Condensation occurs when a cold surface comes in contact with warm air. There is no better example than seeing water droplets begin to appear on the outer surface of a glass or can that is filled with a chilled beverage and exposed to room temperature. Another good example is when water vapor condenses, or *sweats*, on the interior surface of a cold window on a cold winter day. The same is true of any water pipes in your basement. Chances are that the ceiling of your basement is warmer than the temperature of the water running through the pipes — hence, pipe-dripping or condensation occurs.

Physics

Atmospheric air consists of oxygen and nitrogen, as well as other miscellaneous gaseous components and water vapor. Dry air exists when all water vapor has been removed from atmospheric air. Moist air is a mixture of dry air and water vapor. The water vapor content in moist air varies from zero (dry air) to a maximum (saturation) dependent on temperature and pressure. To quantify the water vapor content in moist air, a humidity ratio is used, based on *water vapor weight* versus *dry air weight*. Relative humidity (RH) is just another convenient way of expressing air humidity in terms of a percentage of the humidity ratio for saturated moist air.

When moist air is subject to low temperatures at a constant pressure, its ability to hold its water content is reduced (i.e. low humidity ratio). Conversely, raising the air temperature at a constant pressure will allow the air to hold more water vapor content (i.e. high humidity ratio). Hence, as the air gets near, or comes in contact with, a cold medium, the low temperature surface robs the air of its ability to hold water. The consequence is that water droplets form on the cold surface.

The temperature at which water vapor in the air begins to condense is normally called the dew point temperature. The dew point temperature of a given air sample will decrease, or increase, in accordance to the air temperature because of its ability to hold water vapor content (i.e. humidity ratio). For instance, water vapor from an air sample of 60% RH at 75°F will condense at a dew point of 60.4°F. In other words, water droplets will form on a surface when the surface temperature drops below 60.4°F.

January 14, 2005

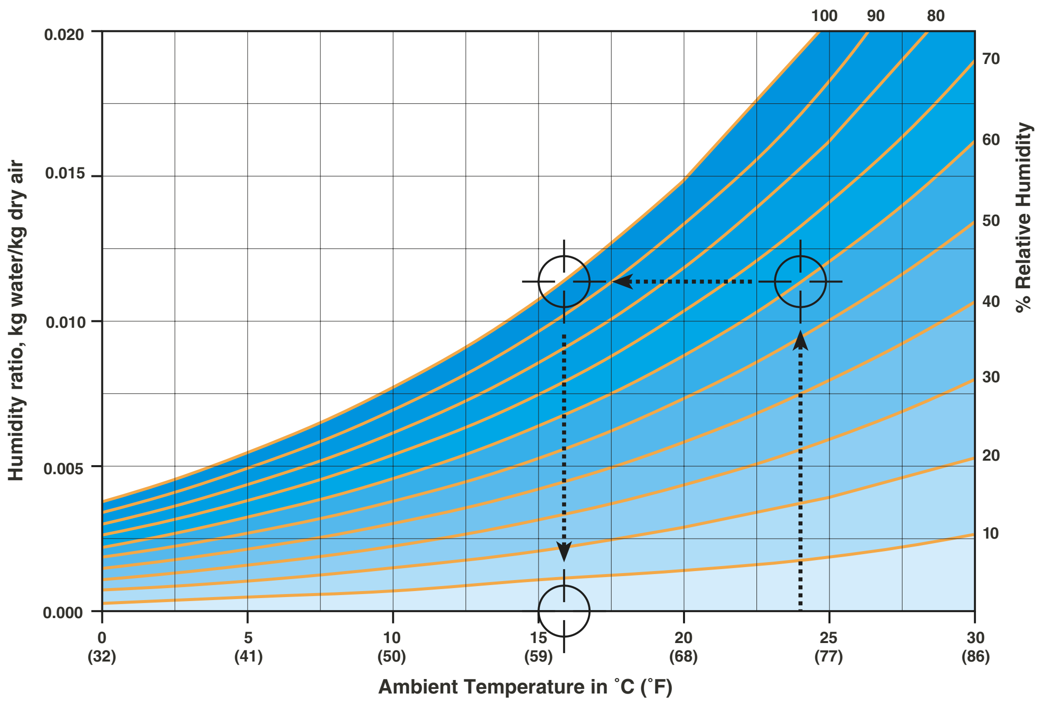

Figure 1. Relative Humidity. Water temperature of 10˚C (50˚F)

Example: At an Ambient temperature of 24˚C and a relative humidity of 60%, condensation will appear at a surface temperature 16˚C.

The dew point temperature observation can be extended to any PEX pipe with a flowing cold medium. An example is chilled water for an air conditioning system, in relation to the ambient air temperature to which the pipe is exposed. The following chart illustrates the limiting conditions in terms of ambient air temperature and humidity on uninsulated HeatLink® PEX pipes, flowing 50°F cold water, just before the pipe surface condensation begins.

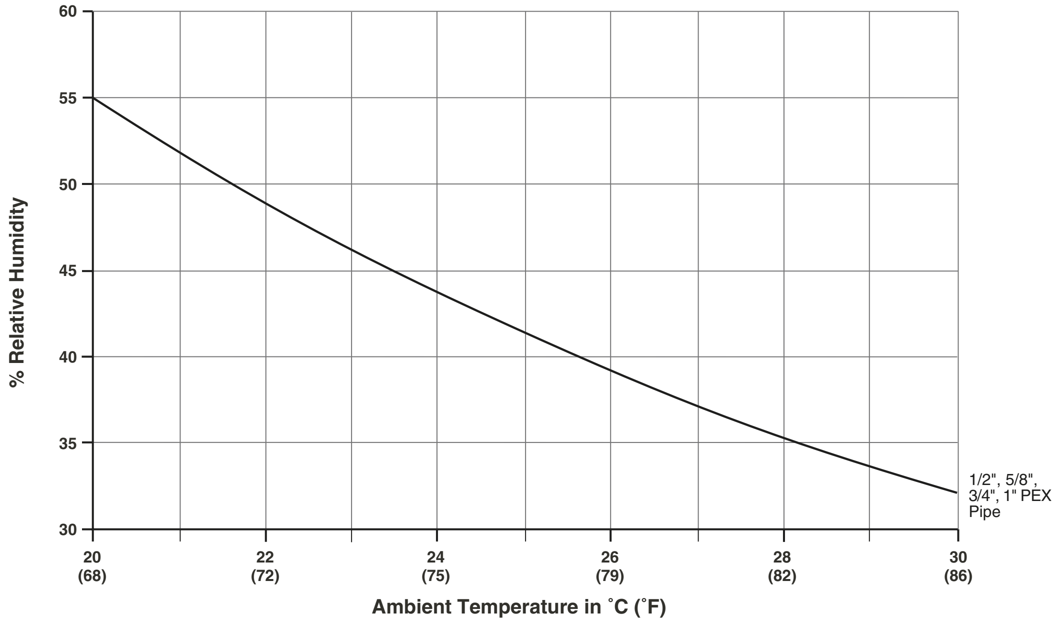

Figure 2. Highest relative humidity to avoid condensation on uninsulated PEX pipes. Water temperature of 10˚C (50˚F)

External condensation on a cold HeatLink® PEX pipe will not cause corrosion. Anti-corrosion painting on PEX is unnecessary. Water condensation does not tarnish PEX pipe. PEX pipes do not corrode, but proper corrosion prevention measures should still be put in place in light of other metal components used in the same system.

Insulation

Standard types of insulation, such as glass wool or polyethylene foam, can be used on PEX pipes. Insulation based on closed cell structure usually has a built in vapour barrier resistant to water vapor encroachment. With other materials, a vapour barrier is to be considered outside the insulation. Most pipe insulation manufacturers provide dimensioning data for metallic pipes, which can be also used for PEX. However, any type of glue or adhesive should not come in contact with PEX pipe.

Questions to ask when considering pipe condensation prevention

1. *What are the working ambient temperatures and humidity conditions the system will be subjected to?*

   Use *average* instead of *worst-case* ambient conditions to avoid any unrealistic situations when it comes to condensation control.

2. *What is the operating temperature of the application?*

   The answer to this question will shed light on: the necessity of putting insulation in place; how much insulation to use; and the insulation thickness that is needed.

3. *How important is condensation control in the overall performance of the installation?*

   In many applications, condensation does not present as much of a process problem as it does an aesthetic problem.

Condensation Control

This is normally an issue with a cold pipe flow medium. Problems associated with condensation are: wetness around the piping and the related thermal degradation; the staining of ceiling panels in interior building applications; and the health risk due to mold and fungus growth of the affected materials. While insulation systems can be designed to retard surface condensation, they cannot, in most cases, be designed to prevent condensation.

In arid climates, the insulation system can prevent condensation most of the time. However, even in the driest desert, dew settles on the ground in the early morning hours. When dew settles on the surface of an insulation system, it is considered condensation. In humid regions, it is not feasible from a financial point of view to consider designing an insulation system to be completely fool-proof to condensation. The insulation thickness required to achieve this would not be economical and practical.

As with personnel protection, the outer membrane or jacketing selected for limiting condensation plays an important role in providing good condensation control. The surface temperature of the insulation system is the controlling factor in how often condensation will form, and how long it will be present. On cold pipes, a dull-finished jacketing with higher emissivity, results in a warmer outside temperature, produces less of a difference between the pipe temperature and the ambient air, and thereby reduces the likelihood of condensation. A low-emissivity reflective jacketing will reflect the cold back into the system, and thereby keep the surface temperature cooler. This increases the vapor drive toward the pipe, raising the alarm to a condensation problem.

HeatLink® HeatSeal™

When it comes to insulating PEX pipes, HeatLink® HeatSeal™ provides a handy solution. HeatSeal™ is specifically designed for low temperature range applications, more specifically for installations spanning from refrigeration plants, drinking water systems, to waste water systems. Contact any HeatLink® representative for more information on HeatLink® HeatSeal™ products.

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