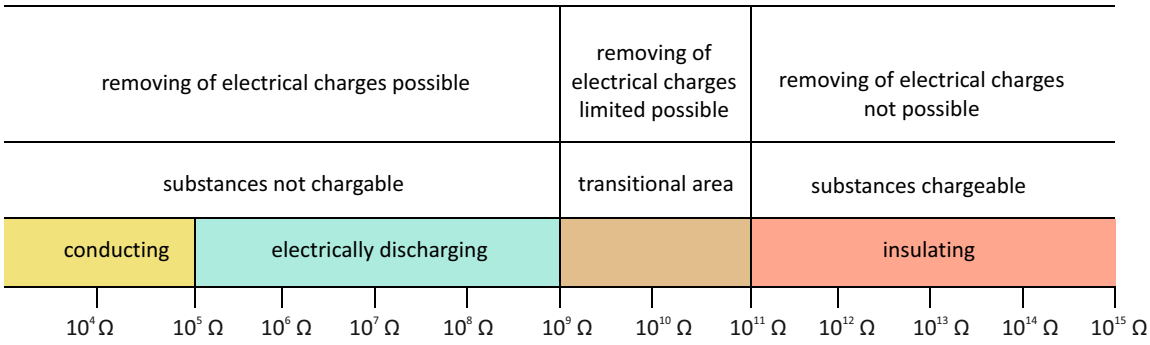
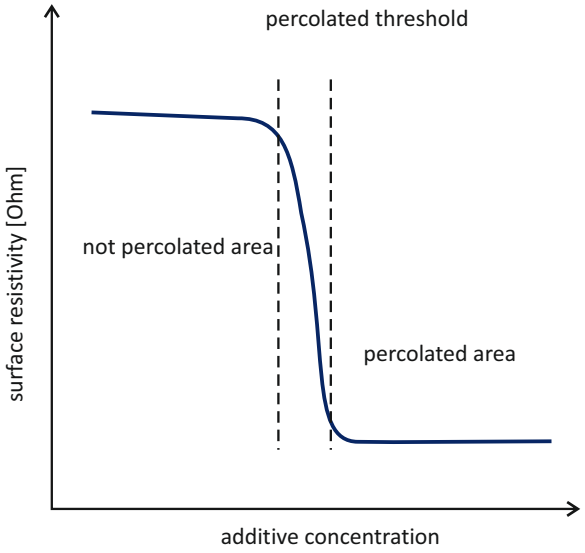
Polymeric antistatic additives for thermosetting plastics

Because of their chemical structure plastics are usually insulators with a specific surface resistivity of >10^{12} Ω/☐. To avoid electrostatic discharge of polymers, for example in electronic devices or to perform an electrostatic coating process, an antistatic treatment of these plastic components is necessary. There is a demand to lower the specific surface resistivity into the range of 10^{6} Ω/☐ to 10^{9} Ω/☐. There are two ways to lower the specific surface resistivity of polymer materials: integration of conductive additives or application of antistatic primer.



Electrical conductivity of solids/ overview (picture: http://www.pro-kunststoff.de)



Surface resistivity of a polymer with conductive additive

State of the art

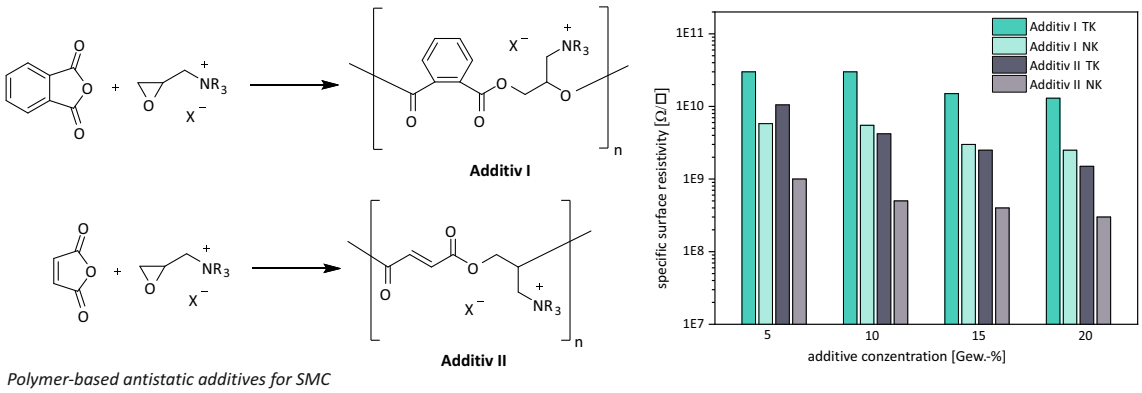
To improve the antistatic properties of polymers usually conductive additives are mixed into the matrix physically. For this, mainly carbon black, but also inorganic pigments, inorganic salts, metal powder or CNT´s are used.

Disadvantages by using carbon black

- high filling degrees are necessary to exceed the percolation threshold
- required high contents result in a reduction of the mechanical material properties
- there are problems to disperse the particles homogeneously
- the strong coloration of the additive changes the color of matrix extremely

Concept: Antistatic treatment with matrix bonded polymeric additives

In order to receive an efficient antistatic treatment and to prevent the migration to the surface, oligomer/polymer based additives as well as a reactive bonding are of advantage.
E.g. unsaturated, oligomer/polymer-based antistatic additives with ionic units were developed for SMC. During the thermal molding Additive II forms covalent bonds with the polymer matrix. Additive I is matrix-compatible and homogeneously distributed by physical mixing.



Polymer-based antistatic additives for SMC

Specific surface resistivity of SMC in the presence of Additive I (compatibilized and physically mixed) and Additive II (covalently bonded), (DC: dry climate, NC: normal climate)

Conclusion:

The reactive bonding of oligomeric/polymeric additive to the thermosetting matrix is strictly necessary for an efficient antistatic treatment.

Electrostatic powder coating application on SMC with / without antistatic treatment

SMC before powder coating application

SMC after powder coating application

Left/ each: SMC without additive, right: SMC with 3.0 % w/w Additive II

Innovative advantages of oligomeric/polymeric additives

- high compatibility with the polymer matrix
- high permanency by chemical bonding with the matrix
- high thermal stability under processing conditions
- colorless
- no negative impact on mechanical material properties
- less expensive

Adaptation of the specific concept of antistatic finishing to different materials → **Wood based compounds, Elastomers, Organic coatings**

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