Technische Information

Performance of carbon brushes at higher temperature

Modern electrical drives are design according to insulation call H. Amongst others this means for he carbon brush sliding contact, that commutator- and slip ring temperature will ihave a distinct increase. Therefore there will also be a distinctive influence on the total brush performance.

As an overview about the performance of the three materials electro graphite, metal graphite and resin bonded graphite you find below some graphs.

The main elements of the surface film – the so called patina - on a copper commutator are:

- copper oxides CuO und Cu_2O ,
- carbon of the carbon brush ,
- impurities from the environment,
- a thin water layer.

The copper oxides give the patina semiconductor like properties. Compared with the ideal collector temperature of 60 to 90°C (140 – 195°F) the electric resistance of the patina will be decreased at higher temperature. But water molecules, an important part of satisfactory carbon brush performance, will desorb from the surface. The friction between carbon brush and counter material will increase and an increase of the brush wear can be observed (Fig. 1 -3). This effect is enforced by an intensified oxidation of the surface and a thereby increased surface roughness.

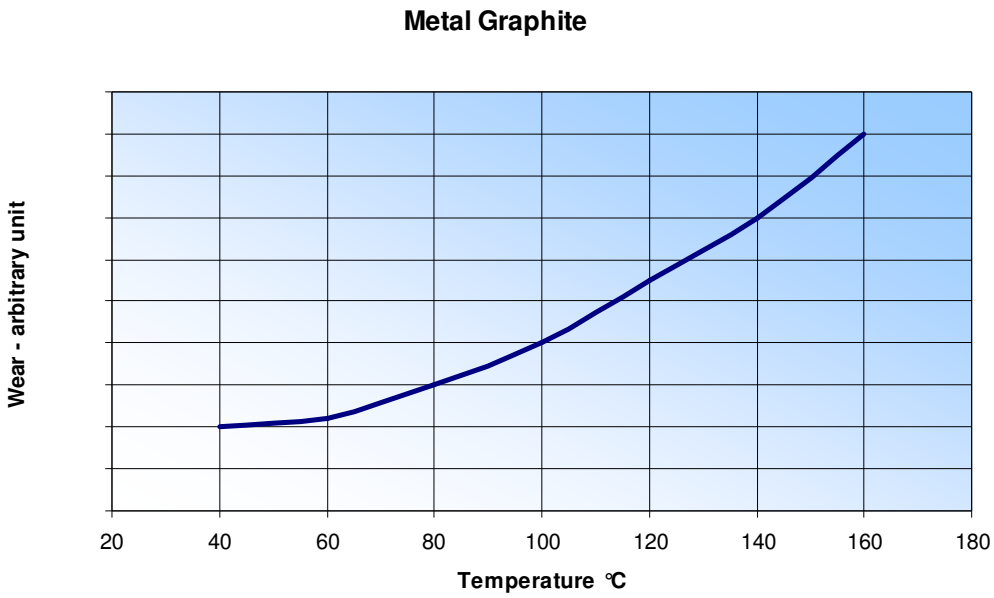

Fig1: Brush wear as a function of temperature – metal graphite brush grade

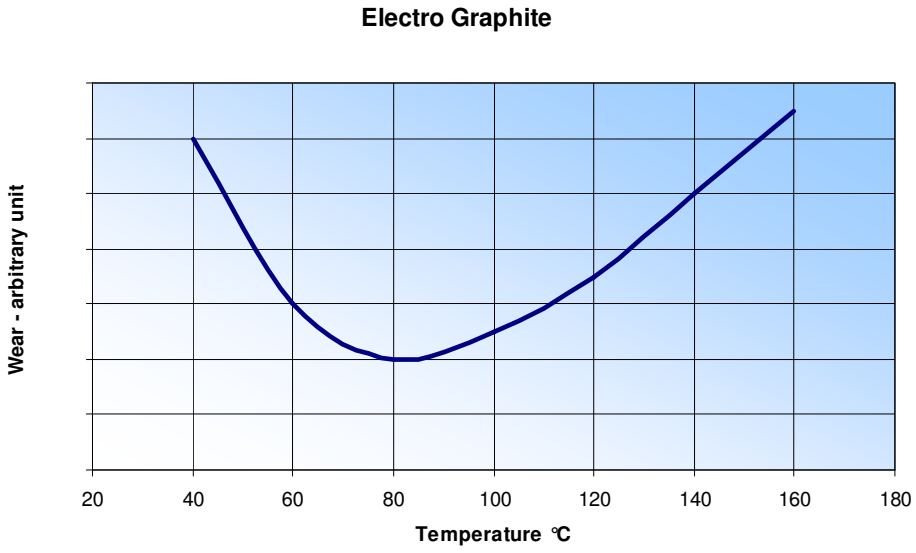

Fig 2. Brush wear as a function of temperature – electro graphite brush grade

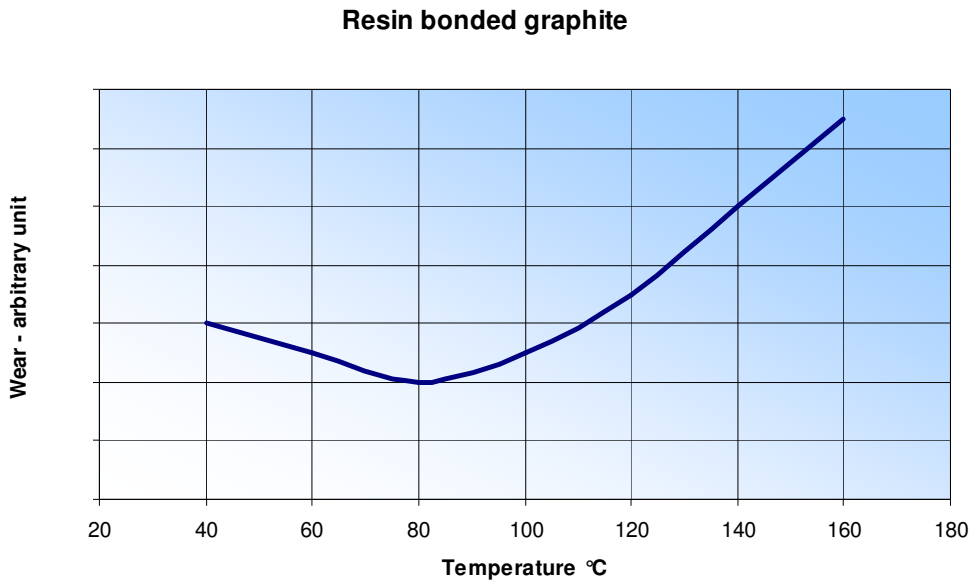

Fig 3. Brush wear as a function of temperature – resin bonded graphite brush grade

Concerning the friction coefficient there is no uniform trend for the three materials. Dependent ob the carbon brush grade a temperature rise can cause a decrease or an increase of the friction coefficient as well. This is shown in fig 4.

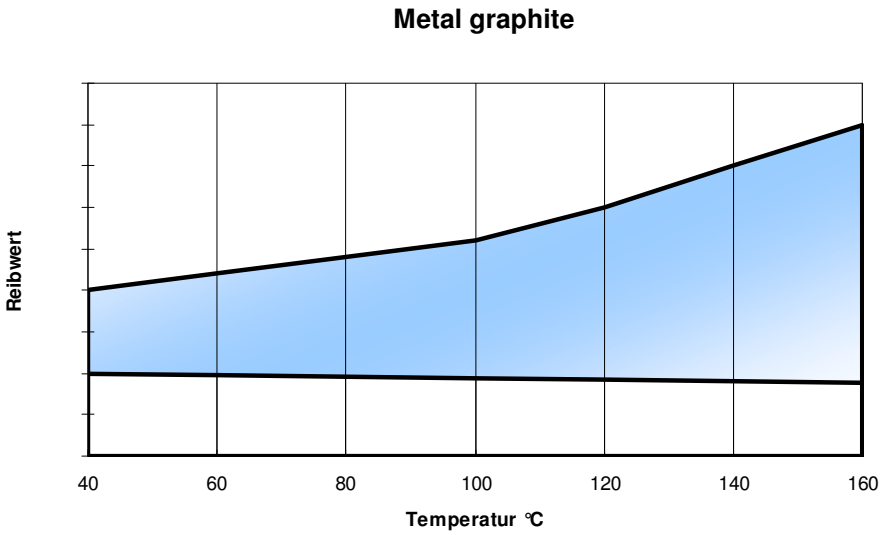

Fig 4: Friction coefficient as a function of temperature

The behaviour of electro graphite grades on steel as counter material is specific. In this case the friction coefficient rises with the temperature. This may cause heavy brush vibrations , e.g. on rings of turbo generators. Hence the upper limit of 90°C surface temperature should be kept if electro graphite grades are used on steel slip rings.

In conjunction with the voltage drop there is a universal trend for all three materials that an increase of the surface temperature is associated with a decrease of the voltage drop (Fig 5).

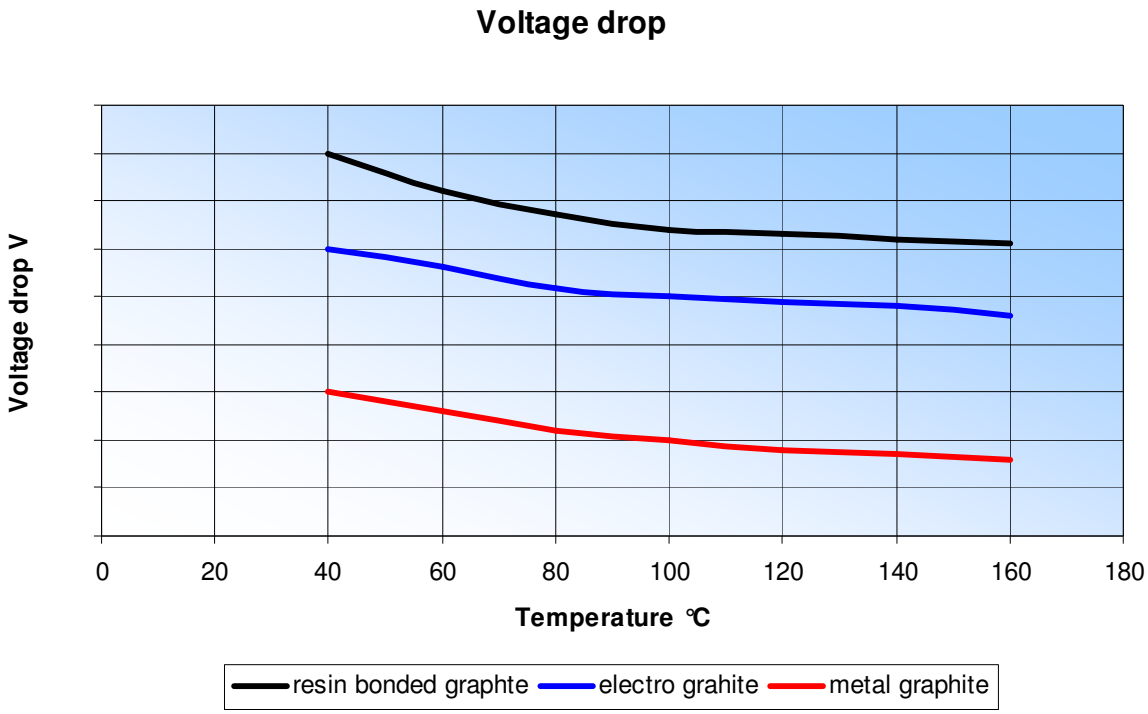

Fig 5 Voltage drop a as function of temperature

This is mainly determined by the fact that the electrical resistance of the patina decreases with rising temperarture.

Technische Information

It's easy to be recognised that a temperature rise causes a distinct change of the parameters of a brush sliding contact. The change of the contact behaviour influences also the commutation performance.

Brush grades used at standard temperature might not be optimal anymore at high temperature, but other grades can show better performance. The performance can be adjusted with special after treatments. It's always advisable to find the optimal brush grade by means of brush trials in the lab.

Compact

- The optimal surface temperature for brush sliding contacts is 60 – 90°C (140 – 195°F)
- Higher temperature cause higher brush wear
- No uniform temperature effect on friction coefficient
- Voltage drop declines with temperature
- Adaption of carbon brushes to the operational conditions with after treatments