

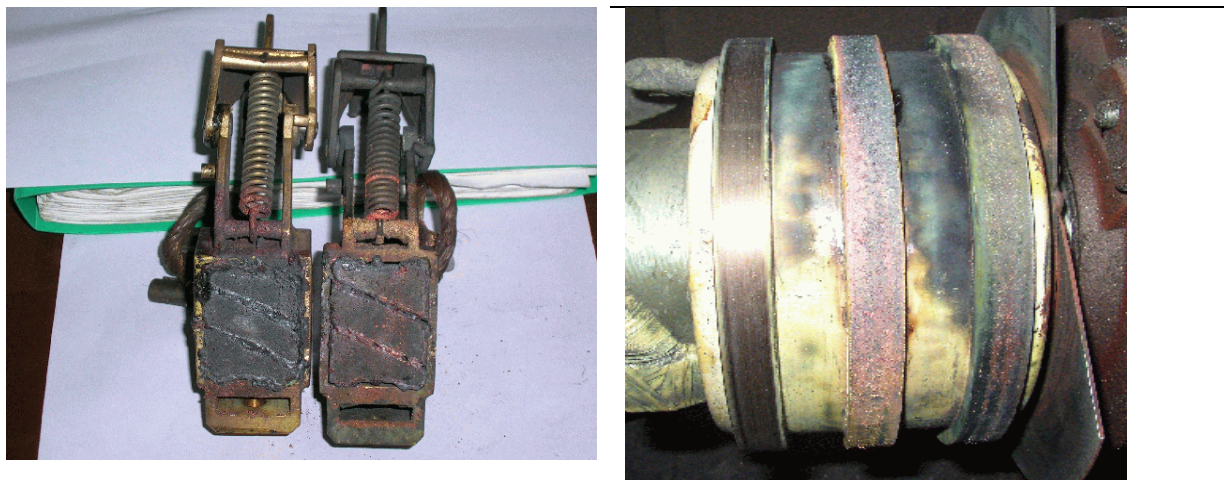
Technical information

Dr. Ulrich Ringleb

August 28th 2007

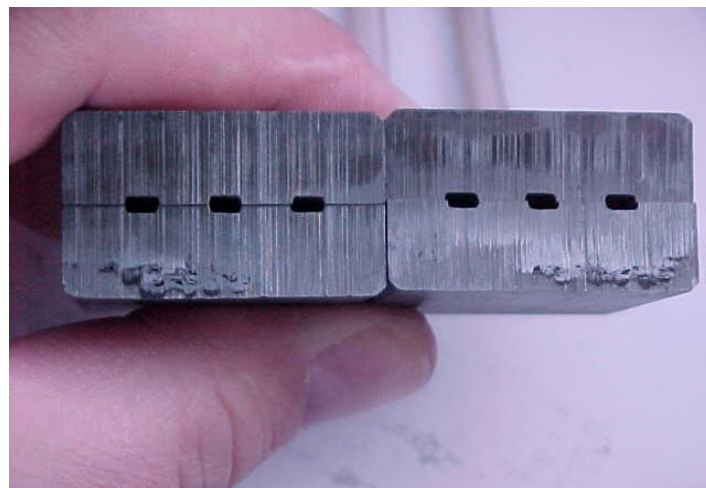
Swelling of Carbon Brushes

Who doesn't know such pictures?



Stuck brushes of an induction motors and damaged slip rings.

Or a destroyed contact surface of a resin bonded graphite brush grade.



What are possible causes and which counter measures do exist?

Technical information

Dr. Ulrich Ringleb

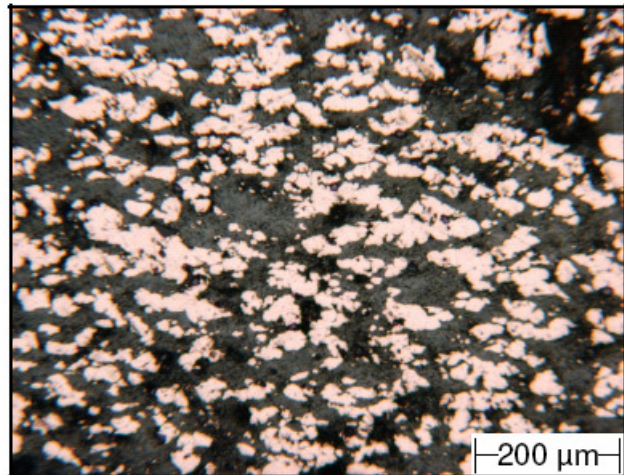
August 28th 2007

The mechanism causing the problems is different for the three main materials for industrial and traction brush grades.

a) **Metal containing brush grades**

Such materials consist of different portions metal powder and graphitic components. Additionally additives can be used to improve the performance. .

Depending on the metal content metal bridges are formed during the sinter treatment (see micro photography) or the metal particles are more singularly distributed.



These metal particles have a large, active surface. At elevated temperature, possibly in combination with high humidity, this surface is covered by a layer of metal oxides, even in the inner spheres of the grade.

The oxidation goes with an enlargement of the volume. The brushes get larger, are swelling and get stuck in the brush holder box. Finally they will be destroyed by arcing. Collectors and slip rings are heavily damaged by the arcing as well.

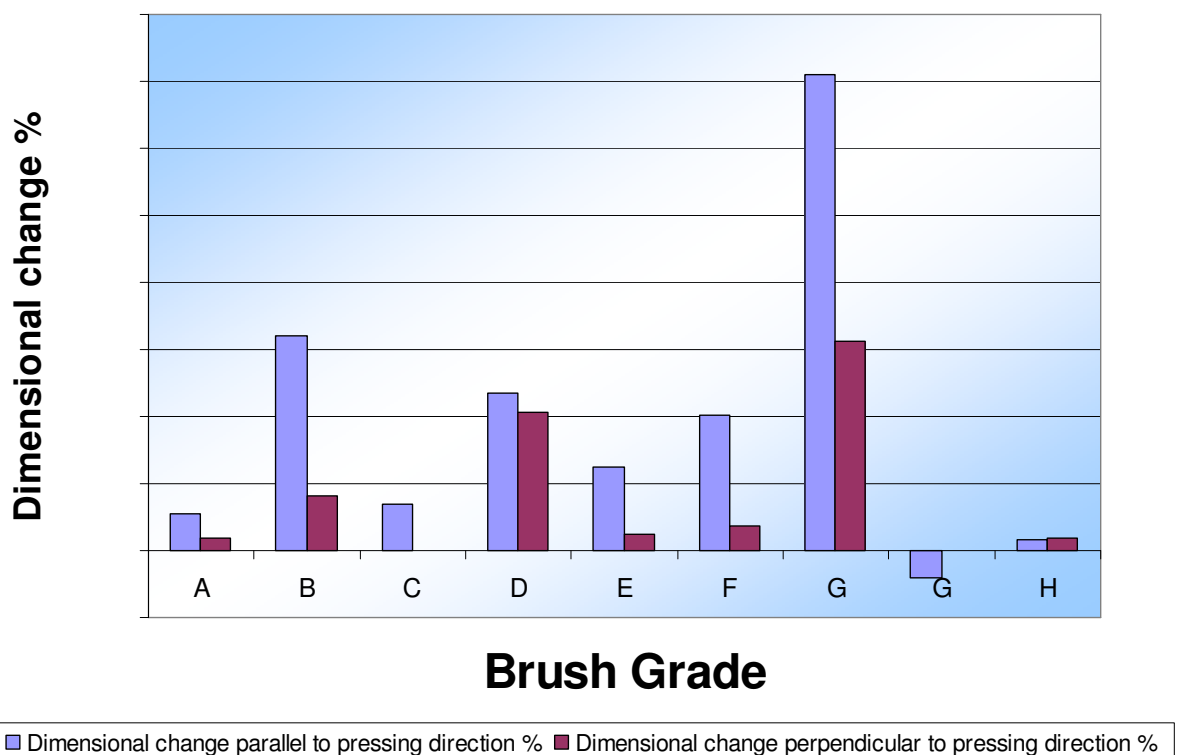
Typical problems arise, if brushes are electrically overloaded, i.e. are permanently used above the current density, permitted by the brush manufacturer. The swelling is triggered by high humidity. .

Technical information

Dr. Ulrich Ringleb

August 28th 2007

As an example the following graph shows some results found in the SCHUNK laboratories. Carbon brush grades were stored first at 150 °C (300 °F) and afterwards approx. 200h at 100 °C (212°F) and 95% relative humidity. The dimensions were measured before and after the treatment.



The dimensional change can be up to 1% and is not reversible.

Technical information

Dr. Ulrich Ringleb

August 28th 2007

Two main facts can be seen from the diagram:

- The swelling depends on the grade
- The swelling perpendicular to the pressing direction is smaller than parallel to the pressing direction.
-

If you face problems with stuck brushes we would like to ask you to contact our field engineering department to select a grade with probably less swelling sensitivity.

b) Resin bonded graphite brush grades

There is a reason giving values for the permanent current density of 8 A/cm² (52 A/in²) in our data sheets of such grades. The contact points of these grades are heavily loaded at high current density by means of the high specific resistance of the resin bonded grades and the high voltage drop of up to 5V between two brushes. This gives locally rise to high temperature. The resin used as a binder changes its structure, which will lead to swelling brushes.

Therefore we would like to point the finger once more on the guide line values for the resin bonded brush grades:

8 A/cm² (52 A/in²) permanent current density and short term overload of 10 A/cm² (55 A/in²).

c) Electro-graphite brush grades

During production these brush grades get a temperature treatment at approx. 3000!C (5400 !F). So at usual service conditions and even during overload phases they are inert against oxidation up to a temperature of 350 °C (660 °F) and don't show any dimensional change. Impregnated variants also do not change their dimension.



Technical information

Dr. Ulrich Ringleb

August 28th 2007

d)

Compact

- Metal containing brush grades change their dimension at high temperature and high humidity due to internal oxidation. They are swelling. There are less swelling alternatives existing.
- There are upper tolerance values for current density of resin bonded brush grades. Swelling will come up in case of overload.
- Electro-graphite grades do not swell.

Heuchelheim, August 2007