

High structure carbon blacks for improved efficiency rubber applications

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Latest tire developments are focused on the reduction of rolling resistance resulting in less fuel consumption and consequently reduction of CO₂ emission. To reduce CO₂ emission and to give the consumer a better comparability about the tire performance the European legislation introduces a tire labelling in 2012 which also contains minimum requirements for rolling resistance. Therefore, three categories are in the focus: rolling resistance, wet grip and noise. Apart from tire construction all rubber compounds have to be optimised taking into account conflicts of interest.

An option to reduce the rolling resistance of the tire is to improve the sub-tread compound. Reinforcing fillers like carbon black are used to reach the desired stiffness of rubber compounds. The energy dissipation during dynamic deformation of such a rubber compound is mainly affected by the particle-particle interactions.

Consequently, the rolling resistance / energy dissipation can be reduced by increasing the inter particle distance in the rubber matrix. These distances are affected by the size of the aggregates using the same mass fraction of carbon black, or by the mass fraction keeping the size constant. However, the reduction of reinforcing filler volume results in a loss of mechanical stiffness. Therefore, a filler aggregate with the ability to increase the stiffness of the rubber to a large extent is needed. The stiffness can be increased by highly structured aggregates. Such carbon black morphology has the ability to shield bigger volume fractions from stress and thus leads to the desired increase of stiffness.

Hence, the stiffness could be increased by substituting a normally structured by a highly structured carbon black. The amount of carbon black with optimised structure in the compound can then be reduced to achieve the desired stiffness. Consequently, we obtain an increased inter particle distance in the rubber matrix and therefore a reduced energy dissipation/rolling resistance.

The newly developed ECORAX S 247 is a tailor made carbon black to meet these requirements. Its structure is more than 10 % higher than the one of the reference carbon black (characterized by the compressed oil adsorption number (COAN) of 102 ml/(100 g)). The specific surface area (STSA) of the new carbon black is 42 m²/g and equivalent to the reference black.

A standard mixture containing a polymer blend of NR , SBR and 50 phr CORAX N 550 is compared with a blend using this newly developed ECORAX S 247. If the same amount of filler is used in the mixture the stiffness is increased by more than 10 %. Therefore, it is possible to reduce the amount of carbon black to 44 phr to obtain the same stiffness. This reduces the hysteresis losses by more than 20 %.

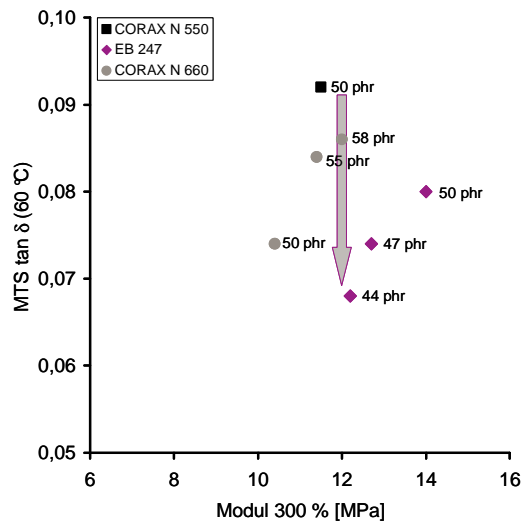


Fig. 1 Reduction of hysteresis losses by using highly structured carbon blacks