Technical information

Humidity

Humidity has a big influence on the friction coefficient of carbon brushes and is one of the main operational parameters for the performance of carbon brushes.

Definition

The quantity of water vapor in the air is called humidity. The **absolute humidity** is the amount of water vapor in grams in one cubic meter of air. That is the decisive parameter for brush performance.
The maximum amount of water vapor which one cubic meter air can contain is called **maximal humidity** or saturation limit. The maximal humidity depends very much on the temperature. As more warm the air as more water vapor it can take.

The **relative humidity**, the value which can be measured with a common hygrometer, is the ratio between absolute humidity and maximal humidity and is given in percent.

$$\text{relative humidity} = \frac{\text{Absolute humidity}}{\text{maximal humidity}} \bullet 100\ \%$$

Conversion of relative humidity into absolute humidity

For the conversion a diagram as given in pict.1 has to be used

An example for clarification:

- Measured value relative humidity 80 %.
- Air temperature is 20 °C.

The intersection point of the 80 % curve with the temperature line is projected onto the x-axis. A value of 14 g/m³ absolute humidity can be read off from the diagram.

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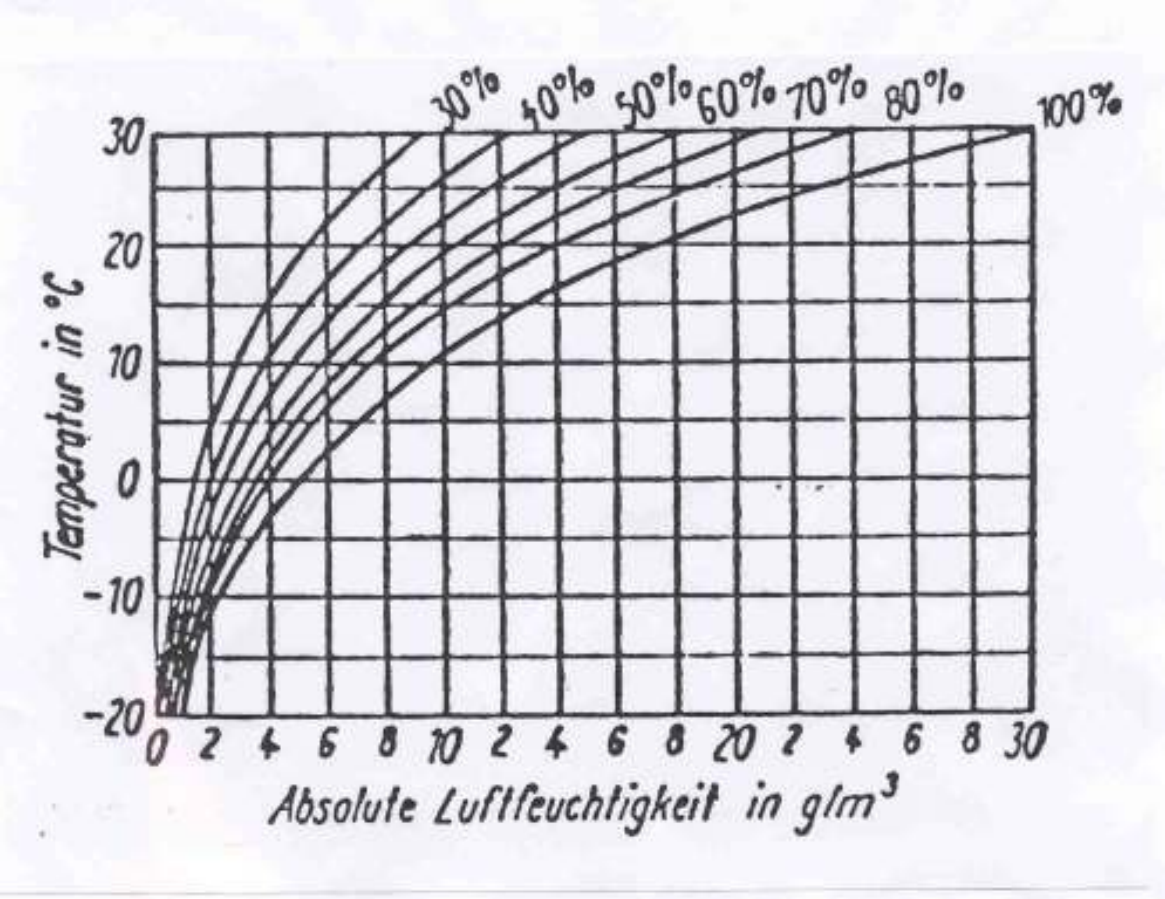

Pict. 1 Nomograph for the conversion of relative into absolute humidity

An easy conversion is possible on the following website: :
http;//www.cactus2000.de/de/unit/masshum.shtml

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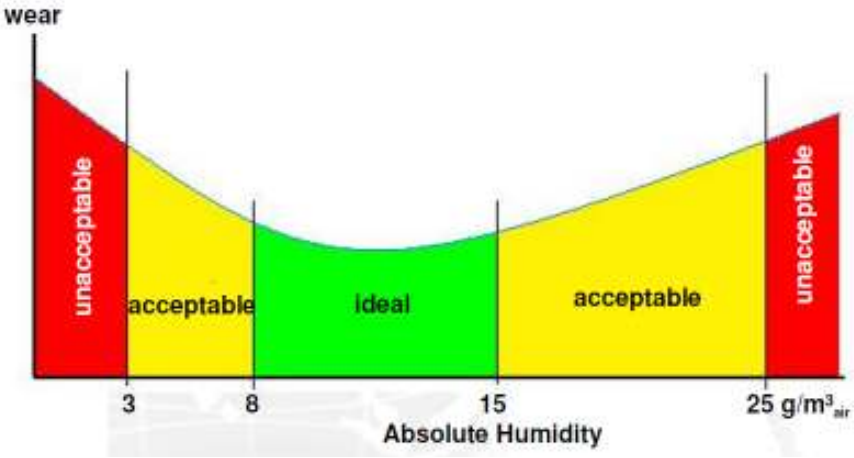
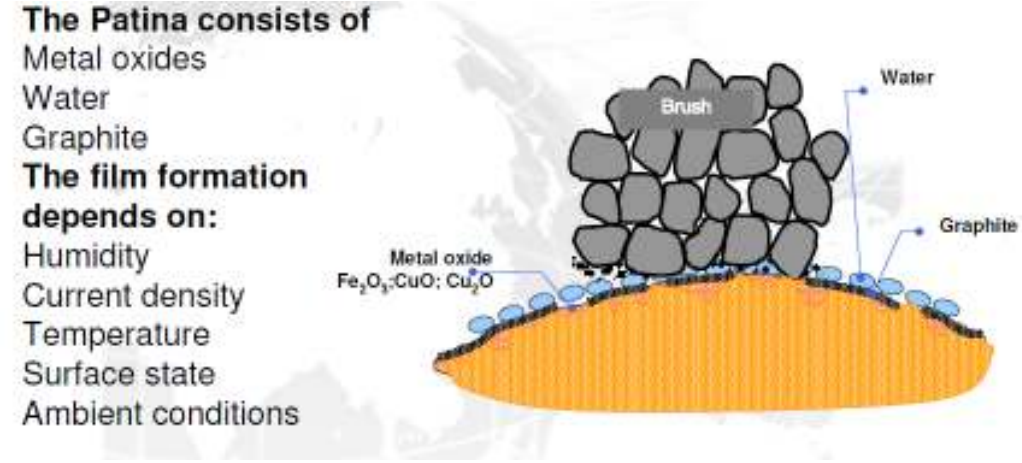
Guide line values



The following guide line values are valid for the absolute humidity

- Lower limit 2 g /m³ .
- Optimum 8 – 16 g/m³
- Upper limit 25 g/m³

Film formation



The surface film on a slip ring or commutator is essential for the carbon brush performance. Beside graphite from the carbon brush and metal oxides from the ring material water is one of the substances which can be found on such a surface.

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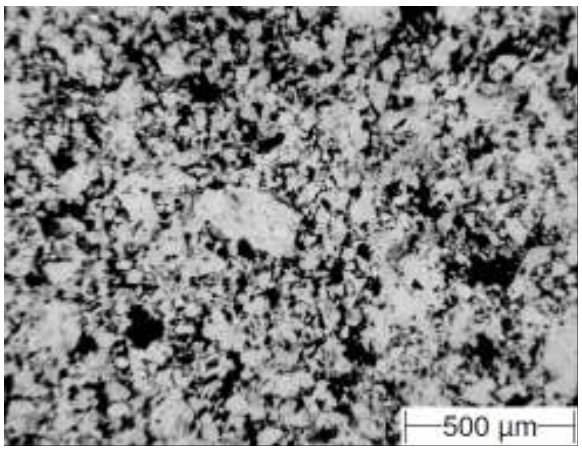
Dry air

In dry air, in vacuum or e.g. with a protecting gas atmosphere the water skin on the collector surface is absent which is important for a stable friction coefficient of the brush material. The skin deteriorates, the friction coefficient increases, the brushes begin to vibrate and the brush wear will increase.

Typical applications are:

- Aircraft motors
- Cold environments , e.g. in winter time or in elevated heights
- Motors under protecting gas
- Totally encapsulated motors
- Fully encapsulated motors

As can be seen o the micro-photograph a carbon material contains a lot of pores, approx 10 – 40%. These pores can be filled with special substances, e.g. to improve the performance at low humidity. By brush wear the pores are opened and the impregnates are set free.



SCHUNK has several of these after-treatments in its portfolio. They are indicated by the letter X,Z1,Z2,Z3 and Z4. The final grade designation is e.g. E49X, C80Z2 or K14Z3.

High humidity

Hot atmospheres and over-saturated humidity influence the brush performance negatively, too. The brushes tend to overfilm, the film will become patchy and grooves will be formed.

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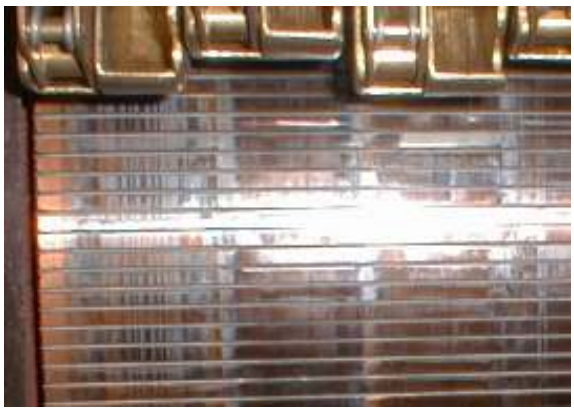

Typical application with high humidity environment are

- Pumps in pulp and paper mills
- Motors and generators in certain tropical countries

Brush grades with self-cleaning properties can help to keep the surface film uniform and to stabilize the brush wear.