1300 Sumner Avenue, Cleveland, OH 44115
P: 216-241-7333 F: 216-241-0105
E: cagi@cagi.org
URL: WWW.CAGI.ORG

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Compressed Air & Gas Institute

TECHNICAL BRIEF

Technical Brief – System Controls for Industrial Compressed Air Systems

Proper Controls Improve Productivity Through More Stable Air Pressure and Lower Energy Costs

Most industrial facilities depend on compressed air and have specific pressure, flow, and purity requirements. Yet meeting these requirements without careful planning can be wasteful, as compressed air is an expensive utility. There are many opportunities that exist to reduce air system operating costs and compressor controls should be considered in any energy cost reduction initiative.

The purpose of any compressor control system is to match the compressed air supply to the demand as efficiently as possible. There are two levels of control: controls for individual compressor units and higher level controllers that integrate an entire air system installation of multiple compressors and possibly other components like filters, dryers and drains.

At both levels, controls address three main facets of system operation:

- How well they deliver sufficient variable flows to achieve stable pressure at points of use.
- How efficiently they run the compressor(s) with respect to energy consumption.
- How well they track and communicate operational data (e.g. status, maintenance hours, service issues, etc.).

Most plant air systems have more than one compressor. If done right, controlling multiple units in concert generally increases both energy efficiency and pressure stability. Running multiple units independently often results in unstable pressure and wasted energy for several reasons:

- Running more machines than are necessary
- Running compressors at higher pressures than are needed
- Excessive idling or modulating

In addition to the operational inefficiencies and pressure swing, there is the likelihood of increased maintenance requirements (and the related costs) due to excessive valve cycling and motor starts.

Individual Compressor System Controls

There are several different ways to control an individual compressor to match output to demand. In single compressor installations, some are better at handling part-load conditions than others. Many newer compressors can be switched from one to the other through their on board controller. Others (e.g. modulation, variable speed, and rotor length adjustment) require different mechanical and electric configurations. We explore these options more in our FAQ section on controls.

Individual compressor controls have come a long way over the past two decades. The most advanced types combine safe and efficient internal supervision of the machine with important maintenance-related information. In addition, newer controls may offer the ability to monitor and control compressed air equipment remotely via built-in web servers or connecting into existing plant monitoring systems via Ethernet or industrial bus options (DeviceNet, Profibus, etc).

Advanced Energy Management with System Master Controls

The more advanced the master controller for a compressed air system is, the more it will optimize energy performance. Smarter controls can manage multiple compressors of different sizes and pick the right mix of units to meet demand as it changes, while reducing energy consumption in three key ways:

> ***Reduced compressor run and idling time*** –saving energy by operating only the units needed to satisfy demand, while reducing compressor starts and switching losses.
>
> ***Improved pressure performance*** –recognize changes in air pressure quickly and accurately, thereby maintaining tighter pressure control. Eliminating "cascading" pressure controls with wide pressure bands can save another **10% in energy**.
>
> ***Reduced "artificial" demand and leak losses*** – To compensate for potential leaks and pressure drop, many users set system air pressures higher than actually needed. This "artificial demand" results in a good deal of wasted energy. Advanced adaptive controls allow users to reduce the pressure while avoiding the risk of under pressurizing tools and equipment. Operating at lower pressure reduces both artificial demand and leak losses.

Master controllers take operational efficiencies a step further by controlling all compressors and accessory equipment in an air system installation together, and in relation to each other. Master controllers improve the pressure stability and reliability of a compressed air system by turning the individual compressor units on and off only when needed to meet a specified pressure. This greatly improves overall system specific performance (cfm/kW), and often helps balance compressor load hours for more effective maintenance scheduling. Newer system controls offer some or all of these advantages:

- Maintain system pressure within a narrow pressure band.
- Monitor the rate of change of air pressure to determine the change in demand – and then calculate which compressor will best meet that demand.
- Track the starting frequency of all compressors in the system so that they can be switched on or off quickly to minimize idle-mode running.
- Be programmable with each compressor's capacity and specific performance characteristics.
- Provide historical data to facilitate energy performance analysis.

By using the correct combination of master controls and properly sized compressors, concerns about part-load efficiency of fixed speed compressors are effectively eliminated. They will not idle for any significant time– instead running at full load or on standby.

Monitoring and Communication Capabilities

Modern compressed air system controls can also deliver communications capabilities that are hugely beneficial to plant operations personnel. The entire air system can be monitored – either as a standalone network or as part of a larger control system. In many cases, these controls allow access via Internet, giving the manager full access to their system virtually anytime and anyplace.

Remote monitoring also means that technicians can view system status and diagnostic codes prior to undertaking service activities. This capability makes troubleshooting easier, and typically reduces service or repair time as well.

Outbound alerting is another valuable functionality, providing the ability to automatically notify plant O&M personnel (or the plant's compressed air service provider) of problems or shutdowns.

Conclusion

An air system control unit is the quarterback of your compressed air system – calling the plays, spotting the dangers, and ensuring everybody knows what to do. A control unit will often be your first alert when there is a problem so you can contain and fix it before it gets out of control. Having a great compressor is like paying for a world class wide receiver – without a great quarterback… you cannot perform to your true ability.

A central controller can monitor, measure, and direct optimal sequencing of a compressed air system's numerous components through a series of valves that direct and redirect air flows through the system's various compressors, dryers, and other measurement equipment to produce a dependable and efficient network. Many times, the inclusion of a central control system can reduce energy efficiency by 10 percent. Applications for mobile phones and tablets can also provide an additional level of real-time remote monitoring and control of one or many compressed air systems from almost any location.

Investing in a control system does not have to involve a large capital expenditure. If you are not sure what control systems you are following, call your manufacturer today.