Seaway Fluid Power

16 Questions to Ask About Your Compressed Air Systems Energy Efficiency

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Upwards of 90% of the energy that goes into your compressed air system is wasted. By its very nature, the act of compressing air to the extent possible in compressed air systems generates a significant amount of heat. Most of the heat created by the compression process is lost. From this perspective, compressed air systems may be viewed as being inefficient.

Energy use within compressed air systems is also the single most costly aspect of a compressed air system. This is based on the fact that over the typical useful life of a compressed air system the energy costs for powering the system can far exceed to cost of the system itself.

Given this, it is no wonder that considerable effort is expended on reducing the energy loss associated with compressed air systems. According to a U.S. Department of Energy paper “Improving Compressed Air System Performance” it may be possible to achieve energy savings of 25% to 40% over time via the adoption of best practices. In the following document, we will review a number of the ways in which you can improve the energy efficiency of your compressed air system. To do so, you need to consider the following questions.

1. **Can You Use it Less?**

   How often does your compressed air system sit idle? This is an important question to consider because even when sitting idle a compressed air system can use up to 40% of the energy used to run the same system at full potential.

   Consideration for compressed air system usage optimization can be taken further by stopping to consider the impact of turning your system off when not in use. How much can be saved by doing this will depend on the way that your system is being used (e.g., number of shifts).

For example, a single eight-hour shift running five days a week would mean 33% utilization of the system.

By shutting down the system when not in use the energy used to maintain the operational readiness of the system can be saved.

2. **Is Your System Leaking?** "A typical plant that has not been well maintained will likely has a leak rate equal to 20 percent of total compressed air production capacity." This statistic comes from the DOE document mentioned earlier, and it is eye opening.

   The report went further in discussing the impact of leaks on system efficiency by stating the following "In addition to being a source of wasted energy, leaks can also contribute to other operating losses. Leaks cause a drop in system pressure, which can make air tools function less efficiently, adversely affecting production. In addition, by forcing the equipment to run longer, leaks shorten the life of almost all system equipment (including the compressor package itself)."

   Increased running time can also lead to additional maintenance requirements and increased unscheduled downtime.

Finally, leaks can lead to adding unnecessary compressor capacity."

Based on the above the severity of the impact from system leaks is obvious.

A question remains however concerning where leaks are commonly found. The following list of potential leak sources sheds some light on where leaks in your system may exist:

- Compressed air pipes and joints
- Compressor hoses & couplings
- Open valves not in use
- Poorly sealed fittings

A major challenge in leak detection is the fact that the vast majority of leaks cannot be heard, rendering them difficult to find.

Tracking down system leaks can be done most simply by applying soap and water to suspected leaks. More advanced methods of leak detection include the use of specialized leak detection equipment, the cost of which is readily justifiable when compared to the potential energy savings provided, or the hiring of specialists in leak detection.

The final step in leak detection is to identify and log leaks when they are found. The value in this is that it may shorten your leak detection efforts the next time around.

3. Can You Stop Leaks From Starting?

Establishing a regular maintenance routine to get ahead of leaks in your system is critical if you hope to keep energy costs from leaks in check.

As a starting point equipping and training your personnel with the appropriate leak detection equipment is a good first step in terms of preventative maintenance.

Once your maintenance personnel have been addressed the establishment of a regular schedule for your preventative maintenance activity should be established.

Finally, the establishment of a baseline leak rate for your system is important to provide you with an indicator as to the degree of change regarding your leaks.

To establish the baseline leak rate a measure should be taken with the system at full operational capacity. Shutting down the compressor and tracking how long the system takes to drop to a predetermined level establishes your baseline leak rate.

4. Is Your System Pressure the Right Pressure?

There is a direct relationship between air pressure levels and energy consumption. As you might anticipate, higher air pressure levels lead to higher energy consumption levels. It has been estimated that a reduction of two pounds per square inch in the pressure level of a system reduces the energy consumption level by one percent.

The implication of this relationship between air pressure and energy use is that it pays to maintain your system and address leaks. Leaks cause a drop in pressure leading to action being taken to increase the pressure, and hence, energy use.

One way to manage the pressure in your compressed air system, and its related energy costs, is with the use of a controller devise. Controllers in a compressed air system serve to manage the overall system pressure more efficiently. This, in turn, leads

"…compressed air typically comprises from about 5% to 20% of a plant's annual electric costs."

(Schmidt and Kissock, 2015)

to a reduction in operational energy costs.

An additional incentive exists to maintain a lower overall system pressure on terms of potential maintenance costs. This is as a result of lower pressure having a lower negative impact on system components such as diaphragms, gaskets, and seals. In turn, the useful life of these system parts may be extended.

5. Are Your Drains Working Properly?

Drains exist in compressed air systems to remove moisture from the air supply. Moisture removal is an important element in maintaining air supply quality in your compressed air system.

The majority of moisture drain traps operate on timers which control the opening and closing of the drains. Manual inspection of the drains and timers should be undertaken on a regular basis to ensure their continued trouble-free operation.

There are many parameters that go into determining the exact timing of the drain opening schedule. One example of such a parameteris seasonal humidity. Where energy savings enters into the picture here is that in many cases a drain opening schedule is set, and then never adapted to changing conditions. This results in the moisture drains being opened more frequently than is necessary, creating air loss and forcing the system to work harder to compensate for the air loss.

To deal with this situation the use of no-loss moisture drain traps should be considered. These valves can monitor moisture and open at predetermined moisture levels, and then close when the moisture is drained minimizing the time drains are open and bleeding air.

6. Is Your Piping Infrastructure the Best it can be?

Maximizing piping infrastructure in a compressed air system is a balancing act. Piping that is too small can impede the ability to provide the necessary pressure to support the applications the compressed air system is intended to support.

On the other hand, piping that is too large results in the system having to work harder than it should to supply the necessary air pressure. This overwork results in wasted energy consumption.

Minimizing the length of piping runs through a well-designed piping infrastructure will also pay dividends regarding energy use.

Some estimates as to the resulting pressure drop from shortened piping runs is in the area of 20 to 40%.

To determine the appropriate size of pipe required for your piping infrastructure, there are a number of online resources available including calculators and tables such as [Compressed Air Pipe Sizing Table].

7. Do You Change Your Filters Regularly?

Regular inspection and replacement of your air compressor filters will maintain the quality of your air and prevent drops in pressure within the system.

Reducing pressure drops means less work is required by your compressor to maintain the required pressure leading to energy savings.

8. Are You Optimizing Heat Recovery?

Air compressors by their very nature generate heat as a function of the air compression process. In most cases, this heat is simply lost to the environment.

Making use of heat recovery equipment in conjunction with your air compressor system can recover upwards of 90% of the heat generated by the air compression.

Heat recovery can be used for creating hot water or air for use in various locations within your facility. By capturing this otherwise lost heat energy you can reduce the energy required from energy providing utilities.

9. How Are Your Maintenance Practices?

As with any mechanical device, a compressor motor will run more efficiently if it is properly maintained. A more efficiently running compressor will use less energy and lead to savings.

The other aspect of your **air compressor system** that requires regular maintenance in order to prevent excessive energy costs is the pipes. Any form of contamination within the pipes such as moisture or dust can lead to filter clogs and their associated pressure drops requiring the system to work harder and use more energy.

Additionally, if left unchecked dust and moisture contamination can lead to corrosion and the replacement of system parts along with their associated cost.

10. Are You Using Your System for the Right Things?

While compressed air systems are versatile and can be used for a wide variety of applications, this is not to say that they should be used for all applications.

Applications requiring more power for heavy lifting, for example, are better suited to a hydraulic-based solution.

Where compressed air is used in inappropriate situations efficiency is lost, and higher costs are incurred.

11. Are There Alternatives to Using Compressed Air?

Yes, there are. The ready ease of use and availability of compressed air systems have led to their wide acceptance and use in industry. Yet, compressed are systems may not be the best solution for your application. As we have been highlighting here in this document compressed air can be wasteful in terms of energy inefficiency. By some estimates compressed air systems operate with efficiency levels in the 10 to 15% range. This means considering alternatives only makes sense.

For example, when it comes to providing motion, you could consider a cheaper to run electrical / mechanical motor. Consideration here does have to be given to the environment in which the motor operates and potentially explosive fumes.

Alternatives related to cooling needs, such as an air conditioning system, may prove to be less expensive and more efficient than adding the requisite equipment to a compressed air system to accomplish cooling

As a general statement vacuum based cleaning systems are more efficient and cost less in the long run than compressed air used for this purpose.

Similarly, electric tools are typically going to cost less to operate than those supported by compressed air systems.

12. Do You Have Usage Guidelines?

As noted in the previous section compressed air can frequently be used for inappropriate applications.

One way to try and ensure you make the best use of your valuable compressed air is to establish guidelines for its usage to assist employees in making the best use of this resource.

As noted, compressed air is not the best tool to use for things such as drying. Making employees aware of this and providing examples of the misuse of compressed air for drying activities will help to reduce your energy requirements.

When you create your compressed air guidelines, make sure you provide examples of alternative solutions to the activities you are attempting to deter your employees from using compressed air for.

13. Is Your System Design Optimized?

Getting your compressed air system design right the first time will pay significant benefits regarding energy savings down the road.

Having said this, what types of things should be considered in your initial compressed air system design? The following points are some of the things to consider:

- **Air Filters** – while these parts play an important role in maintaining clean air flow and overall system performance, their use ctheir use comes at a cost. Take the time to properly calculate and locate the air filters you will need on your system.

- **Air Intake Location**–as discussed dirty air reduces efficiency and adds costs. Making sure the air intake for your compressed air system is located in an area where there are no potential air contaminants will reduce costs in the long run.

- **Right size components** – making sure you have the right sized air compressor system parts will go a long way to ensuring optimal operation and lower costs. Parts such as piping, as previously noted, along with air receivers, drains, and dryers should be looked at.
- **Materials** – in addition to the sizing of the systems pipes consideration should also be given to the material used for

the pipes. Aluminum has an advantage as compared to steel in the join for the fittings tend to be smoother. A more seamless connection serves to provide a smoother airflow leading to less work for the compressor and energy savings.

14. Is the Environment the System Operates in Helping or Hindering?

Compressed air systems work more efficiently when the air intake to the system is lower in temperature. Some estimates have indicated that lowering the air intake temperature from 32 Celsius to 21 Celsius can improve system efficiency by close to 4%. The rationale behind this efficiency gain lies in the fact that it is easier for compressed air systems to compress denser (i.e., colder) air as it starts from a more compressed state.

This means that you should make an effort to ensure your systems air intake is from as cool a source as you can.

15. Have You Considered Total Life-Cycle Costs?

The upfront cost of your air compressor should not be your sole consideration regarding cost.

The type of compressor you purchase makes a difference over the life of the system. A variable speed compressor can reduce energy costs by upwards of 50% over the life of your system as compared to a fixed speed compressor. This savings comes from the variable speed compressor adjusting to lower air stream demand and hence using less energy.

Consider the total life-cycle costs of a compressor, not just how much the machine costs to purchase. Typically, a fixed speed compressor costs 7% in the purchase price, 11% in maintenance and 82% in energy costs – based on a 75kW compressor running at 8000 hours loaded and subject to regular maintenance. A VSD compressor will on average reduce the portion spent on energy by 35-50%.

Over the first ten years of life of a typical air cooled compressor (see Figure 2), with two shift operation, the operating cost (electricity and maintenance) will equal about 88% of the total lifetime cost. The cost of the original equipment and installation will account for the remaining 12%.

Source: Compressed Air Energy Efficiency Guide – Natural Resources Canada

16. Can the Industrial Internet of Things (IIoT) Help You?

The adoption of smart technology (Industrial Internet of Things or IIoT) to monitor compressed air system performance can lead to solid improvements in both uptime and operational efficiency.

The ability to monitor energy consumption on a real-time basis and develop historical performance means allows for the monitoring of system changes to determine their effectiveness.

The predictive capability of the IIoT to identify potential maintenance issues in advance also serves to reduce downtime and energy waste.

By taking the time to answer the questions outlined above you can reduce your energy use and save money as well. What are you waiting for?