P. Carey

# The Effects of Humidity On Modern Core Processes

## Introduction

Foundries  which expereince periodic or seasonal problems with coreblowing processes should look at their air drying equipment as the possible cause. Sometimes "dry" air just isn't dry enough.

If your foundry works with one of the modern coreblowing processes and you have noticed that the same core problems occur at about the same time each year, chances are good the problem lies more in your compressed air system than in the core process itself. This may be because foundry compressed air is really intended for use as a power medium, that is to raise and lower objects, power hand tools, etc. But it can be and often is used as a process medium for blowing cores in various core processes. In power applications where compressed air is used, only the liquified moisture is harmful; but in a coreblowing process any water, even minute quantities in a vapor state, can result in physical and chemical impairment to the process and the core products. The extent of damage may be profound or insignificant depending on a combination of factors related to the chemistry of the binder and various process controls.

The worst time for coreroom production is the spring and fall of the year because warm air contains much more moisture than cold air. Why is it nobakes are slower to strip, shell cores suddenly begin to sudder from peelback, hotbox cycles go up and coldbox cores become weaker and sometimes unstoreable? Because the moisture capacity of the air has undergone a dramatic change.

The subject of compressed air is a complex one and to better understand it we must first acquaint ourselves with some basic compressed air terms and principles before we can begin to understand why seasonal changes and small amounts of moisture in the air can have such a disastrous effect on our blown cores.

### Compressed Air Terminology

**Moisture capacity** is the amount of moisture air can hold at a specific temperature: It will always to hold as much moisture as it possibly can at a given temperature. Warm air will contain much more moisture than cool air; ait at 80F has four times the moisture capacity that, 40F air has.

**Relative humidty** is a percent value stating the amount of moisture present in the air based on the temperature.

**Dew Point** is the specific temperature at which the moisture present in the air begins to transform from a vapor to a liquid. When a dew point temperature is given it is usually understood that is is for atmospheric air at 14.7 psi and in our discussion this will be the case.

**Pressure dew point** is a term best defined by an example: seven feet of air at 80F and atmospheric pressure with a relative humidiy of 15% is compressed to a volume of one cubic foot. Assuming the temperature is still 80F the relative humidity increases seven times since we have now squeezed sevene times the number of water grains in the original space. The air is now saturated with moisture (7 x 15% = 105% RH) at 100 psi (7 atmospheres x 14.7 psi pressure dew point of 80F). Thus when pressure dew point is reffered to it is stated in units of temperature and pressure.

**Condensation** is the act of transforming water molecules from a gas (or vapor phase) into a liquid state.

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## Facts About Air & Moisture

The effect of temperature on saturated (100% relative humidity) air is especially pertinet to our understanding about the coreroom problems caused by weather changes. Air at higher temperatures can hold more water vapor than air at lower temperatures; i. e. there is moe vapor in the air during the summer than during the winter because of the effect of temperature. This means tha an air dryer system that works well in cooler weather starts to become inadequate in warmer weather and just cannot keep up as the weather becomes warm and wet. The combination of a high air moisture capacity (caused by suddenly increasing temperatures) and high humidity (rainy, muggy days) naturally combines to cause problems.

As a coreroom operator the BIGGEST mistake you can make is to believe that your plant's compressed air dryer is all you need to dry your core-process air. The function of the plant's main air dryer is to prevent free air droplets from forming in the power medium's air lines. This requires an atmosperic dew point approximately equal to the lowest temperature that the plant's compressed air piping will be exposed to, or in most cases 10-20F less than ambient. For plant compressed air any of three basic air dryer types (regenerative, refrigerated or deliquescent) adequately sized and properly maintained will do the job of preventing droplet formation. Recognized, however, that each of the three dryer types operate quite differently and provides a drastic difference in dew point.

## Air Dryer Types

A deliquescent dryer is a tank filled with urea-type pellets that chemically absorb moisture. During the absorptive process the pellets are gradually consumed by dissolving into the absorbed moisture so that they must be routinely replenished. In combination with a compressor aftercooler and seperator, deliquescent dryers are quite effective for eliminating droplets from plant power air. This dryer depresses the dewpoint 20F from its air inlet temperature. The 20F reduction occurs no matter what the inlet temperature so that provides a type of built-in compensation for seasonal temperature fluctuations. Unfortunately, especially in the tem-peratures and higher humidity often combine in such a way that the deliquescent dryer approach does not always provide the uniformaly low dew point level necessary for reliable high speed core production.

A refrigerated air dryer cools the compressed air to condense the moisture out of the system. It can provide a fairly constant dew point of about 0F. Refrigerated systems are usually satisfactory for core processes such as shell, hotbox or blowing nonurethane nobkaes provided they are well maintained.

Of the three basic types of air dryers the third, a regenerative system, is the only one that provides a dew point that is constantly low enough to ensure year round trouble-free production for all the core processes and especially the urethane coldbox process. The zero to -- 80F dew point obtained with the regenerative dryer is low enough to almost totally eliminate the moisture from core process blow and purge air. Thus in systems like the coldbox process the moisture sensitive isocyanate part II resin is not prereacted with the moisture in the air, hampering the part II's reaction with the part I resin. Moisture-free air ensures consistent and total reactivity between the two resin components and therefore a quality core. It has been proven by actual foundry experience that coldbox cores made with less than 0F dew point air are much stronger, totally storeable and have been observed to generate low amounts of lustrous carbon and superior shakeout characterisitics. In fact, all blown core processes are greatly improved when process air completely free of any moisture is used.

## The Core Blowing Process

The process is begun by pressurizing the coated sand-filled blow head with air in order to force the sand through the blow tubes and into the corebox cavity. The act of forcing the sand through the blow tubes and into the pattern is made possible by the fact that the sand grains in the blow head have been changed from a compacted chunk into a turbulent, fluidized mass of air, resin and san. The act of fluidizing the sand in the blow head obviously causes the sand grains to impinge against each other and bounce against the inside of the blow head. The agitation that these sand grains undergo causes resin to be splashed from the surfaces and to form a sort of vapor mist as the turbulence of the compressed blow air passes around through the multitude of bouncing sand grains. By pressurizing the blow magazine, moisture in the blow air is forced to mix (and possibly react) with the resin mist before it ends up back on the surface of the sand grains.

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The potential for damage from the blow air continues even after the sand comes to rest in the corebox. Since the mixture of moisture and resin vapor can be deposited into and onto the core itself (the sand surfaces acting as a condensing of filter-type media) it is obviously best to use the lowest blow pressure for the shortest period of time.

The blow magazine size is a very important consideration in the core-blowing process. If a magazine has a capacity that is quite large (as most of them do since they are sized for the largest potential job) and the machine happens to be blowing cores that require a small amount of sand, a resin, coated sand grain in the magazine may go through the very damaging fluidizing process as many as 20 times before a core is finally made from it!

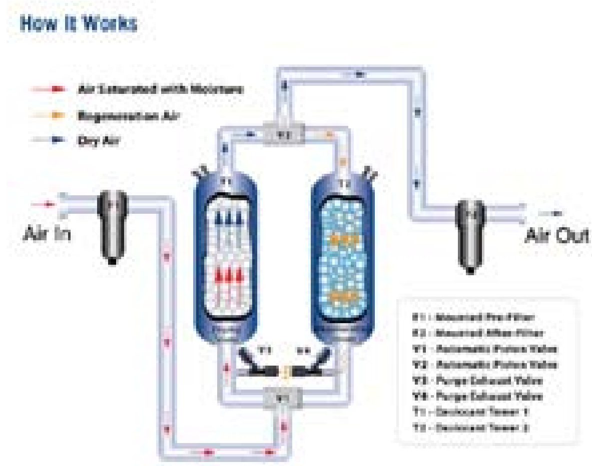
It should be remembered:

- That warm air contains much more moisture than cool air.
- A foundry's central dryer system that provides the "power" air is designed to prevent droplet formation in the lines, but the core "process" air dryer must be of a type, if possible, to eliminate all of the moisture from the air transporting the core sand.
- Some binder systems are more sensitive to moisture degradation than other binder systems; the pressurized blow magazine and the core blowing process itself can combine to force moisture into the core sand's resin coating.
- Most important -- unless you have a regenerative air dryer capable of reliably providing very low dew point air you will always have problems when the weather changes!

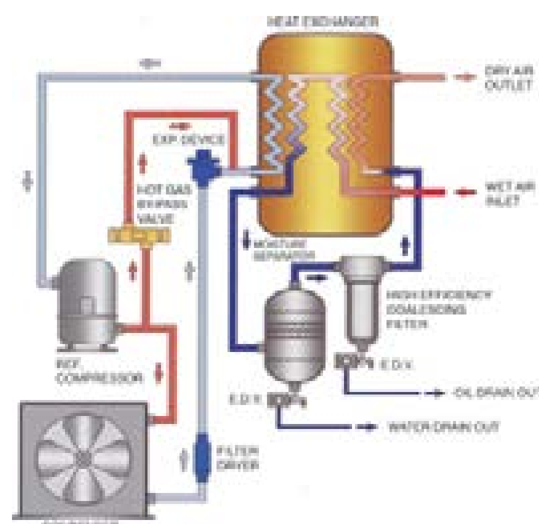
The physics of air drying is an extremely complex subject and perhaps oversimplified in this article. A subsequent article will provide a detailed look at the air dryer system components, examine air dryer, theory and analyze the physio-chemical mechanisms that produce specific core defects related to wet air.

Deliquescent Dryer


Typical Air Flow Through Various Air Dryers Regenerative Dryer




Refrigerated Dryer



# Acknowledgements

The author wishes to acknowledge the contributions regarding air dry equipment from James E. Miller, Daniel L. Bowers Co; and core processing experience from Al Scargall and Rick McBride, CFD Pontiac and Ken Siems, Chevrolet Grey Iron Foundry.

ASK Chemicals L. P.
495 Metro Place South | Suite 250 | Dublin, OH 43017
Phone: +1 800 848 7485 | Fax: +1 614 761 1741
info.usa@ask-chemicals.com | www.ask-chemicals.com