

Polymer-Filler Interaction and Particle Dispersion in Rubber Nanocomposites Reinforced by Carbon Black and Silica Nanoparticles

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Abstract

Elastomers are Widely Used in Various Industries Due to their Design Flexibility, Light Weight and Processability. These Materials and Polymers in General have much Weaker Mechanical Properties (such as Tensile Strength and Elastic Modulus) than Metal or Ceramic Materials. Adding Filler Particles is a Solution that has been used in the Past Decades to Strengthen Elastomers. The Properties of the Composite Created Depend directly on the Type of Filler. Fillers are divided into two Categories based on their Effectiveness: Ineffective or Non-reinforcing Fillers and Active or Reinforcing fillers. The Aim of this Study was to investigate the Effect of Interaction between Filler Particles and Polymer Chains as well as Particle Dispersion as two very important Factors on the Reinforcement of Nanocomposites in the Rubber Nanocomposites Reinforced by Carbon Black and silica Nanoparticles. The results Showed that Parameters such as Increasing the Contact Surface of the Filler, Reducing the Particle Size, as well as the Surface Activity of the Filler (Reactive Functional Groups on the Surface) Improved the Interaction between the Filler Particles and Polymer Chains and Ultimately Increased Properties such as Physical-Mechanical and Thermal Properties. Rheological, Permeability, and so on. In addition, the Results of Observations Obtained from the Comparison between Carbon Black and Silica Nanoparticles Showed that Due to the Similarity of the Carbon Black and Polymers Solubility Parameter, the Dispersion of Carbon Black nanoparticles in Rubber Blends is more Favorable than that of Silica Nanoparticles, Resulting in Increased Polymer-Filler Interactions.

Keywords: Filler-Polymer Interactions, Dispersion, Carbon Black, Silica