The Business of Compressed Air

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by

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Why should there be any interest in your compressed air system? Operating cost is the reason. Compressed air is the most poorly designed and managed of all the industrial utility systems. There is enormous opportunity to reduce operating cost ranging from 25 to 40% and additionally, to improve the quality of the air that frequently negatively affects performance of most, if not all, of the air consuming equipment in the plant. One might immediately ask how any facility could have such a large opportunity.

We frequently find systems that were originally designed with a single compressor where the compressor was significantly larger than the actual demand and a spare purchased of similar size. After a year or two of operation, both compressors are operating all the time because of a single event that happens once or twice a year where the pressure decays beyond an acceptable level. As plants increase in size, the next compressor added is more often than not the same as the first two because of ease of maintenance with no knowledge of whether the compressor is appropriate for the system or operating cost. As the facility continues to grow, a portion of the plant has an insufficient pressure problem, which is solved by adding another compressor room in the general vicinity of the symptom with no idea of what the actual problem is. Most plants have no idea how much demand they have other than the total of the "on" compressors. An "on" compressor is not an indication of need or that it is actually compressing any air into the system. Compressed air is the last issue engineered for a new plant or expansion and frequently the design agenda is to make sure there is enough or "more is better."

Compressed air is the most expensive of all utilities, for the amount of work derived from the energy input to the compressor motor and clean up equipment. Eighty-five percent of the electrical energy is dissipated as heat and another 4% is lost when the air is cleaned up and distributed to your customers, which leaves 11% to perform work. And this only if the system is very efficient. It is not at all unusual for systems to be less than 5% efficient once all the part loaded compressors, poor applications, artificial demand, drainage, and leaks are identified.

More often than not, there is very little understanding of the working relationship of the different components within the supply side of the compressed air system. What type of compressors are required; recip, centrifugal, contact cooled rotary screw, or dry screw? Will different types of compressors work in the same system? Is one design more efficient than another and what is the most appropriate size for my facility? How many compressors are needed and what is the intensity of maintenance? What about variable frequency drives? Is one large compressor better or worse than several smaller ones and how is the risk of interruption defined and what provisions are made to prevent interruption? All compressors are rotating equipment and will fail. It is not "if," but "when." What dryers do we purchase; desiccant, non-cycling refrigerant, cycling thermal

mass refrigerant, or externally heated blower purge desiccant? What is instrument quality air and how do we obtain it? Do we need instrument quality air? Is filtration necessary? What efficiency is required and where in the system should the filtration be located? Most compressed air purchasing decisions are based on capital cost, as there is little knowledge of the "system" to make purchasing decisions on any issue other than price.

Often the different departments within the plant will have totally different agendas for compressed air. Production wants "all that they want" and it must be instrument quality as defined by the Instrument Society of America, but want nothing to do with how it is generated, how much they waste, or what it costs. Maintenance wants a system that is dependable with minimum effort that never fails. Maintenance may evaluate system performance based on the number of complaints from production concerning pressure and if there are no complaints, the system must be pretty good. Systems where there are no complaints and operating personnel feel the quality is good most often present the greatest opportunities to reduce operating cost. Plant management wants nothing to do with compressed air as long as no one complains and compressed air never interrupts production. Accounting wants minimum cost regardless of whether the system is maintained properly. Frequently, the different departments do not discuss or communicate with one another about compressed air as long as there is enough. "More is better."

Why is the system contaminated with water and oil, when there are functional dryers and filters in the system? How do we tell if the compressed air system is working well? If there are no complaints, are we doing a good job? This and those above are just a few of the questions that we are asked when providing an audit.

One of the issues about compressed air that is always true is the use of "absolute" words. Notice the word "always" in the preceding sentence. Sooner or later, the use of an absolute word in reference to compressed air will be wrong. Compressed air is very dynamic and variable and since it is a compressible fluid, it does not behave the same as other non-compressible fluids. Flow direction arrows on compressed air piping will not always be correct, especially when trying to analyze an existing system. One area where we are confident of issue is the "more is better" statement. There is nothing about compressed air where "more is better" other than storage. And even here, the storage must be with tanks, not in the piping.

What does this auditor define as the perfect system?

> The pressure must be constant for all operating conditions at ± some value (0.5-psi for example) and the air must be clean and dry if used for actuation, instruments or any other application that is sensitive to water and/or oil if the compressors are lubricated. Dryness depends on the system and how the air is used. Clean, dry, and free of all liquids absolute for all operating conditions is a more than satisfactory statement of dryness for most systems. This system will not have a pressure dew point below 0 °F, which is a common requirement for instrument quality air. However, some systems and processes are sensitive to moisture as a contaminant such as computer chip manufacturing where moisture

is absorbed by the silicone chip, which is unacceptable. Pressure dew point for chip manufacturers will be near minus 100 °F.

All "on" compressors must be base loaded (operating at 100% of volume at design pressure) except for one compressor that provides trim.

System efficiency is expressed as standard cubic feet per brake horsepower (scf/bhp) not at the compressor inlet or discharge, but at the point of use. Purchasing efficient compressors for an inefficient system is a poor business decision.

What is an audit, what can it do for me, what will I receive, what can I do with the final report, and what does it cost?

An audit consists of a thorough analysis of the supply side of the system including but not limited to the following. The amount of air being compressed and the pressure fluctuations and what causes the pressure fluctuations. The amount of waste in the compressor room; part loaded compressors, compressor blow off, drainage, artificial demand, leaks, etc. The total power of supply including dryers with a calculated efficiency, compressor by compressor expressed as scf/bhp or kW. What is the quality of the air with a detailed explanation of why there is water and/or oil in the system with functional clean up equipment?

The distribution system will be evaluated for differential and the ability to deliver the air to the most distant point in the system. Pipe size will be evaluated and discussions of closed loops and whether or not additional piping has any benefit evaluated. Old carbon steel piping will be evaluated for contamination source and risk of failure.

Storage will be evaluated for size and location. Additional storage will be recommended, designed and located with detailed explanation of how to best implement storage. There are four different types of storage that may offer opportunities. Control storage, which is located on the supply side of the system; general storage, which can be anywhere in the demand side of the system; dedicated storage for one specific application; and high pressure off-line storage that is sometimes referred to as load shaping.

The demand side of the system is also evaluated for poor application of compressed air that may have an alternate source of energy (low pressure blowing for example) that is less expensive with an attractive return to install the low pressure blowing system versus using regulated high pressure compressed air. Specific recommendations are provided to modify the demand side use of compressed air with the savings opportunity defined comparing the existing with proposed operating costs with a calculated return of investment. Most systems will have about half the savings opportunity on the demand side of the system.

Drawings will include an existing process flow diagram and a proposed system arrangement plus any detail of demand side issues that are necessary to

modify point of use applications or a change of energy source. Specific recommendations are provided for modification of supply to improve efficiency and to clean up the compressed air. The same is also provided for demand side opportunities with enough detail that project engineering can implement those recommendations.

An Excel spread sheet is provided detailing all the financials of the existing system and proposed system with an action plan including capital and installation costs for all recommended equipment or systems. A calculated return of investment is provided including the cost of the audit as a line item. Most plant wide audits can be accomplished four to five days on site. Firm pricing for the audit can be provided once the type and number of compressors are known, the number of entry points into the system, and the type of dryers are provided to the auditor. General estimates of savings potentials can be provided with the audit quotation.

An out briefing is provided at the end of the on site portion of the audit to provide the details of all recommendations that permit plant personnel the opportunity to ask questions discuss the recommendations while the auditor is still on site. The entire audit is a learning process where we educate as many plant personnel as possible about compressed air systems. Or only goal is to better educate the plant about compressed air systems.

Robert B. Laine II is President of Southern Corporation of South Carolina and a Senior Auditor for Plant Air Technology. For the last 10-years he has participated exclusively in auditing more than 250 compressed air systems in the Americas for many small and Fortune 500 companies from Abbott Labs to Y & S Candies (part of Hershey Foods). Robert (Bob) has no financial interest in the audit solution and does not sell or receive commission for any sales of equipment associated with compressed air systems. Please feel free to visit the Southern Corporation web site: bobbysc.com or contact him at bobbysc@aol.com. As a former manufacturer's agent, he sold chemical process equipment to the phosphate industry in Florida and is familiar with the processes of both sulphuric and phosphoric acid.