Meeting Emission Control Through Improved Actuation

Introduction

Reducing fugitive emissions, particularly methane, is a major priority in the fight against climate change. Although valves and actuators have been the focus for reduction efforts because valve leakage accounts for more than half of total fugitive emissions, the problem is mainly old valves that weren't designed using the latest materials and technologies. New technologies can also help to detect system leaks.

The task of complying with applicable standards can prove challenging. However, steps can be taken to ensure the highest degree of reduction from fugitive emissions. This article will explore these considerations and how they affect actuator selection.

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Emission Control Technology in Oil & Gas Production

Oil and gas wells, pipelines and processing facilities are receiving heightened attention from regulators and environmentalists.

Pressure is mounting on the global oil and gas industry to reduce its environmental footprint while, at the same time, the industry is under significant pressure to reduce costs.

In the USA, the Environmental Protection Agency (EPA) recently adopted three new rules that will curb emissions of methane and VOC for the first time. These rules require owners and operators to find and repair leaks, mandate fixed inspection schedules and urge the use of special equipment such as cameras and analyzers to find leaks.

In October this year, the EPA also agreed to review the accuracy of its decades-old estimates of air pollution from flaring near oil and gas drilling sites and refineries.

The control of gas and fluids is undertaken by large numbers of valves at the wellhead. Traditionally spring diaphragm actuators, powered by the produced gas, were used to actuate these valves. Because they released gas at each operation into the environment, the EPA mandates now limit this process in order to reduce greenhouse gas emissions to the atmosphere.

The EPA suggests that as many as 80% of high-bleed valve and control devices can be replaced or retrofitted. With the use of electric actuation the cost of the implementation is usually recovered within a year.

Fig 1 - Many shale wells and flow lines are unmanned and located in remote areas that are difficult and expensive to monitor.

Electric actuator replacement for natural gas powered pneumatic devices on control valves can help eliminate methane and VOC emissions, updating equipment to maintain technology can improve the operator's return on investment and profits. From the producer's point of view, eliminating emissions allows more gas to be sold, regaining the lost vented gas revenue and decreasing the need for emission monitoring.

Remote oil and gas wells often use the produced gas to power valves and equipment and these generate emissions to atmosphere.

Fig 2 - In the coal mining industry, remotely sited wellhead skids designed for degassing duties are used in conjunction with control and telemetry systems to enable methane and other flammable gases to be extracted from underground coal seams prior to the commencement of mining operations.

Smaller, continuously modulating electric actuators are now a possible alternative and do not emit fugitive emissions. Efficient electric motor design and robust control improve reliability.

New USA government regulations require all pneumatic controllers at the wellhead to have a maximum consumption of 6 SCFH (Standard Cubic Feet per Hour). In Canada and other countries, carbon credits can provide economic incentives to utilize low emission products, so the challenge is to provide controllers which reduce or eliminate these fugitive emissions.

Many shale wells and flow lines are unmanned and located in remote areas that are difficult and expensive to monitor. Skilled technicians must check data and perform manual shutdowns, increasing costs for the time to travel to site, identifying the problem and stopping the flow, which is not cost-effective or practical. Actuators provide an ideal solution to automate valves at the remote wells.

Traditionally, spring diaphragm actuators powered by the produced gas have been used, but EPA mandates now limit this process to lower fugitive emissions. A key objective is therefore to provide an efficient and reliable process control actuator which can be retrofitted on installed valves to improve the level of control without venting gas and with the low power demand required for renewable energy sources.

Emission Control Technology in Water Treatment

In this industry, operators are making capital improvements to plant-wide facilities at metropolitan wastewater treatment plants throughout the USA. Old landfill sites are filling up and new ones are becoming increasingly difficult to obtain. Therefore, waste reduction through incineration is becoming a favored disposal practice.

In 2011 the EPA issued new, more stringent air emission limits for existing and new sewage sludge incinerators. Compliant equipment should now be in operation. The upgrade is vital to meet the Maximum Achievable Control Technology (MACT) standards. Electric actuators can make important contributions in all areas of these plants.

Biological sludge is disposed of by incineration with the carbon, nitrogen and sulfur removed as gaseous by-products and the inorganic portion removed as ash. After liquid is removed from the sludge, the remaining cake is burned and water is used to cool down the exhaust to prevent venting out of the scrubber. This incineration and water cooling process eliminates any visible plume and meets the most stringent air pollution codes.

Many wastewater treatment plants are designed for increased rainwater and effluent treatment capacity with improved treatment quality and reduced environmental impact. These plants incorporate a range of integrated energy saving and energy recovery processes including solar water heating, heat pumps, heat recovery from final effluent and biogas production from sludge digestion processes. Significant biogas production can be used as an economical energy source.

The biogas is produced in a process which uses a combination of solids filtration and biological aeration to remove pollutants including ammonia. Electrically actuated valves enable these plants to run efficiently as well as reducing air wastage.

Emission Control Technology in Power

In today's environment, power plant managers are continuously challenged with new requirements demanding higher efficiency, lower emissions, greater fuel flexibility, higher availability and lower operating costs.

Standards for the control of NOx (Oxides of Nitrogen) were originally established in the Clean Air Act of 1977. These standards were intended to promote the use of the air pollution control technologies in new generating units. As a result, a number of technologies for reducing NOx emissions have been developed and are commercially available.

In general, combustion controls are the least-cost approach for obtaining an initial reduction in the uncontrolled NOx emissions on any stationary furnace. Combustion controls reduce the level of NOx emissions by altering or modifying the firing conditions under which combustion is achieved. The efficiency of the combustion process and the level of carbon dioxide (CO2) emissions are also improved by the implementation of combustion controls.

The ratio of air to fuel is a critical factor in efficient combustion. It is therefore important to achieve precise regulation of the final control elements handling the mix of fuel and air in order to optimize performance. Precision electric actuators are the key to this.

Striking the right balance can be difficult. An insufficient supply of air will result in incomplete combustion. If air levels are too high, heat efficiency is reduced because the extra air carries more heat away in the flue gas, resulting in a lower overall boiler fuel-to-steam efficiency. The ideal situation is to achieve a fuel to air ratio that minimizes excess air as far as possible. However, operating at this point can present the risk of a plant running outside of its design parameters, where there may be too little air for excessive air designs or excessive air for low air designs.

The precise control and fast operation of dampers is the vital requirement. As a result, in recent years electric valve and damper actuators have grown in importance in modern power plants. Highly responsive and accurate actuators help plants achieve the best fuel, air and operating pressure, improving the fuel efficiency of their processes and helping to reduce CO2 and NOx emissions.

The Boiler Maximum Achievable Control Technology (Boiler MACT) Rule requires boiler owners to carry-out tune-up procedures either annually or bi-annually. Two major components of the tune-up procedure where damper drives directly influence boiler performance are the accurate control of the air-to-fuel ratio and in optimizing CO2 emissions. Many boilers employ old-style technology that is neither accurate enough nor powerful enough to position the dampers quickly and precisely to mitigate emissions.

Modernizing a utility boiler is a common challenge with the aging of many of today's existing power boilers. While the equipment ages, the experienced manpower decreases in many utility plants throughout North America. Couple these conditions with increasing environmental pressure to reduce emissions and you can better understand the squeeze that many utilities are experiencing.

To meet these challenges, plant staff are continuously designing and installing equipment upgrades. These upgrades also create new opportunities for achieving performance and profitability improvements through advanced control using electric actuators.

These can be summarized as:

- Improved boiler draft control
- High speed continuous modulation of ID/FD fan and inlet guide vanes
- Improved modulation and control of secondary air dampers
- Improved automation and burner management
- Simple commissioning and diagnostics
- Quick response to plant demand
- Improved reliability in high temperature environments
- Efficient fuel control
- Low running costs
- Replacement of redundant and costly hydraulic systems
- Precise damper and burner positioning

Fig 5 - Actuators on air dampers are ideal for applications where precise control and speed reduces fugitive emissions and increases boiler efficiency.

Conclusion

Fugitive emissions are a large and growing concern. The strategies outlined in this article are aimed at minimizing the potential for leaks and, where they do occur, detecting and correcting them as quickly as possible. Valve actuator flow control has been a considerable focus in the effort to reduce fugitive emissions and will play a critical role in leading the charge moving forward.

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.

Fig 3 – Modulating electric actuator on incinerator plant in a wastewater treatment plant.

Fig 4 - A Rotork CVA actuator installed on an air supply line feeding a biogas production process.