) is a very important process that maintains the cleanliness of equipment. Using a combination of chemicals, water and heat, the process offers a very efficient method of cleaning vessels and pipework without dismantling them.

However, time taken for cleaning is time lost from production, so this needs to be kept to a minimum whilst also ensuring that the process has been effective. Optimising the control of CIP reduces costs as well as minimising chemical usage and improving productivity.

The CIP process can involve a range of chemicals that are used to clean and disinfect the equipment. The concentration of these chemicals is very important in achieving an effective cleaning cycle without wasting expensive materials. Also, using control systems that are purely timer-based offers no confidence in the effectiveness of the process and also retains no meaningful data, which may be required for regulatory compliance.

By examining the temperature and the conductivity of the cleaning fluid it is possible to determine if too much energy or too much chemical is being used. Any reductions in energy consumption or raw materials will have a beneficial effect on operational costs. Working with sensor manufacturers that have experience in this application to create a more sophisticated control and sensor feedback-loop system can therefore offer many benefits.

Correctly positioned pH sensors for example can provide data on the effectiveness of the process, while conductivity sensors can provide a measure of contamination – once this figure has reached almost zero, the procedure can then be concluded with minimum delays to production.

Streamlined processes

Ultimately, improving data collection, interpretation and analysis can offer many advantages. Working with experienced process control manufacturers, such as Bürkert, can yield benefits across the board. From designing new installations to improving the efficiency and effectiveness of existing equipment, getting the right sensor in the right place will have a significant impact.

Process optimisation is primarily about acquiring the correct data and using it as effectively as possible. This requires experience in the application as well as with the equipment itself to ensure a cost-effective and reliable installation. Bürkert has over 100,000 catalogue items, including cutting-edge flow measurement equipment that can also provide mass flow data.

This expertise in manufacturing and expansive knowledge of numerous applications helps customers to reduce operating costs, improve productivity and ensure compliance with regulatory bodies where necessary.

Image Captions:

Image 1: Comprehensive process control installations can deliver considerable savings.

Image 2: Automated analysis saves time for many industries.

Image 3: Precision control of cleaning processes in hygienic applications can improve productivity.

Image 4: Oxygen levels can be accurately controlled during fermentation to ensure optimum product quality.

About BURKERT

Burkert Fluid Control Systems is one of the leading manufacturers of control and measuring systems for fluids and gases. The products have a wide variety of applications and are used by breweries and laboratories as well as in medical engineering and space technology. The company employs over 2,500 people and has a comprehensive network of branches in 36 countries world-wide.

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