Is Your Compressor Trying to Tell You Something?

Warning signs that compressor failure could be in your future

By Oscar Duckworth

Anyone can check the fuel, oil, and coolant level of an air compressor prior to use. Unfortunately, these basic steps overlook critically important on-job maintenance essentials that, if ignored, have caused countless costly compressor failures. An air compressor used for shotcrete service requires specific on-job inspection, use, and maintenance procedures. Do you and your crew know what they are?

If It's Running, Don't Mess With It

A compressor that starts easily and runs smoothly may not initially appear in need of immediate maintenance. The classic phrase, "If it's running, don't mess with it," seems ideally suited for air compressors used in shotcrete service. Although most workers can demonstrate how to fuel a compressor or check engine oil, few can provide more than casual information regarding operation, care, and maintenance. Worse, signs of compressor trouble often go overlooked because the symptoms are not well understood.

Routine air compressor maintenance is usually performed at certain intervals defined in the manufacturer's literature. Like other construction equipment, lubrication, filters, and other scheduled maintenance by qualified personnel is the best method to assure reliable operation. Scheduled maintenance however, cannot take the place of the proper operation, daily inspection, and awareness of potential trouble by on-job personnel.

Although portable air compressors' primary components have not changed dramatically in decades, reliability and longevity have steadily increased. With newer models, low maintenance is an expectation. But even the newest models, when used in shotcrete operations, require specific on-job maintenance steps. Shotcrete compressors operate almost continuously at the maximum

output within the dusty air conditions of shotcrete placement. Imagine how long our work trucks would last if they were operated continuously at full speed within these conditions. Scheduled maintenance may not be enough. Because of the special needs of shotcrete air compressors, on-job personnel should be able to inspect and perform several simple but necessary inspection and maintenance steps.

Air Compressor Basics

A compressor head unit is coupled to the back of the engine. Engine rotation spins a pair of rotors within the compressor head at double the engine speed to compress filtered incoming air. Compressor rotors rotate within a precision housing at very close tolerances. Intake air must be clean or excessive wear will occur. The rotors are lubricated and cooled by a non-foaming lubricant (usually automatic transmission fluid) mixed with the incoming air. Next, the lubricant is removed from the compressed air as it passes through a filter/separator assembly. The filter/separator, like other filters, must be replaced routinely. It is easily identified within the compressor unit because it is contained within a tall, pressurized cylindrical tank (Fig. 1). As air is compressed, its temperature rises dramatically. This is normal and is referred to as adiabatic heating. Adiabatic heating occurs when a gas is compressed. To cool the hot air, it passes through a large intercooler (air-to-air radiator) at one end of the unit. An engine-driven fan pushes fresh air through all of the intercoolers to remove heat from the engine, compressor oil, and the compressed air (Fig. 2).

An adjustable pressure regulator controls the pressure and volume of the discharged air. Modern compressors use sensors and a micro-processor unit to control engine function and emissions. Gauges display vital engine and compressor functions. The engine and all of the compressor components are contained within a special sound-deadening enclosure that is designed to draw fresh incoming air through openings at one end and push heated air out the other. Unlike older compressors, opening the doors of a modern air compressor while it is operating defeats the sound-deadening design, interferes with air flow to the cooling system, and may cause overheating. Like modern automobiles, today's compressors are more reliable, efficient, and generate lower emissions than previous models. But, like the automobile, reliable operation will be short-lived without maintenance.

Fig. 1: Due to high compressor pressure, filter/separators are contained within a vertical steel tank near the compressor head unit

Fig. 2: A cooling fan forces fresh air through the engine's radiator and various heat exchangers

On-Job Compressor Maintenance Essentials

Due to near-constant full-throttle operation and the proximity to shotcrete operations, air filters require cleaning or replacement more often than the normal manufacturer's recommended service intervals (Fig. 3).

On-job maintenance of air filters is a constant responsibility. Because adequate engine and compressor intake filtration is one of the most important maintenance elements to equipment service life, cleaning and replacement of air filters should be part of all on-job maintenance.

Check the Vital Fluids (Including Ones that You Don't Know About)

Vital fluids must be kept at the correct levels. Like other construction equipment, fuel, engine oil dipstick, and engine coolant levels must be checked prior to operation. On portable air compressors, the components that compress, regulate, and cool the air are lubricated with vital fluids that must be maintained at safe levels. When asked, many operators cannot identify the procedure to check or fill the compressor head unit, or the type of lubricant required. The compressor head unit and filter/separator assembly fluid must be checked routinely by viewing the lubricant level through a sight glass or opening a large filler plug (with the engine off and all air pressure drained) located near the bottom of the filter/separator tank (Fig. 4). Operating an air compressor with low compressor head lubricant can cause overheating, shutdown, or costly damage to the compressor head unit. Prior to use, on-job personnel should check all vital fluid levels.

Check the Battery

If the battery on an air compressor starts the motor, no one will think any more about it. Typically, batteries only receive attention when the motor will not start. Although most batteries configured for construction equipment are designed to be maintenance-free, the battery's electrical terminals are not. Neglect and corrosion of the battery terminals creates voltage and current fluctuations that can damage the electronic control module, prompt unexpected shutdowns, or other costly problems (Fig. 5). Routinely inspect and clean battery terminals before, not after, a problem occurs.

Fig. 3: A visual inspection can easily identify dirty air filters

Fig. 4: A sight glass or filter plug are provided to check compressor head lubricant level

Watch For Compressor Warning Signs

It is normal for compressed air discharge to be warm, but very hot discharge air may be a sign of initial mechanical malfunction. Very hot discharge air is the first warning sign of an overheating condition. If ignored by on-job personnel, overheating can cause almost immediate engine, compressor head, or filter/separator damage. Excessively hot discharge air can be caused by clogged filters, low compressor head oil levels, excessive tolerances within the compressor head, or plugged cooling fins within the cooling system. If heat cannot be released as quickly as it is created, the compressor will begin to overheat.

By far the most common cause of excessively hot discharge air for compressors used in shotcrete service is dirty filters or partially clogged cooling system exterior fins. Because of the shotcrete environment, oil, cement dust, and dirt tends to quickly plug filters. Dirty air, drawn by the engine's cooling fan tends to build up and clog some (or all) of the cooling system's exterior fins. Check for clogged fins by looking at them through the protective fan guard (Fig. 6). Keep cooling system exterior fins clean by routinely flushing the sticky residue out of the cooling fins with plenty of water. The amount of trapped material released during flushing can be surprising! Modern compressors use protective heat sensor safety switches that will shut down the compressor if an overheating condition is occurring. If very hot discharge air is detected, or a shutdown occurs, check for clogged cooling fins, dirty air filters, or low compressor head lubricant.

A common warning sign of potential compressor failure that on-job personnel should watch for is an oily odor in the discharge air. Because shotcrete service compressors normally operate at near-full-throttle conditions, the filter/separator assembly is prone to failure. As media material within the filter/separator breaks down, its effectiveness at removing all oil from the discharge air diminishes. Not only are filter/separators susceptible to damage from heat and full throttle use, they can be permanently damaged by improper on-job compressor shutdown procedures. To avoid damage, compressors should be idled for a few minutes following full throttle use to cool engine, compressor, and turbocharger components, then shut off. Compressors are designed to automatically bleed stored compressed air SLOWLY after shutdown. Never throw open an air valve to drain stored air. A sudden collapse in internal pressure can distort and permanently damage the filter/separator assembly. If an oily odor is noted in the discharge air, discontinue use and replace the filter/separator.

A compressor failure during shotcrete operations can occur at any time. Fortunately, compressors often display warning signs well

Fig. 5: The air compressor's battery is often in a difficult-to-reach area

Fig. 6: Cooling fins clogged with dirt and oil area common cause of overheating

before trouble occurs. Successful use of air compressors for shotcrete service requires scheduled maintenance, on-job maintenance, and proper use by knowledgeable operators who can recognize warning signs, and avoid costly breakdowns.

*ACI Certified Nozzleman **Oscar Duckworth** is an ASA and American Concrete Institute (ACI) member with over 15,000 hours of nozzle time. He has worked as a nozzleman on over 2000 projects. Duckworth is currently an ACI Examiner for the wet- and dry-mix processes. He currently serves as ASA Executive Committee Secretary and Chair of ASA's Education Committee. He continues to work as a shotcrete consultant and certified nozzleman.*

Air Compressor Checklist

- When operating an air compressor, leave the sound-deadening doors closed.
- Check, clean, or replace air filters often.
- Know the proper method to check and top off all vital fluid, including the compressor head unit, at each fueling.
- Regularly inspect the battery terminals and keep them corrosion-free.
- Routinely flush accumulated build-up in the external cooling fins of the compressor's various intercoolers.
- Note changes in odor and temperature of the discharge air. These can be warning signs of initial mechanical malfunction.