Compressed Air System Maintenance Guidelines

Compressed air is probably one of the most universal operations within a plant environment. It transcends industries, operations and applications. Compressed air is used to power tools, move conveyers, transport products and make process applications possible. Considered a power source, compressed air systems are increasingly more reliable and predictable. Simply, it's considered the fourth utility.

Therefore, similar to electricity, disruption of the compressed air supply can cause costly production delays. With more and more companies eliminating capital budgets to purchase back-up compressed air systems, compressor downtime for repair, adjustments and maintenance becomes a critical issue.

In a recent industry study, 20 percent of calls logged into equipment manufacturers' help desks could have been avoided by proper installation and or maintenance procedure, which is why so many people -- from compressor manufacturers to consultants -- take time out to preach about compressed air reliability and efficiency.

However, before you attend a seminar, sign the predictive/preventive maintenance contract or call your compressor manufacturer, read this article. This guide will provide you with what could be considered common sense advice for compressed air system placement and maintenance that could reduce the amount of downtime you experience with your compressed air system. We will review compressor location, power source, ventilation, piping, filtration, cooling systems, and preventive maintenance.

Compressor Placement

While proper maintenance can help prevent complaints from compressor users, there are several issues that can be addressed before the compressed air system is actually in use. Proper compressor location, power sources, and ventilation can help prevent unscheduled downtime and environment issues.

Location Selection

One important consideration when utilizing a compressed air system within an operation is where to physically locate the unit. While there isn't just one way to install a compressor you should be aware of all the advantages and disadvantages to each system. For most plant environments, compressed air systems are designed to fit in a centralized area, adjacent or near the actual applications in which it serves.

Again, each scenario will offer different sets of advantages and problems. Regardless if your company chooses a centralized, decentralized or outdoor installation, you should consider the advantages and shortcomings and prepare for potential problems.

For instance, if a compressor is located indoors in a centralized compressor room, the compressed air system is protected from the weather, allows for easy access for maintenance and maximizes plant floor space. However, centralized compressed air systems usually requires additional space to provide adequate ventilation and additional piping to reach the actual operation, which can increase the potential of system pressure drops.

A decentralized compressed air layout allows for compressors to be located closest to the largest air users and reduces pressure drop through air lines. However, this configuration can also result in the highest probability of incorrect filtration as well as noise and heat complaints.

Another issue surrounding compressor location is the ambient temperature of the area. Compressed air systems subjected to low temperatures may deal with slow starting, possible control line freeze problems, a condensate freeze problem and/or a possible fluid misapplication. To remedy these issues, maintenance personnel can specify heaters and heat tracing key elements to minimize the freezing or simply relocate the unit to a warmer area of the plant.

On the other end of the spectrum, compressed air systems exposed to extremely high temperatures can experience unscheduled shutdowns, increased maintenance, and decreased lubricant life. These factors can be reduced by adjusting ventilation, utilizing a higher performance lubricant or again, relocate the compressor to a better location.

Power Ratings

The quality of the incoming power from your utility company will greatly affect the reliability of the electrical components of your air compressor.

For obvious reasons, the power supply should be free of any phase variation and voltage droops. For this reason many manufacturers offer phase and voltage monitors on their air compressors in order to help extend the life of the motor and any other electric/electronic components.

A simple rule to keep in mind when selecting a power source is matching voltages -- the voltage emitted by the power source and the voltage needed to run the compressed air system. The closer the voltages, the longer your motor will last. During relocation "voltage matching" can be solved by having the original motor rewound or simply buying a new one.

Ventilation

One of the leading complaints by plant workers and causes of unscheduled shutdowns is heat. Because compressed air systems generate such large amounts of heat, require extensive ventilation is required. Contrary to popular belief, ventilation is equally important for all compressors, regardless if it is water-cooled or air-cooled.

When there is insufficient ventilation, heated air from the compressor exhaust remains around the unit and is then ingested by the compressor increasing the operating temperature of the unit. This will cause the unit temperature to spiral upward and eventually shutdown.

It is important to plan for ventilation and access when deciding compressor placement. Plant designers need to be aware that they need to allow for three feet around the entire compressor package for maintenance and approximately 42-inches at the motor starter access panel. In addition, you need to avoid areas that are extremely humid or whose ambient temperatures exceed 115°F.

In addition to the actual ventilation area around the compressor, it is helpful to duct the cooling air exhaust of a compressed air system to either an outdoor area or an energy recovery system.

Regardless on how you decide to duct the exhaust heat, addressing this issue at installation time can help extend the life of your compressor. Specifically, by exhausting the heat, you can increase the life of your coolant, heat exchanger, bearings and hoses.

Filtration

Poor air filtration is the leading cause of early death for air compressors. Here are a few guidelines to help ensure that your compressor will continue to produce clean, dry air:

Know Your Environment: One common mistake that compressor users make is when they neglect to evaluate the quality of the air that they will be using within the compressor. To get to know your environment, evaluate the size and make-up of air-borne particulates and ask yourself some questions regarding your surroundings: Is the compressor near a chemical process? Is chemical cleaning being done in the area? Are noxious fumes present?

Most environments fall into one of three categories -- dusty, hostile and clean. Here is a brief description and the potential problems:

Clean

A clean environment is defined as having low dust and debris. This type of environment does not require much more beyond what would be considered standard maintenance.

A common problem, however, is that many people think that because they are situated in a "cleanroom" environment their compressed air system is safe from air quality issues. However, cleanroom environments often contain gases that are incompatable with the cooler lubricant. One solution to this problem may be to add additional ducting that will bring in ambient air from outside the facility.

Dusty

Dusty conditions, on the other hand, may contain dust as well as dirt, casting sand, and other airborne particulates. The hazards created by these conditions can be reduced by using a high dust inlet filter. While it may not remove any additional particles, it can reduce frequency of replacement.

Hostile

A hostile environment is defined as having caustic gases/chemicals, chlorine, ammonia, acids, in the air. With a hostile environment, one solution may be to remove the problem by relocating the compressed air system or the caustic materials. Another option is replacing standard materials of construction with more tolerant materials; for instance stainless steel coolers vs. copper coolers. In addition, to save money, evaluate the compressor fluid life in the hostile environment. A smart move may be possible conversion to a more cost effective fluid given the shortened life.

A proper evaluation of air quality at the time of installation and at least once a year could help prevent a premature failure of your compressor.

Confirm Inlet Filter Size: When inlet filters are not sized properly, it allows micron size dust to enter the compression system, which can decrease the life of the coolant and separator filters. A basic guideline for maintenance personnel is to monitor the pressure drop of filters and replace elements before the cost of increasing pressure drop, due to dirt or dust build up, exceeds the cost of a replacement element.

Inlet and oil filters left too long before changing can literally choke a compressor, reducing its flow. This will also accelerate the wear rate of rotating elements, such as bearings, in rotary screw compressors.

In addition, you should remember that the air filter that came with the compressor originally may no longer be adequate for your changing facility. Systematically evaluate your air filtration needs to fit your application.

Evaluate Your Compressed Air Dryer Needs

Liquid water occurs naturally in air lines as a result of compression. Additional condensation occurs downstream as the compressed air continues to cool. Moisture in compressed air is responsible for costly problems in almost every application that relies on compressed air. Some common problems caused by moisture are rusting and scaling in pipelines, clogging of instruments, sticking of control valves, and freezing of outdoor compressed air lines. Any of the se could lead to downtime of your compressed air system.

Compressed air dryers help to reduce the water vapor concentration and prevent liquid water formation in compressed air lines. Dryers are a necessary companion to filters, aftercoolers, and automatic drains for improving the productivity of compressed air systems.

Refrigerated and desiccant dryers are the most commonly specified for correcting moisture related problems in a compressed air system. Refrigerated dryers are normally specified where compressed air pressure dew points of 330°F. to 390°F. are adequate. Desiccant dryers are required where pressure dew points dip below 330°F.

Evaluate Your Cooling Water

Aftercoolers are essential elements of air compressors. These aftercoolers are heat exchangers that utilize either water or ambient air to cool the compressed air. The compressed air is typically cooled to within 15°- 25& deg; F of the cooling media.

In addition, aftercoolers typically remove 60 percent of moisture content in the air and help insure that the temperature of the air within the piping system is not considered a safety hazard.

Just as clean cool air is important to every compressor, clean cool water is critical to units fitted with water-cooled heat exchangers.

At a minimum, water conditions should meet the manufacturer's requirements for flow, pressure and temperature, however, one item that is often overlooked is the relevant "hardness" of the water. Hard water deposits lead quickly to clogging and fouling of coolers causing temperature shutdowns.

Water quality test kits are readily available from hardware or even swimming pool supply stores. Once a "bad" condition is identified, the cure could be as simple as scheduled chemical treatments of your cooling tower or the addition of an electro static or magnetic treatment system.

Piping

Regardless of what you do to maintain your compressor, if you are not maintaining your piping system your efforts have been wasted. All air/water inlet and discharge pipeworks are affected by vibration, pulsations, temperature, pressure, corrosion and chemical resistance. In addition, lubricated compressors will discharge small amounts of oil into the air stream; therefore, you need to assure compatibility between discharge piping, system accessories and software.

Nearly all of the compressed air system manufacturers recommend that customers do not use plastic piping, soldered copper fittings and rubber hose as discharge piping for compressed air systems. Plastic piping is not recommended because some types might react with compressor fluids, soften due to heat or shatter due to pressure or pulsation of the compressor. Soldered, copper fittings will eventually work loose due to pulsating caused by the compressed air system. Rubber hose piping is unacceptable because it is easily attacked by today's lubricants.

In addition, flexible joints and/or flex lines can only be considered for such purposes if their specifications fit the operating parameters of the system. A modern piping alternative is aluminum piping specifically designed for compressed air applications. Aluminum piping is lightweight…yet sturdy, is non corrosive…so it provides a clean distribution system, and provides higher flow rates vs. traditional piping materials such as black steel pipe.

Condensate Removal

After compressed air leaves the compression chamber the compressor's aftercooler reduces the discharge air temperature well below the dew point (for most ambient conditions), therefore, considerable water vapor is condensed. To remove this condensation, most compressors with a built-in aftercoolers are furnished with a combination condensate separator/trap. One concern when dealing with condensate is the Clean Water Act, which forbids the routing of condensate to floor and storm drains and to the ground outside even after condensate separation.

In situations such as this, a dripleg assembly and isolation valve should be mounted near the compressor discharge. A drain line should be connected to the condensate drain in the base. Keep in mind that it is important that the drain line must slope downward from the base to work properly. It is possible that additional condensation can occur if the downstream piping cools the air even further and low points in the piping systems should be provided with driplegs and traps. It is also important that the discharge piping is as large as the discharge connection at the compressor enclosure. All piping and fittings must be suitably rated for the discharge pressure.

Careful review of piping size from the compressor connection point is essential. Length of pipe, size of pipe, number and type of fittings and valves must be considered for optimum efficiency of your compressor.

Preventive Maintenance

If someone asked, "what is the key to maintaining an efficient compressed air system," my answer would have to be -- preventive maintenance. This is the one way the operator can actively help prevent unbudgeted maintenance expenses from cropping up. One way to execute a preventive maintenance program is by data trending.

Data trending is the recording of basic operation parameters including pressures, temperatures, and electrical data. For example, slowly increasing temperature indicates a variety of maintenance requirements including cooler core cleaning, overloading of system and possible mechanical problems. Another example might include slowly decreasing pressure, indicating increased system flow requirements, reduced compressor performance or increased system leakage.

Keep in mind, once a preventive maintenance program has been implemented, a key element often overlooked is data analysis. If the data is never reviewed, looking for trends, the benefit is lost.

Finally, the operator should understand that the same information used to evaluate and establish requirements for buying a new compressor should be used to re-evaluated periodically to ensure your compressor is still capable of doing the job. If not, there is a good chance you may be asking it to do more than it can, which will inevitably lead to a short life.

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