

Humidity measuring technology

The physical fundamentals of humidity have been dealt with elsewhere. Here, only the explanations necessary for understanding the measured values will be explained. Definition and units in the field of humidity measurement technology are not uniform. The moisture content of a gas, for instance, is given in g/m³ or g/kg, in volume proportions or dewpoint temperatures.

Depending on the field of application, certain definitions are, however, preferred, arising from favourable measurement possibilities. For humidity measurements in gases, these are :

- moisture content of dewpoint temperature
- moisture content of volume proportions

If one establishes the proportion between water weight and weight of gas, or also between water volume and the volume of the gas under consideration, pure proportion figures are obtained. The abbreviated term ppm (parts per million) has proved its usefulness. For reasons of measurement technology, one uses volume shares in the case of gases, ppm_v.

The determination of water vapour volume presents considerable difficulties. Basing itself on the gas laws, the volume share ppmv is determined by establishing the proportional share of the water vapour pressure in relation to the total pressure.

The general gas law applies to water vapour :

$$p \times V_w = n_w \times R \times T$$

Formula 8.2.1

For the overall volume, also called total volume, the following equation is valid :

$$p \times V_T = n_T \times R \times T$$

Formula 8.2.2

Dividing equations 8.2.1 and 8.2.2 leads to the following relation :

$$\frac{V_w}{V_T} = \frac{n_w}{n_T}$$

Formula 8.2.3

The volumes behave like quantities of material. On the basis of the fact that a certain volume is filled with water vapour, the equations defining the state arise:

$$p_w \times V = n_w \times R \times T$$

Formula 8.2.4

$$p_T \times V = n_T \times R \times T$$

Formula 8.2.5

Equation 8.2.4 divided by equation 8.2.5 results in :

$$\frac{p_w}{p_T} = \frac{n_w}{n_T}$$

Formula 8.2.6

The pressures behave like quantities of material or volumes.

$$f[\text{ppmv}] = \frac{p_w}{p_T} \times 10^6$$

Formula 8.2.7

Often, however, only an indication of relative humidity obtained by the relationship of water vapour partial pressure to water vapour saturation pressure, are all that is of interest.

$$r_H [\%] = \frac{p_w}{p_T} \times 10^6$$

Formula 8.2.8

The concept of relative humidity is known from meteorology. The relative humidity is the proportion of the absolute humidity h of the air to the saturation maximum h_s . The latter indicates the water vapour quantity in g, which 1m^3 of moist air can take up without water condensation occurring.