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Technical Information

Why does my air compressor make so much water?

Control of moisture in compressed air is frequently mis-understood and frequently ignored with negative consequences. The amount of water in compressed air is a predictable phenomenon controlled by the laws of physics.

Air compressors do not make water!

Water in compressed air exists in two forms; vapor and liquid (condensate). The amount of water will be determined by the relative humidity (RH) and temperature of the ambient air being compressed. To graphically illustrate the problem, a 350 CFM compressor operating in an environment of 75% RH will take in and discharge approximately 15 gallons of water in an eight hour shift. The higher the air temperature, the more moisture will be present as vapor.

Assuming the air entering the compressor was probably between 70 º and 90 º F, and the discharge temperature of the compressor is 100 º – 150 º F as the result of heat of compression, the discharge air will contain more moisture per cubic foot than the entering air. Given the fact that the RH was 75 %, meaning that the air contained 75% of the maximum moisture possible at that temperature, when it is compressed to 100 PSI (7 cubic feet of air compressed into a one cubic foot space) and heated, the air will be saturated. Any cooling will result in condensation.

The air cools as it passes through hoses, valves and piping . As it nears the ambient temperature (approach), vapor condenses to liquid and can be removed by mechanical separation. As the air cools further, more condensate is present. It cannot be removed as a vapor. Compressed air normally expands back to atmospheric pressure as it is used. This is the “release” of energy stored in the compressed air. As the air expands it cools, condensing more of the vapor. This can be demonstrated by the fact that if you remove the valve core from an automobile tire on a cool day, ice may form around the valve stem. Remember that when a gas (air) is compressed it releases energy. When a gas expands it absorbs energy (refrigeration effect).

The logical answer is to cool the air, then remove the vapor after it condenses, and then reheat the air to ambient temperature. The amount of moisture still present in the compressed air is expressed as a temperature dew point; or the temperature at which condensation can occur. Typically a refrigerated dryer will discharge air at a dew point of 35 º F.

Abrasive blasting and conventional spray painting are among the applications most sensitive to moisture in compressed air. In spray painting, two factors are present.

1) evaporation of atomized solvents causes refrigeration. 2) Rapid expansion of compressed air causes cooling and will also cool the surface being painted, causing it to collect condensation. In abrasive blasting, it is necessary for the abrasive to be dry so that it can flow through the metering valve. The sudden expansion of compressed air within the pressure pot lowers the temperature, causing condensation to collect on the inside walls of the pot and in the abrasive. That condensate will cause clogging at the metering valve. Condensed moisture in the abrasive stream resulting from further expansion of the air as it leaves the nozzle mixes with the dust produced during blasting, impinging on the surface being blasted, resulting in a “muddy” surface.

Off the subject of condensed moisture, I would like to touch briefly on another “contaminant” which can affect production, maintenance and job quality. This is oil carried over from the compressor in the compressed air stream. Oil carryover is normally expressed in parts per million (PPM). From a typical portable compressor the carryover will be from 2 – 15 PPM. This issue is much easier to resolve.

Modern portable air compressors use a lubricated or oil flooded rotary screw design. A male and female rotor rotate together to compress the air. Oil is pumped to the intake side of the rotors, forming an oil cushion which also acts as a seal. The oil also carries the heat of compression away from the rotors to be cooled in an oil cooler which looks like a radiator. The air as it is compressed is laden with oil vapor. an air/oil separator located in the air receiver/oil sump tank removes almost all of the oil from the air through a process called coalescing, which means collecting small droplets of oil (mist) into large droplets which are then returned to the compressor. The higher the pressure, the more effective the coalescing air oil separator. At low discharge pressures, higher carryover can be expected.

An ideal contaminant removal system will consist of a pre-filter to remove particulate, condensed water, and remaining oil mist. This is attached to the inlet of a refrigerated air dryer. at the discharge of the dryer, a final filter removes any remaining oil or particulate. The air leaving this system meets a standard for laboratory quality air, probably cleaner than the air you breath while driving in heavy traffic. The cost of these systems is substantial; However, the cost of not having one can be monumental, due to lost production and compromised job quality. .

For more information about air drying and contaminate removal, consult a reputable trained compressed air professional.

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