MSC THESIS PROJECT

Computational Determination of Macroscopic Mechanical Properties of

Partially Devulcanized Elastomer Composites

Background

Disposal of used tires into nature seriously threatens the environment. A sustainable alternative is their devulcanization. This complex process aims to break the cross-links, bonds that link one polymer chain to another but keep the polymer chains intact. In practice, however, the end product is not a homogeneous medium with only devulcanized rubber but rather a composite comprised of the devulcanizate matrix with low- to non-devulcanized elastomer grain embeddings, see, e.g., Fig. 1. The mechanical properties of the product, such as stiffness, tear strength, abrasion resistance, depend on the degree of devulcanization (modulus of the grains), size, geometry, and distribution of the non-devulcanized grains in the matrix.

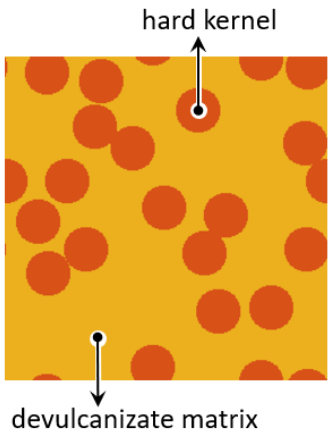

Fig. 1) Microstructure composed of hard kernels (low- to non-devulcanized grains) embedded in a matrix of homogenized devulcanizate.

Project Objective

This work aims at determining the effective mechanical behavior of the partially devulcanized elastomer composites using finite element analysis and computational homogenization.

Project Milestones

Meet the project objective requires the accomplishment of the following tasks

- Numerical generation of material microstructures in three dimensions
- Conduction of finite element simulations over the developed microstructures
- Determination of the macro-scale constitutive behavior with computational homogenization

Student

We seek highly motivated students with a keen interest in the following topics

- Nonlinear continuum mechanics
- Finite element method and available software packages, e.g., ABAQUS
- Programming and scripting, with, e.g., MATLAB and Python

Contact

This MSc thesis project is a multidisciplinary and collaborative project which combines the chair of Sustainable Elastomer Systems (SES) - part of Elastomer Technology Engineering (ETE) - and the chair of Nonlinear Solid Mechanics (NSM) to get increased knowledge for all stakeholders involved. Below are the contact people from each chair:

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