

Compressed air is often called the "fourth utility," after electricity, gas and water. Although "it's only air," compressed air is the most expensive because only ten percent to 20 percent of the electric energy input reaches the point of end-use. The remaining input energy converts to wasted heat. Below are several best practices that companies can apply to reduce their compressed air costs.

1) DETECT AND REPAIR LEAKS

Leaks in an industrial compressed air system can waste significant amounts of energy, as much as 20 percent to 30 percent of compressor output. Detection and repair can reduce leaks to less than ten percent of compressor output. Leak repair, when combined with adjustments to compressor controls, can reduce compressor run time, increase equipment life and reduce maintenance. Repairing leaks also reduces demand for new compressor capacity by reducing wasted air. While leakage may come from any part of the system, the most common problem areas are couplings, pressure regulators, condensate traps, shut-off valves and pipe joints.

2) ELIMINATE INAPPROPRIATE AND UNNECESSARY USES

Compressed air generation is one of the most expensive auxiliary processes for an industrial facility. Over 80 percent of the electricity used for this process is attributed to wasted heat. Consider more cost effective ways to accomplish the same tasks. If air nozzles are required, a Venturi type nozzle can significantly reduce compressed air demand as well as lower noise levels. Also check to make sure that air is not being supplied to unused or abandoned equipment.

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3) MINIMIZE PRESSURE DROP

Pressure drop is the reduction in air pressure from the compressor to the actual point of use. A properly designed system should have a pressure drop of below ten percent of

the compressor's discharge pressure. Systems are frequently operated at higher than necessary pressures to compensate for unnecessary pressure drops, which wastes energy and money. The most frequent problem areas are after-coolers, separators, dryers, filters, regulators and poor connection practices at the point of use. For systems in the 100 pounds per square inch gauge (psig) range, every two pounds per square inch (psi) increase in discharge pressure will increase energy consumption by about one percent at full load.

4) REDUCE SYSTEM PRESSURE

Many plant air compressors operate with a full load discharge pressure of 100 psig and an unload discharge pressure of 110 psig or higher. The actual pressure requirements of machinery and tools are often 80 to 90 psig or lower. Reducing and controlling system pressure downstream of the primary receiver can reduce energy consumption, leakage, demand for new capacity, as well as cause less stress on components and operating equipment. Be cautious when lowering system pressure because large changes in demand can cause the pressure at points-of-use to fall below minimum requirements. You can avoid this by carefully matching system components, controls and storage. Address unnecessary pressure drops prior to lowering system pressure.

In some plants, the high pressure requirements of a few uses drive the pressure requirements for the entire system. If these uses can be supplied by a dedicated compressor, the rest of the system can operate effectively at a lower pressure.

5) SIZE AND CONTROL COMPRESSORS TO MATCH LOADS

Since compressor systems are typically sized to meet a system's maximum anticipated demand, a control system is often required to reduce output for low demand periods. The compressor package usually includes controls. For systems with multiple compressors, it is usually good practice to follow a base-load/trim strategy. This allows some compressors to be fully loaded to meet the base-load demand. The compressor(s) with the highest part-load efficiency is placed in trim service to handle variations in load. This strategy requires controls that operate the group of compressors as an integrated whole. This is typically far

more efficient than placing compressors in modulation, which is a common practice.

An effective control strategy includes adequate storage. Employ storage to cover peak air demands by reducing both the amount of pressure drop and the rate of pressure decay. For systems with highly variable air demand, achieve tight control by combining storage with a pressure/flow controller. Narrowing the pressure variation with better controls uses less energy and minimizes potential negative effects on product quality.

6) USE EFFICIENT PART-LOAD CONTROLS

For rotary screw compressors, throttling the air can allow the output of a compressor to meet flow requirements. Throttling is usually accomplished by closing down the inlet valve, which restricts inlet air to the compressor. However, this control scheme is inefficient for controlling compressor output for displacement compressors. Most manufacturers offer control options for larger compressors that are more efficient at part loads. Load/unload controls can improve the efficiency at part-load operation if there is enough storage capacity. Another efficient approach uses variable displacement control or variable capacity control, which reduces the effective length of the rotors at part loads. Variable speed control can be a very efficient approach to provide "trim" duty. Proper selection of part-load controls depends on specific compressed air system requirements.

7) OPTIMIZE DISTRIBUTION SYSTEM OPERATION

The air distribution system that connects major compressed air system components is very important. Appropriate sizing and layout will ensure proper air supply, good tool performance and optimal production. Size and arrange the complete drying, filtration and distribution system so that the total pressure drop from the air compressor to the points of use is below ten percent of the compressor discharge pressure. Choose equipment and piping components to avoid excessive pressure drops and leakage. You may also dramatically improve the operation of existing systems by replacing worn out or inadequately sized hoses and couplings, inspecting and maintaining filter/regulator/lubricator components and installing adequate storage.

8) USE OUTSIDE AIR INTAKE WHEN OUTSIDE AIR IS COOLER THAN INSIDE AIR

Compressor work increases proportionally as inlet air temperature increases. Cooler air is denser and provides

NEXT STEPS

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Additionally, check out Compressed Air Challenge (CAC) for advanced training seminars. For more information about training and other CAC educational materials, please visit www.compressedairchallenge.org

more mass for each compression cycle with no additional power use. Lower inlet air temperature will result in less compressor work. Use outside air for cooling reciprocating and lubricant-free screw compressors when it is cooler than indoor air.

9) IMPROVE ROUTINE MAINTENANCE

Inadequate compressor maintenance can increase energy consumption significantly via lower compression efficiency, air leakage, pressure variability, higher operating temperatures, poor moisture control and poor air quality. This can add up to thousands of dollars every year. Inspect and adjust controls periodically to ensure that they are operating properly and at appropriate settings for system requirements. For basic maintenance, inspect and clean inlet filters, drain traps, maintain lubricant levels, condition belts, maintain operating temperature, inspect air line filters and check water cooling systems.

10) RECOVER WASTE HEAT

As much as 80 percent to 93 percent of the electric energy drawn by an industrial air compressor is wasted as heat. Properly designed heat recovery can recover 50 percent to 90 percent of the waste heat and use it to heat air or water. Common applications include supplemental space heating, industrial process heating, water heating, makeup air heating and boiler makeup water preheating. Heat recovery systems may also help facilities address negative plant pressure concerns. While most compressed air systems do not take advantage of heat recovery, paybacks can be less than one year.



The Compressed Air Challenge (CAC) is a nationwide government/industry collaborative formed in 1997. The goals of the CAC are to raise awareness in industry to the true costs and efficiency improvement opportunities in compressed air systems operations and to bring compressed air best practices to the plant floor level for American manufacturing. Contact us toll free at 866-442-4247 or www.compressedairchallenge.org for more information.



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