Compressed Air Systems

Leading the Way to a Brighter Future

A program of the Maine Public Utilities Commission

Operating at peak performance, a well-managed and maintained system can save 20 to 50% of the cost to run it, when compared to an unmanaged system.

More than 70% of manufacturing facilities in the United States use compressed air systems as power sources for tools and equipment such as pneumatic actuations, pumping of chemicals, blow offs for cleaning, part orientation, cooling and vacuum. Compressed air is considered industry's fourth utility, but is seldom thought of as contributing to the cost of production. Compressed air systems have low operating efficiencies, typically in the 10 to 15% range and, therefore, can be expensive to operate.

Substantial savings opportunities exist because many systems are not properly maintained.

Evaluation of compressed air systems requires a systems approach, with attention to matching demand with the supply. Compressed air system energy saving opportunities can be broadly categorized into two sectors:

- Demand side opportunities (leaks, blow offs, agitation etc.)
- Supply side opportunities (compressors, dryers, filters etc.)

Assessing a compressed air system should ideally start with optimizing demand side (reducing demand for air) followed by optimizing the supply side.

For More Information

Learn about cash incentives for compressed air energy efficiency improvements and other electric energy saving measures available through the Efficiency Maine Business Program from our Program Allies. A complete list of these contractors and suppliers specializing in energy-efficient products and services is available at efficiencymaine.com, under Business Programs, or call toll-free 866-376-2463. Efficiency Maine's technical staff is also available to make recommendations on steps you should take to improve the efficiency of your compressed air system. Details of Efficiency Maine's compressed air training sessions can be found on our website. The website also provides information for new school construction projects, state government, and residential electric energy consumers.

Detect and Fix Leaks

Typical compressed air systems have leak loads in the range of 10 to 50% of the compressor capacity. Set a goal to maintain compressed air system leaks below 10% of the facility load. Leaks are typically located at the point-of-use connections, filter-regulator-lubricator (FRL) units, solenoid banks and hoses. A preventative maintenance program should be established to locate and fix the big leaks on a quarterly basis, and annually using ultrasonic leak detection equipment.

Replace Inappropriate End Users with Suitable Alternatives

Compressed air systems are typically 10 to 15% efficient. Therefore, any opportunity to replace an existing pneumatic application with a direct electric motor driven alternative (typically 60 to 80% efficient) should always be investigated. Typical inappropriate applications of compressed air that have suitable electric alternatives are: pneumatic agitation/sparging, aspiration, personal cooling, open blow off, vacuum, cabinet cooling, floor cleaning, air hoist, air motors and diaphragm pumps.

Isolate Single High Pressure Users

Compressors can save 1% of their energy consumption for every 2-psig-pressure reduction. If the facility has few machines that dictate the high-pressure set point of the compressor, then identifying those machines and using a single, small high-pressure compressor or a booster compressor for that equipment could achieve significant energy savings.

Monitor Pressure Drop in the System

The nominal pressure drop in the system from the compressor to the farthest end of the facility should be less than 10-psig. If the pressure drop from the compressor to the farthest point in the compressed air distribution is found to be greater than 10-psig, then common pressure drop sources like plugged filters, old dryers and change in pipe diameters should be identified and fixed.

Use Appropriate Pressure Settings at the End Users

Each and every point-of-use in the plant needs a regulator. Provide the end use with the correct pressure, because higher pressure than required results in increased use of air, creating an artificial demand on the compressor(s).

Install Nozzles on Open Blow Offs

Blow offs are commonly observed in manufacturing facilities where open hoses or copper tubes direct, cool or clean parts. In many instances, these blow offs are located in tight spaces and cannot be easily replaced with electric blower systems. In such cases, installation of high performance nozzles that deliver the required thrust at a lower pressure should be investigated.

Install Solenoid Valves to Shut Off Air

Solenoid valves can be interlocked with the machine operations so that, when the machine/line shuts down, the airflow to the machine/line is shut off, eliminating leaks and other end uses.

Identify the Large Demand Events

A demand event is a sudden demand over a short duration of time for a high volume of air (such as that used for dust collection baghouses). This can often cause the pressure in the compressed air distribution to fluctuate, falsely loading the trim compressor. If a demand event falsely loads the compressor, then the source of such a demand event should be identified and assessed for the installation of a dedicated receiver tank (in some cases with check valves).

Decrease Discharge Pressure Set Point

For every 2-psig reduction at the compressor, 1% reduction in compressor power draw can be achieved. Operating compressors at higher than required pressure set point results in greater energy consumption, higher wear and tear of equipment and increased leak losses. Operating the compressor at lower pressures reduces leak losses and saves energy.

Replace Clogged Filters to Reduce Pressure Drops

Pressure drops in the compressed air distribution should always be minimized. For every 2-psig reduction at the compressor, 1% reduction in compressor power draw can be achieved. Compressors work to overcome the pressure drop through the system, the typical pressure drops are:

1) Filter pressure drop @ 0.5 to 1.5 psig

2) Dryer pressure drop @ 2 to 3 psig

3) Piping pressure drop @ 3 to 4 psig

Distribution equipment that cause more than the specified pressure drop should either be fixed or replaced.

Install Efficient Part-Load Compressor(s) and Controls

The compressed air requirements in a facility may change over time and vary between shifts. If the load in the facility is constant for all periods, then one single correctly sized compressor can do the job efficiently. If the load in the facility varies between or during shifts, it is often more efficient to use a combination of compressors, rather than having one big compressor operate partly loaded.

New variable frequency drives (VFD) compressors are more efficient (can be turned down to 20% of full speed) and are available at lower prices, making them economically attractive.

Consider Installing Multiple Stage Compressors

Multiple stage compressors are typically 10 to 15% more efficient than the single stage designs at full load due to the efficient inter-cooling and other benefits offered by multiple step compression. Therefore, when possible, multiple stage compressors should be selected over single stage compressors. Typically, multi-stage compressors are more expensive than the single stage compressors, however you will achieve payback within a couple of years because of the increased efficiency.

Install Central Sequencer Control for Multi-Compressor Plant

In many instances, facilities have multiple compressors that operate at the same time. The simplest control strategy that many facilities use is the independent cascading pressure control, which in some cases can be very inefficient. Central sequencer controls are available in target pressure or cascade pressure options and offer the following benefits:

1) Operation of minimum number of compressors for a given load

2) Selection of the most efficient compressors for a given load in the plant and

3) Efficient start/stop operation

Increase Storage Capacity

Air receivers are designed to provide a buffer capacity between the supply and the demand sides of a compressed air system. According to Compressed Air Challenge, for load/unload type of compressors, storage capacity should be in the range of 3 to 10 gallons/CFM. Having enough storage capacity near the compressor plant protects the compressors and dryers from sudden demand events and prevents false loading of the compressors.

Install Efficient Dryer(s)

Dryers help remove the moisture in the air and reduce the operating cost associated with the removal of moisture. Therefore, assessment of plant air quality requirements is critical for efficient system operations. Use the drying technology that gives you the maximum allowable pressure dew point. New VFD and thermal mass dryers offer better part-load efficiencies than the old standard refrigerated dryers.

Utilize Demand Flow Controllers

The higher the pressure delivered to the plant, the higher the artificial demand and the leak losses. Demand flow controllers help separate the supply side from the demand side, and are set to provide steady low-pressure air into the distribution. This helps reduce air used by artificial and unregulated end users.

Recover Heat from Compressor(s)

Only 20% of the energy input into an air compressor is converted into compressed air energy. The remaining 80% is converted into heat. This heat can be recovered for either process heating or space heating, improving the overall compressed air system efficiency.

Replace Timer Drains

Moisture drain traps are usually located in compressors, filters, after-coolers, dryers and receiver tanks to remove the moisture in the compressed air. Timer drains have the potential to discharge compressed air along with condensate based on the ON/OFF setting. Float type traps only discharge condensate when full, avoiding loss of compressed air. Float type of drains cost from $300 to $700 per unit.

System Maintenance

Maintenance practices for a compressed air system can significantly affect the operating costs and efficiency. Delaying or ignoring maintenance can end up costing far more than the cost of labor or parts. Regular leak detection (and system leak testing), filter replacement, and overall pressure drop evaluation should be incorporated into the maintenance program.