Basic knowledge
Fundamentals of air conditioning

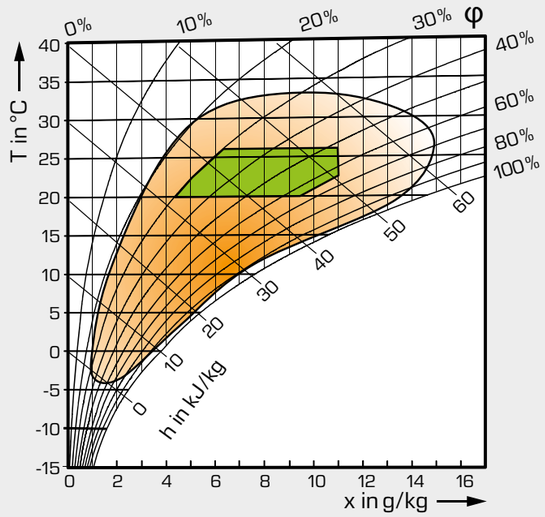
The purpose of air conditioning is to create a room climate comfortable for people. The conditions for describing comfort are standardised in accordance with DIN 1946 and DIN EN 13779. While the temperature should be between 20 and 26°C, a relative humidity between 30 and 65 % is permitted.

Air conditioning therefore means to affect the room air in such a way that people are comfortable and their productivity is not impeded.

The condition of the air is characterised by temperature, pressure and humidity.

Normally, the air pressure is not changed. Exception: air conditioning in the aircraft cabin.

Comfort zone in the h-x diagram for humid air by mollier



In the h-x diagram temperature **T**, enthalpy **h** and relative humidity **φ** are plotted above the absolute humidity **x**.

In the exemplary diagram the comfort zone according to DIN 1946 is drawn in green.

The orange area represents the range of outside temperatures and humidities prevailing in Central Europe. You can see that the outside temperatures and humidities usually do not match the conditions for comfort and that the room air needs to be air conditioned.

In Central Europe this is usually heating and humidification, whereas in the Tropics cooling and dehumidification is required.

For full air conditioning there are four partial functions:

- heating
- humidifying
- cooling
- dehumidifying

Air humidity

Humid air contains water in a vaporous state. A difference is made between absolute humidity and relative humidity. Absolute humidity is measured in g H_2O/kg dry air.

For air conditioning the relative humidity is more important. It is perceived by humans. Relative humidity is measured in % of the maximum possible humidity at a given temperature. 100 % r.h. means that the air cannot absorb any more humidity, it is saturated. Excessive humidity then remains as a liquid (mist) in the air. The saturation curve is the lower limit curve in the h-x diagram.

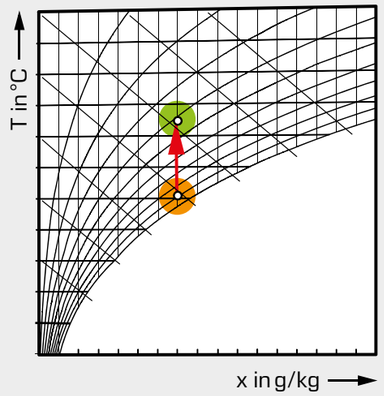
Basic processes of air conditioning

The basic processes of air conditioning can be exceptionally well represented in the h-x diagram.

A change of temperature at constant absolute humidity also always results in a change of the relative humidity and enthalpy. The relative humidity and enthalpy also change with a change of the absolute humidity at constant temperature.

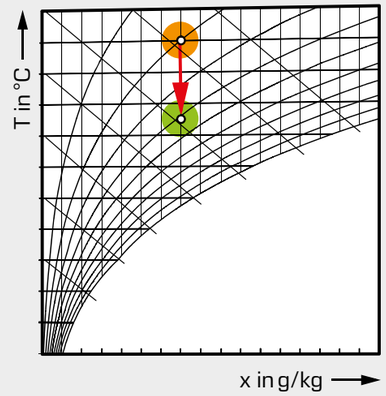
Thus temperature and relative humidity cannot be set independently of each other. An increase in the air temperature (heating), for example, always also results in a reduction in the relative humidity. To keep the relative humidity constant, humidification is therefore also required when heating. Conversely, the relative humidity increases during cooling.

Four basic processes of air conditioning in the h-x diagram



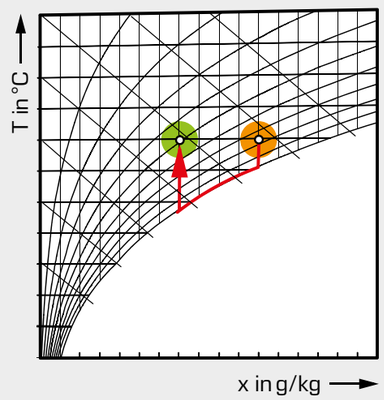
Heating

Supply of heat, relative humidity reduces



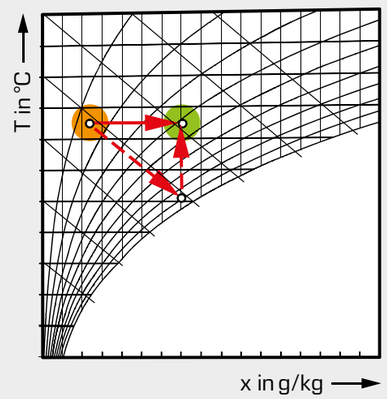
Cooling

Removal of heat, relative humidity increases



Dehumidifying

Cooling to 100 % r.h. (saturation), condensation of the humidity on cold surfaces. Followed by heating to the desired temperature.



Humidifying

Supply of water steam or water mist (for mist additional heating required to compensate cooling due to vaporisation enthalpy 1-1'-2)