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Making Rubber Even More Sustainable by Introducing Circularity

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Research Interest(s):

Circular Economy, material recycling and reuse focused on elastomers; new filler systems; elastomer-based composites.

Abstract

Elastomers are widely used in a broad range of products from tiny sealings requiring outstanding dynamic performance to very large products like roofing foils, in mass products like tires and specialties such as flood defense. The polymers are either bio-based like natural rubber, or oil-based like EPDM, SBR, BR etc. Both these resources for elastomers have their own risks: monocultures and diseases in the case of NR, the depletion of mineral oil resources for synthetic rubber. In order to economize on these resources, elastomers should be recycled and reused. For most elastomer products, the service life of the product is much shorter than the lifetime of the material. An example are tires: when a tire is worn out, the rubber is still a valuable material. The challenge for recycling of elastomers is to re-plasticize the vulcanized rubber and make it reprocessable without damaging the polymer. Such a process is de-vulcanization: the reversion of the network formation during curing of elastomers.

The devulcanization reaction of sulfur cured elastomers requires a certain temperature level, shearing forces and a chemical additive to break sulfur bonds. As there will always be a balance between polymer and crosslink scission, the polymer radicals have to be quenched by the additive as well. The process conditions for the devulcanization as well as the nature of the additive have to be optimized for different elastomers. Besides, the type of network determines the efficiency of network breakdown, as does the type of fillers and polymers.

In this presentation, the devulcanization process, its efficiency as well as the properties of the final recycled rubber for different types of elastomers will be elucidated. This includes different types of polymers, fillers as well as crosslink networks.

Keywords: Devulcanization, tire, crosslink density, polymer scission, crosslink scission