Case Study

Asset management in the water industry – the valve actuator's perspective

Industry: Water and Wastewater

Client: Application in water industry asset management

Product: IQ3, Pakscan

Summary

Rotork IQ intelligent electric actuators are used for asset management within the water industry. With the Master Station and data logging capabilities, operators are able to ensure the efficient and reliable running of their plant.

Overview

The water and effluent treatment industries have not been slow to recognise the benefits of effective asset management resulting from the gathering and analysis of accurate and relevant data from out in the plant. The data identifies the condition of the equipment and gives the operator a real-time view of the plant. Monitoring the data over time enables the operator to avoid unplanned interruptions and plan efficient maintenance programmes in advance. Efficient plant operation is important from not only the fiscal aspect; it also plays a significant environmental role by preventing potential problems including accidents and spillages.

In water and effluent treatment environments, large numbers of valves and their critical function of controlling the flow of media through the plant process have made them a focus of attention for the gathering of this information. The condition of the valves is a fair reflection on the condition of the overall plant, so a great deal of benefit can be gained if the valve actuator can keep the operator informed and updated about the state of the valve that it is operating. This explains that whilst the well-proven mechanical designs of actuators have changed only marginally over the last decades, their functional capabilities have rapidly advanced, embracing innovations and features enabled by electronics and digital communication technologies.

As well as operating the valve, Rotork's latest IQ actuators are now also able to look after it by collecting and storing information about its performance displaying this data locally or communicating it to the control centre where it can be analysed and diagnosed. Rotork has been a pioneer in the evolution of this technology. Providing further improvements to 'a view of the plant' has therefore been at the top of the list of functional priorities for the company's recently launched third generation IQ intelligent electric actuator range.

Challenge

In the early years of actuator development, much of Rotork's attention concentrated on environmental sealing, leading to the introduction of O-rings to keep moisture and dirt away from electrical equipment inside the actuator. Beginning with reversing contactor starters and relays, this enabled an increasing number of electrical components to be housed in the actuator enclosure in the pre-electronic, pre-digital eras. The success of this philosophy also assisted the development of the first intelligent electronic valve actuator in 1992. The first IQ was a breakthrough product, introducing electronic torque and limit sensing, non-intrusive setting technologies and the first generation of data logging and diagnostic capabilities.

Today these control and feedback functions are the keys that drive actuator designs as new ways are found to deliver performance and reliability in an asset management environment whilst keeping the cost of ownership and maintenance to a minimum.

With the third generation IQ the actuator local position indicator window has developed into a multi-functional display capable of providing local indication, valve and actuator status, menu screens for configuring and setting up the actuator, fault diagnostics and asset management information. What was once just a local position indicator is now a window to the plant process. In addition to local position indication it also provides a graphic interface to ensure easy set up and calibration and it displays critical performance data in relationship to actuator performance that allows a user to determine the service condition of the valve, predict when a problem may occur. This is how a modern actuator can become a valuable asset management tool.

In the mechanical specification the separate thrust base design has been extended to the larger sizes, enabling the actuator to be removed from its valve without affecting the valve position. Within the gear case itself, a simple worm and wheel gear train design in a sealed oil bath is retained, continuing a tradition of reliability that has been tried, tested and proven. The accurate measurement of the actuator output torque is also a function provided by the worm and wheel. The axial force of the worm shaft is always proportional to the torque produced by the worm wheel and this is not affected by changes in the efficiency of the gearing caused by long-term operation. The torque is measured by a force transducer rather than disc springs or any other mechanical devices that can wear and change their characteristics over time.

This is very important for asset management, as the torque profile of the valve operating stroke is recorded by the actuator data logger as a 'footprint' during commissioning and subsequently recorded during every valve operation. This data forms a crucial part of the information that can be downloaded from the actuator and used for maintenance planning.

Solution

Valve control relies on accurate, repeatable and reliable position measurement by the actuator. To achieve this, the IQ uses a patented absolute encoder. Absolute encoders are electro-mechanical position measurement devices that sense the relative positions of driven gears to calculate the position of the actuator output and therefore the valve position. Their advantage is that they require no power to track the position change; their disadvantage is that they add complexity and can reduce reliability. Until now the complexity of the mechanical gear trains and sensing devices in the encoder grew with the increased output movement or the resolution required. In simple terms, larger valves or control valves required more complex encoders with more gearing, more sensors and therefore more single points of potential failure.

Using the latest technology and after several years of testing, the IQ absolute encoder overcomes these problems. It is contactless, with only four moving parts and can measure up to 8,000 output turns with high resolution, redundancy and self-checking. Unlike existing absolute encoders, this design increases position sensing reliability whilst providing position measurement with or without power connected.

'A view of the plant' through the actuator window

The toughened glass window of the actuator display is the non-intrusive multi-functional portal for operation, two-way communication and asset management. The hand-held setting tool uses an infrared signal to communicate and check that both items (actuator and setting tool) are Rotork devices before pairing them together using wireless Bluetooth®. The security enabled by this technology is further enhanced by the ability to enable or disable a Bluetooth link as the method of further communication. The use of infrared protocol also enables the actuator's basic functions to be operated using the previous IQ models' setting tools, whilst using Bluetooth for downloading to a PC.

The display itself has been designed as a double display with a very wide viewing angle. The front segment display enables the actuator to be fully set up and operated, whilst the second enables detailed diagnostic and operating data screens to be permanently displayed, delivering the 'view of the process'. Four selectable screens are available, depending on the information that the operator wishes to see at all times, including diagnostic graphics, simultaneous demand and position, torque and position and actuator settings. Valve position is displayed to one decimal point, offering greater accuracy and resolution for diagnostic analysis. Diagnostic graphics offer a window into the process showing the valve torque graph and facilitating analysis of the situation in real-time.

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Advanced data logging, display and communication capabilities have been introduced in response to the recognised desire from end users to get more data both in the field and into the control room. The quest to know exactly what is happening all around the plant has also dictated the design of new data channels within the actuator to give network cards access to more information.

A lot of diagnostic information is available from the data logger which can be extracted from the actuator and downloaded on any PC running the Insight 2 diagnostic software. Using the setting tool and either infrared or Bluetooth, the data from up to 10 actuators can be transferred for transporting to a PC. The data logger information can also be transferred via the Rotork Pakscan™ wireless digital network. The Pakscan Master Station is Ethernet enabled so the control room can access it through a local area network or the internet by calling up its IP address.

There are standard preconfigured web pages that display status and diagnostics of the Master Station, field network (wired or wireless) and each actuator on the network.

There are many different styles of valve and they each have their own unique torque demand curve. Capturing the torque demand curve from a newly installed and calibrated valve actuator assembly provides a reference point against which future curves can be measured. As the valve ages it becomes more difficult to open and close because of internal and external factors. For example a threaded stem on a rising stem gate valve that has not been lubricated will increase the torque demand uniformly across the valve stroke. By identifying issues such as these the Insight 2 software can be used to plan maintenance without interrupting the plant and improve overall asset management.

To sum up, in addition to increased reliability, the functionality available from the modern valve actuator as illustrated by the Rotork IQ enables improved preventative maintenance and allows extended opportunities for integration into the asset management programme. This is achieved through comprehensive logging of commissioning and operating data within the actuator combined with dedicated and reliable communication channels between the actuator in the field and the control and diagnostic centre.