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TECHNICAL PUBLICATION 49
HUMIDITY AND MOISTURE
HUMIDITY ALARM

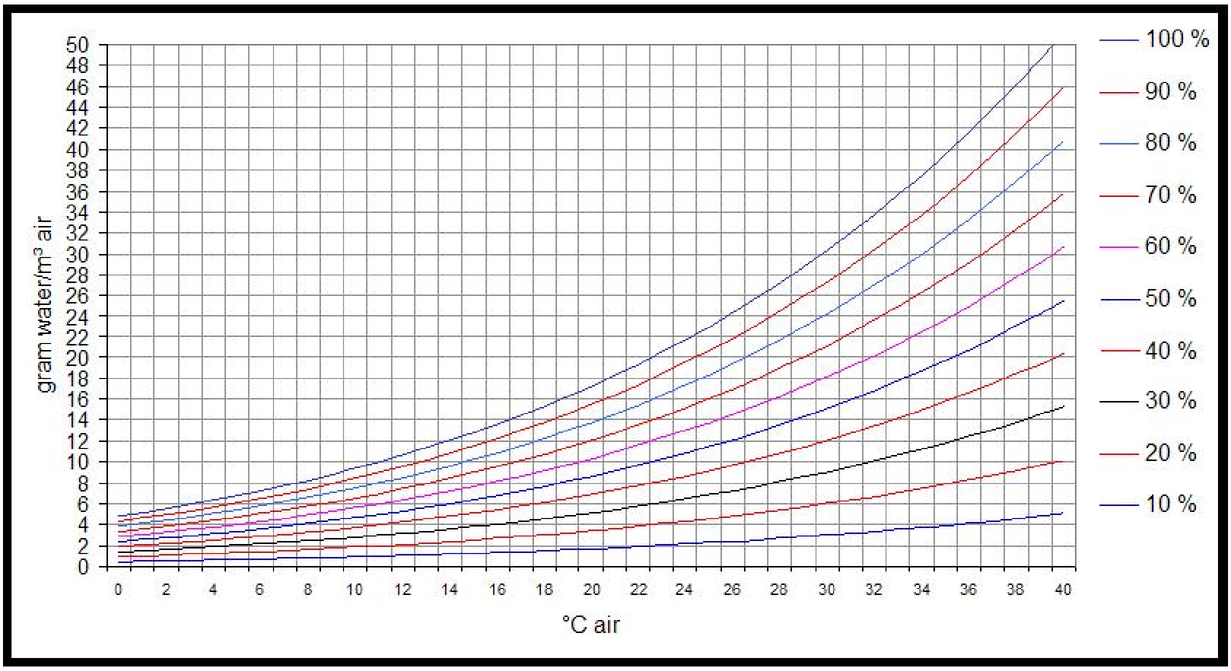
About humidity and moisture.

Among the various global parameters that an operator may adjust, there is one called Relative Humidity. We all know that it affects the transmission of the atmosphere between the camera and the thermal scene, but this is not what we deal with here. Our point of interest is to understand how humidity modifies thermal transfers in a building structure. So, what does it correspond to?

Well, there is some water in the air we breathe, most of the time under the form of vapour. Relative humidity represents the ratio between the current water vapour mass in the air and the maximum it may contain in saturation conditions.

The warmer the air is, the more moisture it can contain. For instance, considering a water vapour mass content of 2,4 grams per m^3, the relative humidity is 95% in case the air temperature is -8°C, but only 13% if the temperature is 20°C.

The graphical representation of relative humidity is called a *psychrometric chart*.



The relative humidity is dependent not only on the temperature, but also on the absolute pressure. Therefore, a change in relative humidity can be explained by a change in temperature, a change in the absolute pressure, or a change in both of these properties. When doing a building survey, pressure is usually not accounted for. That is why we say that the only solution to reduce the relative humidity is to increase temperature. Ventilation and air conditioning help to reduce the absolute, not relative, humidity.

When the mass content is greater than what the air may contain, the excess of water becomes liquid and condensation occurs. This is called the *Dew Point*.

Dew point is very easy to determine graphically from a psychrometric diagram!

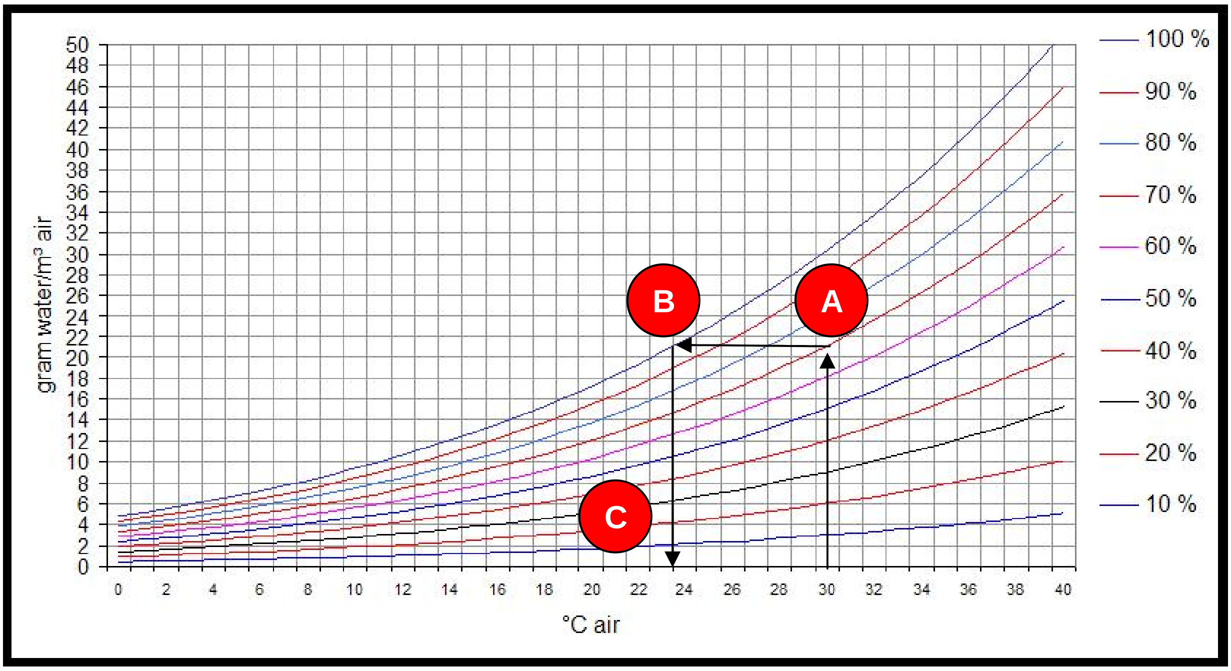
Consider for instance an air with the following characteristics:

- Temperature 30°C

- Relative humidity 70%

I. Draw a vertical line from the abscissa 30°C, to the 70% curve. Point A.
II. Draw a horizontal line from A to the 100% curve. Point B.
III. Draw a vertical line from B to the horizontal axis. Point C.

The temperature value on point C is the dew point.



Dew point here is ca. 23,5°C. It means that on any surface below 23,5°C, condensation will occur.

A device used to measure humidity is called a hygrometer. Some examples:

It is of great importance to localise zones in walls and ceilings where there is a risk of condensation, not only where condensation occurs.

An instantaneous effect of the presence of water on a surface is temperature cooling down due to evaporation. It is indeed an endothermic effect, which means the liquid-to-vapour phase-change needs heat to generate. The consequence of heat removal on a system if that the temperature decreases.

The second effect is more mid-term. All construction materials are porous to water. Of course, we all know that concrete is less permeable than plaster or wood. But it cannot be zero. Water in a material largely affects global properties that are involved in thermal transfers: conductivity, density and specific heat. When conductivity of a wall increases, its thermal resistance decreases, and thermal losses get bigger. Not only this may cause discomfort for dwellers, but the building structure itself may also become at risk.

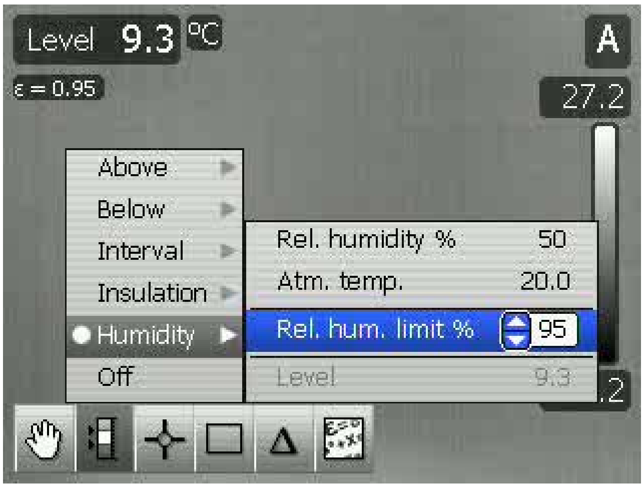
The third effect of moisture is mold growth. In the good conditions of humidity and warmth, they multiply and release spores in the air. Some molds produce various mycotoxins. Health effects vary widely, but some of the possible effects indicated by scientists include asthma, allergic reactions, suppression of the immune system, various lung problems and possible neurological effects. It is a real biological hazard. A mold problem means a moisture problem. If you prevent materials from staying wet for longer than a day or two, you prevent mold.

So, the key objective should be moisture control.

Humidity alarm

Some FLIR cameras are equipped with a feature called *Dew Point Alarm (1)*, or *Humidity Alarm (2)*.

InfraCAM SD *Dew Point Alarm* menu (1)



T400 *Humidity Alarm* menu (2)

In the first case, an alarm is set to the value of dew point.
To achieve that, the operator manually enters the relative humidity and atmospheric temperature. Dew point is then calculated by an internal algorithm.
It automatically becomes the threshold level for the alarm. All pixels which apparent temperature is below this threshold therefore appear in contrasted colours[1].

In the second case, the alarm level (or threshold) is also calculated from a psychrometric diagram such as the one from the previous page. However, instead of taking the temperature under saturation conditions (100%), a lower percentage is considered. Again, the operator manually enters the parameters into the menu. The threshold level is automatically calculated and assigned to a *below isotherm*. Due to the shape of the psychrometric curves, the resulting alarm threshold is slightly higher than in the first case[1].

On a practical point of view, defining an alarm to a humidity limit that is below saturation may help localizing zones on a wall where condensation occurs in the material itself, and not necessarily on its internal surface.

[1] Note that, after an image is stored, post-adjustment in the camera or with a FLIR reporting software, is always possible.

Graphically speaking, the example below starts with the same numbers as page 2: air temperature 30°C and relative humidity 70%. Point C, which corresponds to the dew point (100%) is ca. 23,5°C.

Should the limit be set for instance to 90%, the alarm level becomes ca.25,5°C (point D). The difference with the previous case is +2°C.