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Compressed Air & Gas Institute

TECHNICAL BRIEF

Technical Brief on Variable Speed Drive

The simple economic model of matching supply with demand optimizes productivity and helps control costs. This makes sense not only in the economic world, but also when considering how compressed air is produced and used in a manufacturing facility.

Compressed air is critical to a wide range of functions within manufacturing. But poorly designed and maintained compressed air systems, by some estimates, account for significant energy losses and waste every year. One quick and easy way to ensure your facility is not squandering energy in its compressed air production process is to consider the benefits that can be provided by a properly sized variable speed drive compressor.

While many plants require continuous, round-the-clock operations seven days a week, there likely are times when lulls in production present opportunities for energy savings. For example, there are 168 hours in a week and many compressed air systems only require full capacity between 60 and 100 hours, or about half the time. When this partial demand load event occurs, the air compressor output capacity must be regulated or stopped. With units 15 HP or larger, it is not feasible to stop and start the air compressor motor several times an hour throughout the day, so a form of inlet control regulation is the choice. Whether you run the unit with a load/no-load control (fully loaded or a closed inlet for unload and bleed-down) or modulation (cutting back the inlet throttle plate) to accomplish a partial load run-time, these control systems may not be the most efficient.

Operating a car is a very good example; when you exit the highway you go from highway speed (let's say optimum full load at 55 MPH) and then you come to a stop at the bottom of the ramp. There, the car is idling and wasting energy as long as it sits at the stop sign. City driving is even worse or similar to a very fluctuating demand; starting and stopping, but idling at every stoplight. Now, think of your car sitting (idling) at stop signs and lights for 60 to 100 hours per week.

Properly sized Variable Speed Drive compressors offer the capability to fine-tune a compressor output precisely to fluctuating compressed air demands. By varying the speed of its drive motor, as air demand decreases, the VSD lowers the delivered air flow as well as the electrical power consumption in a largely linear fashion. This reduces energy consumption to a minimum when fluctuating demand is the norm. In fact; due to the comparatively low in-rush currents inherent in variable speed drive motor designs, some VSD compressors will stop at the lower compressed air demands vs. idling at unloaded conditions. Even with several starts per hour there is not an issue, so wasteful energy (idling time) is virtually eliminated.

Statistics compiled through compressed air system assessments and performance analysis show that many air compressor applications are ideal for VSD. Compared to a fixed speed drive compressor, a VSD compressor, properly sized for the same end use, can yield significant power savings. In some cases, based on the demand profile, compressed air costs have been reduced by one-third. Another thing to remember is that, due to economic cycles and shifting of manufacturing to other countries, many facilities have significantly reduced the volume of compressed air needed and are therefore operating oversized air compressors. This highlights the need to review the facility compressed air needs when significant production and compressed air demand profiles change.

In addition, many local municipalities and state utilities offer rebate incentives for energy savings compressed air solutions, of which VSD technology qualifies.

Energy costs, already on the rise in recent years, have garnered additional attention of late as facility managers are continually charged with finding new ways to cut costs. Many corporations have instituted “green” policies with aggressive annual energy reduction targets.

Let’s consider a situation where a manufacturer’s compressor system was running a single 200 horsepower air compressor. The operation has fluctuating compressed air demands 24 hours a day at 3 cents per kWh. These energy costs have doubled in the last five years, increasing in some areas to 8 cents per kWh or more. The annual cost to operate that compressor at 3 cents per kWh was $41,273. Today, at 8 cents per kWh, that same compressor costs $110,062 to operate every year, or more than a half a million dollars over five years. After a detailed compressed air demand assessment, it is determined that the fluctuations were within the control range and averaged 35% less than the full capacity of the compressor and the factory had inadequate storage. In this case, switching to a properly sized VSD compressor could potentially save this facility $38,521 annually or more than $192,000 in five years, if the current conditions remain similar over that time period.

Combine these savings with the greater efficiency that is realized when you replace older equipment with newer, more efficient machines, and the return on investment with many of these installations is often realized in less than two years. Not every installation can yield this kind of payback, that is the purpose of a professional air demand assessment and proper compressor selection, but for sure…it is worth the consideration.

In summary, by varying output to meet compressed air demands, manufacturers who choose a properly sized VSD compressor as part of their infrastructure can realize immediate energy savings that will only compound over time.