## Analysing Existing Compressed Air Systems (CAS) For Performance Improvements

Demand of Compressed air goes beyond what is needed to perform work. As shown in Figure 1.1 demand includes potentially inappropriate uses, leaks and increased demand due to excessive system pressure. To effectively cut costs in a compressed air system, these demands need to minimised.



The Following Best Practices will guide the Compressed Air Users to analyse their CAS along with exploring in detail the opportunities that prevail for Performance Improvements and Cost

(1)Know what equipment you have.

Reductions.

Develop a basic block diagram of compressors, dryers, filters, receivers, and other equipment as shown below,



# (2)Know what is happening in your system.

Create a system pressure profile, using pressure readings at key points throughout the system.



It is important to establish a baseline against which the effect of any system changes can be measured, including pressures, temperatures, and power consumption. After each change, remeasure to determine the effectiveness of the change and establish a new baseline before making the next change.

- (3) Baseline the existing conditions by measuring kW, total weekly hours of compressor operations and present plant production levels.
- (4) Determine the electrical cost of operating each compressor.
- (5) Accurate measurements of air consumption and electrical power allow proper assessment and appreciation of the true cost of operation. This in turn can help in management and conservation of available resources.

#### Example of Electrical Costs and how to reduce the demand charge.

The following example illustrates the difference between demand (kW) and energy (kWh) and the impact on electrical costs in a **Typical Spinning Mill leading to Cost Reductions upto 12 %**.

Assume a textile spinning plant has two duplicate air compressors, either one of which can supply production needs for the 660 hours per month of operation (30 days, 22 Hours/ day). However there is also a process that requires the second compressor to start and operate for 45 Minutes once a day, therefore 22.5 hours per month of operation (30 days, 0.75 Hours/day).

Energy Charges are assumed to be Rs 4 per kWh, and demand at Rs 300 per kVA.

Compressor	Kw	Running Hrs / Month	Cost / kWh	Energy Consumption Calculation	Energy Consumption for Compressor 1 in a Month	Energy Consumption for Compressor 2 in a Month
Energy:						
Number 1	100	660	4	Kw x Run Hrs x Cost / kwH	Rs 2,64,000.00	
Number 2	100	22.5	4	Kw x Run Hrs x Cost / kwH		Rs 9,000.00
Demand:						
The Demand Rate is Rs 300 per kVA						
Number 1	100		300	Kw x Demand Cost	Rs <b>30,000.00</b>	
Number 2	100		300	Kw x Demand Cost		Rs <b>30,000.00</b>
Electric Utility Charges for the Month per Compressor					Rs 2,94,000.00	Rs <b>39,000.00</b>
Total Charges for electricity for the Month (not including tax, adjustments and other charges)					Rs 3,33,000	

# Note That:

- 1. The Demand charges for Compressor 2 is significantly greater than its actual energy charges.
- 2. The demand charge for Compressor 2 represents more than 9 % of the total charges for both Compressors.

Best Practices to reduce demand charges for this example might include:

- (i) Restructure the process so that the second compressor operation is performed after normal production hours.
- (ii) Utilize high pressure off-line storage
- (iii) Do not base the calculated or estimated energy cost reductions on the average blended total amount of the monthly electric bill and the total kWh consumed, which provides the "aggregate" rate. Rather, evaluate the reduction, if any, in demand charges. Also, the use of the marginal or incremental cost of the final kWh consumed will provide a more accurate estimate of savings.
- (iv) The Person responsible for efficient energy management and compressor operation should understand:
- a) The electric utility's rate structure
- b) The process requirements and the compressed air and total plant electric load profiles of the facility.
- (v) Involve the utility account representative by requesting a written response to the question of how to obtain the most favorable rate.

- (6) Before embarking on a comprehensive improvement program, determine which tasks can most easily be done. Perform these tasks one at a time and measure the effects of each, including energy savings, system stability and operational benefits.
- (7) Make Sure that the system should be delivering air at the lowest possible pressure.

Operating at the minimum practical pressure at end uses, together with a corresponding reduction in compressor discharge pressure(s), will reduce both the consumption of compressed air and the energy to compress it. Reduce pressure gradually and progressively with the consent of end users. Often, the process most sensitive to pressure has a very small consumption but is responsible for the elevated pressure in the system. This single use should be addressed by component replacement, adequate storage, or a separate air supply.

- (8). Adjust compressor controls to ensure that only one air compressor is operating at part load and that it is the one with the best part-load efficiency. If the compressor is fully unloaded for a period of time, such as 15 minutes, most newer compressor controls will automatically shut off this compressor. contact the local compressor service provider to fine tune the adjustments.
- (9). Review and understand the cost of leakage and repair all leaks beginning with the most significant.
- (10). Reduced system pressure also reduces the rate of leakage.
- (11). Check the appropriateness of equipment used to control and deliver compressed air, as follows:

a. Are compressor controls of the right type to provide efficient operation at reduced capacities and with the right range of operating pressures?

- b. Are primary and Secondary receiver sizes adequate and well located?
- C. Should the air supply from the compressor room be controlled by a pressure/flow controller? If so, is it, and the distribution piping, properly sized?

# (12). Use automatic system controls to anticipate peak demands.

Only the number of compressors required to meet the demand at any given time should be in operation and only one should be operated in a trim control mode. Automatic sequencing of compressors can optimise the selection of compressors for changing demand cycles.

- a. Address point-of-use issues
- b. Investigate and reduce highest point-of-use pressure requirements.
- c. Determine actual air quantity requirements and address high volume, intermittent applications.

d. Determine actual air quality requirements and treat air appropriately. But not more than is required for tube end use application.

e. Take stock of what you have and challenge point-of-use requirements and appropriateness ( or inappropriateness) of applications.

f.Involve compressed air supply side personnel in process related decisions.

Changes in processes and end uses of compressed air can impact the entire system. Required flow rates and pressures can impact the number of compressors required, their control pressure ranges, compressed air treatment equipment, and the distribution system. Coordination among departments is essential for an efficient operation.

(13). The preceding remedies must be followed by a review of the number of compressors in operation and their control settings so that a corresponding reduction in energy is realised.

(14). Compare kW and compressor weekly operating hours to the original baseline data.

(15). Keep management fully informed of each system improvement, energy savings, and improved quality and reliability.

The Above article is part of the Best Practices Training Manual of Compressed Air Challenge. The author can be contact in the below address

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