The impact of actuation developments on fugitive emissions

Efforts are being made worldwide to reduce emissions from industrial activity - from vehicles to virtually every manufactured product - led by policies and then by the products that lower or eliminate emission levels as demanded by the general public. Manufacturers are committed to investing in innovation and technology to make processes more efficient, modern, economical and environmentally friendly.

By Derek Olson, Business Development Director, Rotork Controls Division

Oil and Gas

The oil and natural gas exploration and production industry is growing rapidly; the number of wells in service and the potential for greater emissions from oil and natural gas sources is also increasing. Most of these wells and flow lines are unmanned and located in remote areas that are difficult and expensive to monitor. As a result skilled technicians must check data and perform manual valve shutdowns, increasing costs for the time to travel to site, identifying the problem and stopping the flow, which is not cost-effective or practical. Therefore using automation in the form of actuators provides an ideal solution to control valves at the remote wells. In the USA the EPA mandates now limit this process in order to reduce greenhouse gas emissions to the atmosphere. Around the world, similar mandates have been or are being introduced and manufacturers must respond with effective solutions.

The EPA summary of alternative mitigation techniques for pneumatic controllers includes the following data concerning the use of mechanical and solar powered systems in place of bleed controllers:

Description	*Electricity or small electrical motors (including solar-powered) have been used to operate valves. Solar control systems are driven by solar power cells that actuate mechanical devices using electric power. As such, solar cells require some type of backup power or storage to ensure reliability.*
Applicability	*Electric powered valves are only reliable with a constant supply of electricity.*
Efficacy and Prevalence	*100% emission reduction, where applicable.*

(Source: Report for Oil and Natural Gas Sector Pneumatic Devices, Review Panel April 2014; US EPA Office for Air Quality Planning and Standards)

The data recognizes that electric control valve actuators which are capable of delivering an efficient and reliable process control solution can eliminate venting and greenhouse gas emissions in compliance with new environmental protection legislation.

Electric actuators significantly improve traditional performance

Modern electric control valve actuators can provide excellent performance and are ideal for a wide variety of process applications. They are also suited for situations where main power isn't available, such as remotely sited shale gas installation. Solar powered DC electric actuators are ideal for such applications.
Important considerations for control valve actuator selection are resolution, repeatability and precision. Resolution is defined as the minimum change in demand signal that results in a change in output when moving in the same direction. This is an important measurement as it determines how finely the control valve can be positioned to affect the process.
Repeatability is the closeness of agreement of a number of consecutive measurements of the output for the same value of inputs when approaching from the same direction. The combination of resolution and repeatability impacts the precision in which the control valve can be positioned.
Accepting an industry-standard 4-20mA control signal, modern electric actuators can provide resolution, repeatability and hysteresis performance that is quoted at <0.1% of full scale, making them suitable for the most demanding applications, while low power consumption enables operation from renewable power sources such as solar panels.
Electric actuators, with their mechanical drive train, are inherently stiff and hold the set point, under surge or cavitation conditions, the valve will hold its position and maintain the process set point.
The benefit of precise control on process variability is well documented; the greater the precision, the greater the control that can be exerted over the process. That is, a greater precision can significantly reduce process variability, which can have a positive impact on the quality of the product produced as well as the production capacity the plant can achieve. These benefits accrue from using a more precisely controlled valve. Actuators that are able to deliver high repeatability and high resolution are therefore more valuable to the process than actuators that do not have this capability.

Technological advances

Until recently, the electric drive of electric actuators was too slow to provide the response required or the motor and drive train inertia of high-speed actuators precluded precise positioning. New control technology has overcome these problems by sensing not just the output position of the actuator but also the motor position and speed.
This means that in the control circuit the output of the actuator is fed back and compared to the demand position signal. The resulting error signal is fed into the motor speed profile. The actual speed of the motor is then compared to the demand speed and that error signal in turn is fed into the motor controller. The accuracy of the sensors coupled with the control logic circuit can result in the elimination of overshoot normally experienced on "sticky valves."
By eliminating overshoot, process variability is significantly reduced and many significant benefits result. Also, electric control valve actuators eliminate a common perception that electric actuators are susceptible to mechanical wear when used for constant modulation. Today's electric actuators can achieve many millions of cycles, even under the full rated load. In fact, some tests have shown that over 200 million cycles can be achieved even at elevated loads.
Another consideration is the ability to fail to an open/close position. Recent developments in electric actuators have utilized stored energy in super capacitors. The electrical energy stored in the capacitor can generate high power, enabling the electric motor and drive train to position the actuator not only to an open or close position but to any selected intermediate position. This versatility can deliver additional benefits to some processes where complete shutdown of the process could be a problem.

Case Study - Gas Blending

Fluxys is the independent operator of the natural gas storage and transmission system in Belgium, supplying domestic and industrial consumers throughout the country. Because the natural gas can come from different sources and the composition of each source varies, the quality of the gas is closely monitored for calorific value and density at blending stations. The gas blending process is therefore a critical part of the transmission and storage structure, impacting on product quality, environmental regulations and profitability.

Engineers installing an ATEX certified explosionproof Rotork CVL-5000 actuator at a Fluxys gas blending plant.

Wishing to improve the blending process, Fluxys identified valve actuation as a key area. Improving process valve response times whilst reducing dead-time and overshoot would increase control efficiency and eliminate potential cycling and variability problems. If an electrical solution could also be found, it would reduce operating costs by eliminating the requirement to waste gas through venting to air as determined by existing equipment and improve environmental performance by reducing greenhouse gas emission. Fluxys has decided to adopt the Rotork CVL-5000 as the standard actuator for its gas blending plants; over time, existing valves will be retrofitted whilst new valves will have the actuators factory fitted. It is estimated that the improved performance achieved by each valve installation can be accompanied by an annual saving of up to 5000 euros in operating costs per unit.

Glass Manufacturing

Energy and emissions are the largest challenges for many industries. Glass manufacturers worldwide focus to improve sustainability efforts and reduce their carbon footprint, and furnace efficiency is the first place for improvement.

Temperature and pressure control in the furnaces is essential for improved production, product quality, and ultimately a more efficiently operating furnace. Actuators play an important role in newly installed gas-oxygen furnaces at plants worldwide where newly constructed, low-energy furnaces are heated using natural gas and purified oxygen rather than natural gas and the oxygen present in the air. This uses less energy and substantially reduces emissions with significant reduction in nitrous oxides, or NOx.

Actuators are used for the critical control function of valves for controlling the temperature and pressure in the furnaces by regulating the air and gas mixture with extreme precision. Maintaining a constant temperature and pressure is essential for energy efficient glass making. Traditionally, the industry uses a variety of actuators for the modulating and isolating valves involved, but has recognised the need for a more reliable and energy efficient universal solution for this application.

Conclusion

The technological developments incorporated in the new generation of electric actuators offer many significant functional and performance advantages and are ideal as an alternative technique to mitigate fugitive emissions. Additionally electric actuators deliver improved process variability due to the precision of their performance. The introduction of the smart gearbox enhances the ability to promptly detect fugitive emissions from the valve itself, facilitating timely repair or replacement.

About the author

Derek Olson is the Business Development Director for the Controls Division of Rotork. A veteran of serving the flow control and automation industry, Derek has been with Rotork for nearly 20 years. In that time he has held a number of key strategic business positions in both the UK and USA with responsibilities for systems integration and the manufacturing of products for the power and process control industries.