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White Paper

Chemical dosing and blending - ***the role of precision actuators***

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Sector: Oil & Gas, Chemicals, Power Generation, Water Treatment, Food, Beverages, Pulp & Paper
Category: Electric Actuators
Products: CMA, CVA

Overview

Chemical dosing is the introduction of a measured quantity of a chemical into a process fluid so that a chemical reaction occurs in the process fluid or a particular blend of fluids is achieved.

Process control actuators have an important role to play in chemical dosing and blending. Constant, precise control of the volume of fluid injected into the process is dependent on the accuracy and reliability of these actuators. Regardless of the environmental conditions, these electromechanical devices must maintain precise control as required by the process demand.

In almost every industrial process chemical dosing can be found in one form or another. Oil and gas industries use chemical dosing in upstream, midstream and downstream applications to enhance production and protect equipment. Power plants use chemical dosing to demineralise the make-up water in the steam circuit, as well as to remove oxygen and other undesirable elements. At the other end of the industrial spectrum, the soap and cosmetics industry use chemical dosing to add perfume and colour to their products. The beverage industry uses dosing to measure precisely the mixing of syrup concentrate with water to produce colas and other beverages. Some examples of chemical dosing in various industries can be found in the table below:

Industry	Dosing example
Oil & Gas Production	De-emulsification, Biocide, Drag reducer, Dehydration, Wax control, Scale control
Power Generation Plant	Boiler water treatment, Feed water conditioning, Demineralisation
Petrochem and Refining	Crude desalting, Anti-gumming, Corrosion inhibition
Sugar	Boiler water treatment
Food & Beverage	Edible oil additives, (Phosphoric acid, Citric acid, Caustic Soda), Blending
Water & Waste Water Treatment	pH. control, Disinfection, SBS de-chlorination, Fluoridation
Pulp and Paper	Alum, H2SO4 for pH. control of pulp

There are many different methods of introducing chemicals into a process fluid. The most usual is to pump the chemical into the fluid using a positive displacement pump. These pumps can come in many forms, however their common feature is their ability to vary their volumetric flow rate.

The peristaltic type pump, for example would vary its speed of rotation so that the volume delivered would increase as the speed increases. The reciprocating type pump, using a piston or diaphragm, could either vary the length of the stroke or the speed of reciprocation. Precision metering pumps usually have a micrometer adjustment on the stroke length to facilitate fine control of the stroke length and so the volume delivered. The American Petroleum Institute (API) has the API 675 standard for controlled volume positive displacement pumps to which many pump manufactures comply.

A piston pump equipped with a Rotork CMA modulating electric actuator for injection duty.

The alternative to positive displacement pumps is injection via a precision micro-valve. These are usually small bore valves, often needle valves, with the ability to change the volumetric flow by incremental changes in the needle position.

Most chemical dosing processes have a measuring element that allows the process fluid to be monitored. This is to ensure that the correct amount of chemical is being dosed to achieve the desired reaction. Too much chemical would be wasteful and too little would leave the process fluid insufficiently treated.

For example, in a water treatment plant where the pH of the water is the process variable, the pH monitor would feedback the pH reading to a controller, which in turn would adjust the control element manipulated variable (pump speed or stroke) to maintain the set point.

In some processes the chemicals used are expensive and so the need for precision dosing is of economic importance. An example would be corrosion inhibiting chemicals used in an offshore production platform.

In other processes the tolerance band on the process variable could be very tight for other reasons, such as quality constraints. So precision in dosing would be of critical importance to the composition of the product; for example the flavouring additives in foodstuffs.

Some industries operate in harsh, hazardous or hostile areas requiring the metering equipment to be not only accurate, but also robust and resistant to the local environment. This applies not only to the pumps and valves involved in the dosing but also the control elements such as valve actuators or pump stroke adjustors that are operating in the environment.

Valve and pump automation equipment therefore needs to have the appropriate hazardous area certification as well as the environmental

protection requirements - the appropriate IP rating. They must also be robust and proof against any corrosive chemicals that may be in the immediate environment.

Not only does the equipment need to survive in this environment, but it also needs to adjust the pump stroke or valve position as frequently as is required, up to and including constant modulation. It also needs to do this with the minimum of maintenance for the life of the plant. This is a significant requirement, particularly as this equipment is often electronically controlled either with a 4-20 milliamp control signal or a digital field bus communications system. Physical protection of the associated microcircuits and components is essential.

Today's process control actuators for valves and stroke adjustors are able to resolve the problems of fine control in hostile environments by utilising robust hazardous area certified enclosures, coupled with high precision motion control technology and field bus compatible control interfaces.

Application examples

Oil and gas production

There are many reasons to inject chemicals into oil and gas production wells. Depending on the well there may be problems of wax, corrosion, microbes or other items that may be need chemical treatment by dosing. These facilities may be offshore or onshore, so heavy duty, hazardous area certified equipment is essential. The most common method of injection for these applications is the electrically driven reciprocating metering pump. Various chemicals can be injected into the flow from the well to reduce scale, inhibit corrosion, reduce drag and for microbial control to remove bacteria.

Many thousands of process control actuators have been supplied to metering pump manufacturers for these applications.

Process control actuators for metering pump stroke adjustment on corrosion inhibitor service in Saudi Arabia.

Process control actuators for stroke adjustment on metering pumps in the Emirates.

Gas production

A common unwanted by-product of gas production is the water that is often present in gas wells. Although separators remove the majority of the liquid water, there is often water vapour entrained in the gas. This can freeze in low temperatures to form hydrates in the gas flow lines which could cause blockages in the pipelines or process equipment.

Many gas production facilities use regenerative glycol dehydration equipment to remove most of the residual water vapour. However, an alternative is to inject methanol directly into the production gas pipeline. The methanol prevents hydrates from forming in the gas line. In some circumstances this method has been found to be less costly and simpler than conventional glycol dehydration.

Precision automated methanol metering valve in gas hydrates mitigation process.

Potable water treatment

Municipal water treatment plant in the UK.

At treatment plants the water needs to be pH controlled before being pumped to the consumer. A lime slurry is therefore introduced into the filtered water. In the application illustrated above, two inch and eight inch valves were used to modulate the flow into the filtered water by using the two valves in parallel. This gave the rangeability needed to accommodate the variation in water flow rate. Originally standard valve actuators were used but they could not provide the accuracy required or the robustness for constant movement. They were replaced with Rotork CVA process control quarter turn valve actuators capable of constant modulation and high precision. A secondary benefit was the controllability and precision of these actuators such that only a single eight inch valve now needs to be modulated to provide tight control on the pH.

Water treatment plant in USA.

At the water treatment plant in USA illustrated here, chemicals are dosed both by peristaltic pump and by pinch valves operated by CVA process control actuators.

Water treatment plant in Canada

At this water treatment plant in Canada the de-chlorination dosing is performed with precision automated control valves. SBS (sodium bisulphite) is injected into the backwash process water by micro-valve to ensure the elimination of residual chlorine prior to discharge into the river.

In these applications, it is important to note that the constant movement demanded by the process necessitates the use of a process control actuator. This is not only because of the higher precision achievable with a process control actuator, but the constant movement required to maintain the process. Today, electric process control actuators deliver continuous, repeatable modulating control with a programmable fail to position option. Resolution, repeatability and hysteresis performance is quoted at less than 0.1% of full scale, offering suitability for the most demanding control valve applications whilst a rugged, double-sealed IP68 watertight and explosionproof enclosure enhances long term maintenance-free reliability in the harshest of environments.

rotork®

Redefining Flow Control

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