Today, a new major technological advance is available that can help control-valve users avoid many of the problems and inefficiencies associated with using compressed air as a power medium.

The new solution uses electric power and eliminates dependence on compressed air. This totally electric solution is appropriate and cost-effective for a wide variety of control-valve applications, including those found in such sectors as power generation, chemical, petrochemical, and most other process industries.

While the new generation of electric control-valve actuators may not be suitable for all process applications, it is ideal for many situations, especially where users have experienced problems with frozen air hoses, lack of process precision, stick slip, and so on.

Therefore, it is prudent for today’s process control engineers to take a serious look at how the design features of the new generation of totally electric control-valve actuators can benefit them.

In many situations, this technologically advanced equipment can substantially increase the output and efficiency of their process as well as help reduce maintenance and operating costs.

**Control-valve actuation: a brief history**

Before discussing today’s latest technology, it’s beneficial to understand how control-valve actuation has evolved.

Decades ago, the main medium for controlling process control valves was by varying the pressure of the air supply to the valve’s actuator. Typically, this air pressure varied between 3 and 15 PSI. A closed valve position would relate to 3 PSI and the open valve position to 15 PSI. This was an international standard for positioning linear control valves (and later rotary valves also) by balancing this air pressure against an opposing spring. The higher the pressure, the more compression was exerted on the spring, and the greater the movement of the control valve. As the pressure backed off down to 3 PSI, the spring pushed the valve stem back to the original position.

This simple means of position control was used in a wide variety of process control plants. It was the mainstream solution offered by control valve actuator manufacturers as well as control system suppliers.

In the simplest form, compressed air was both the power medium and the control medium. Desired positions were achieved by varying this applied pressure and entire plants were controlled by compressed air channeled through small-bore copper tubing. The backs of control panels were a mass of tubes skillfully arranged by control systems craftsmen into symmetrical layers of.
carefully laid pipe. However, with the advent of computers and programmable logic controllers (PLCs) the days of the 3-15 PSI control signals were numbered.

Soon, they were replaced by electronic signals carried on much lighter-duty copper wire with control at the speed of the electrons rather than pressure waves. This was a revolution in control technology, bringing with it tremendous cost savings in installations as well as vastly improved control capabilities.

The other great benefit of this change in technology was the elimination of the labor-intensive maintenance of the pneumatic control system. Filters, regulators, lubricators, and a multitude of small pilot control valves were eliminated and replaced with PLCs and their final element controllers. In place of the 3-15 PSI pressure signal, a 4-20 milliamp current control signal was adopted as a global standard.

Although the control air signal has been superseded by a control current signal in most process plants, the power to move many of these process control valves is still compressed air.

Having used instrument air as the control medium in the past, it was perceived by many that there were some benefits in retaining instrument air as a power medium. The air can be used to transport energy from one place to another to operate remotely positioned control valves, dampers, and other equipment. In the evolution of pneumatic process control, the instrument air was upgraded from the 3-15 PSI supply to a nominal 80 PSI. This allows greater forces to be generated by smaller pistons or diaphragms. The result is pneumatic spring diaphragm and piston type actuators have been the default standard for positioning control valves for many years.

The method used to translate or relay the applied control signal from 4-20 milliamp’s to a high pressure acting on the diaphragm is the valve “Positioner.”

The simple pneumatic Positioner has evolved, from the basic functionality of controlling applied high pressure air using a low pressure signal, to the smart Positioner of today that not only directs high pressure air to the valve actuator, but also is able to gather information at the various pressure positions within the actuator assembly to provide diagnostic information, which can be transmitted back over the 4-20 milliamp signal using a communications protocol such as HART.

This method is currently the de-facto standard for the majority of linear and rotary process control valves in almost every industry, from oil and gas production through power generation to the chemical, petrochemical and many other process industries.

**Why electric powered actuation may be better**

However, this de-facto standard of coupling instrument air with a smart Positioner, may not be the best solution for every application. Just as electronics have usurped the control signal technology, electrically powered actuators now offer a viable alternative to those using the pneumatic spring diaphragm and piston design.

Specifically, there are many drawbacks to using compressed air as a power medium. For years, process engineers have had to engage in complex workarounds to overcome them.

The drawbacks vary in degrees depending on particular applications. Generally speaking, taking electrical energy, converting it to compressed air then transporting it via a filter regulator, lengths of tubing with fittings, and then directing it into a chamber for expansion is an incredibly inefficient method of moving power from one point to another.

The inefficiencies of compression, and the friction losses in transmission, can easily account for a net loss of 50% of the applied energy. This can be directly compared to the much more energy efficient method of transmitting the power via electricity and translating that electrical energy to kinetic energy in a motor located directly at the process control valve. In effect, the electric motor drive has been transferred from the compressor to the actuator, eliminating all the intermediate conversions and transmissions together with their attendant losses.

When considering the large number of process control valves in a plant and compounding this with the constant movement of process control valves, the elimination of compressed air in a plant can be significant and can result in a much more productive and cost-effective operation.
In addition, plant reliability and the associated availability is a significant factor in our consideration. Air supplies require proactive maintenance to ensure that moisture, dirt, and other contaminants do not accumulate in the air lines and cause the small orifices in smart controllers to plug up. This proactive maintenance has a significant cost, which should be included in every objective analysis.

Although many processes are enclosed in buildings that protect the valves and instruments controlling the process, this is not always the case. There are several examples where valves are located in open areas and are vulnerable to temperature swings that can drop below the freezing point of water. This affects not just European and North American plants, but also Asian plants such as the many new process plants being built in China, Japan, Korea, and other areas.

A drop in the temperature below freezing point can cause airlines to freeze and incapacitate the pneumatic control valve actuator or controller.

**Examples of why electric control valve actuators are often the best solution**

In Halifax, Nova Scotia a refinery technician recounted that every year he needed to replace frozen airlines because they had ruptured. After the hoses ruptured, certain modulating control valves could only be operated by hand. This, of course, defeats the basic reason for investing in automatic process control.

Another example is from a power plant in New Hampshire which recently replaced all of its spring diaphragm control valve actuators on fuel control due to the effects of reduced temperatures. Low temperatures not only had an adverse effect on the actuators, but also on the viscosity of the medium being controlled and the friction effect on the valve seats. That is, the valve became very difficult to control due to the stick slip effect, causing “over shoot” of the desired set point of the valve.

In high altitude mining applications, such as those found in Chile and Peru, reduced temperatures and high altitude combined to make power air supplies extremely costly. Maintenance and running costs were problematically high. In such an environment, freezing airlines were also an ongoing problem which caused valve actuator failures with attendant loss of production capability.

There are some instances where an air supply is not required for anything other than controlling a single process control valve actuator. In these circumstances a small air compressor complete with air set needs to be provided, taking up space, weight and cost. There are many small package boilers for example that require a steam control valve. Quite often this requirement also includes the need for a fail to position capability.

The traditional method of doing this would be to use a spring diaphragm actuator where loss of air or a shut down signal would vent the air to allow the spring to close or open the valve depending on the requirements of the process.

With the advent of new technology, electric actuators are capable of storing electric energy such that a loss of electric power can trigger a fail to position, which has been pre-programmed into the actuator. Furthermore, because of the greater degree of control available with an electric actuator, a preset position – either fully open or fully closed or anywhere in between can be programmed easily into the actuator should power or control signal be lost. A different failure position could be programmed dependent for either loss of power or loss of control signal.

Finally, compressed air is by definition a resilient medium. In
In addition to solving problems associated with air supplies, Rotork CVA actuators include advanced diagnostics capabilities that provide significant predictive maintenance benefits. For example, valve stem packing life can be more precisely related to the total distance that the valve stem travels against the material. Once this travel limit is reached, then maintenance is required, regardless of the time it takes to reach the limit.

Data loggers, such as those integrated into Rotork CVA electric actuators, are capable of recording this total travel and displaying it through a digital communications link or on a PDA. By reviewing the “Distance Travelled” data, maintenance engineers can easily review the total travel and predict when adjustment will be needed.

Electric control valve actuators: a summary of features and benefits

Electric control valve actuators can provide superior control performance, are easy to set up, and they eliminate the need for troublesome power air supplies and all their problems.

They are available in linear and quarter-turn actions and are suitable for a wide range of control-valve applications throughout a wide range of process industry applications including power generation, pipeline and gas installations, petrochemical and refinery facilities, mining, and many other process applications.

The new actuators eliminate the need for costly air supplies and are easily integrated into most process control environments, including those that use Hart and Foundation Fieldbus protocols.

Rotork’s CVA actuators, for example, provide extremely precise control-valve operation with repeatability and resolution performance at <0.1% of full scale. In addition, they include, as a standard feature, wireless Bluetooth communication technology that can be used for quick and easy actuator set-up and adjustment. Rotork CVA actuators incorporate a data logger, which provides an extensive record of such operational and maintenance-related data as valve torque profiles, dwell times, and relevant statistical information. They also utilize a built-in super-capacitor that provides an advanced, programmable method for fail-to-position protection, and Rotork CVA actuators can be specified for single-phase AC or DC electrical supplies.

About the author:

Chris Warnett has over 32 years experience in the valve and actuator industry. He is a registered mechanical engineer, has worked in actuator design and application in both Europe and the United States, and is currently Sales and Marketing Director at Rotork Process Controls. He has extensive experience working with valve diagnostics and is the author of a guidebook about using valve actuators as diagnostic instruments.

NOTE: You can obtain a document that will help you calculate the cost savings of electric vs. air power by contacting the author at:

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