

# MORPHOLOGY AND PROPERTIES OF PARTICLE-LADEN TYRE RUBBER



This MSc assignment is done in cooperation with the Multiscale Mechanics group (MSM). Their assignment 'Simulations of particle-laden tyre rubber' is done in parallel.

The rubber in car tyres is a complex material, a polymer matrix containing dispersed and aggregated nanoparticles, tuned for optimum driving properties. The flow properties of the initial mixture during the production stages of tyres, and the mechanical behaviour of the vulcanized rubber in tyres under driving conditions, are only partly understood. The design of tyre rubber, and hence tyres, with desired advanced properties is largely based on craftsmanship and extensive testing of selected rubber formulations.

Within these combined MSc assignments, one student at ETE will actually prepare the elastomer composites, which are going to be simulated by the student at MSM. The MSc student at ETE will blend elastomeric materials with particulate fillers, and the morphology and properties will be studied depending on quantity and type of filler as well as processing conditions of the material. This knowledge poses the input for the simulation and allows to check the outcome of the simulation.

## Objective

The goal of these two assignments is to define the parameters for simulation of particle-laden elastomers, and to crosscheck the outcome of the simulation with practical experiments.

## Assignment

The graduate student working at ETE will start with a literature search into elastomer-filler composites, and the influence of morphology on properties of the material. Within the practical study, elastomer composites are prepared with fillers differing in particle size and distribution, as well as in the tendency to form clusters. Additionally, the blending conditions will be varied in order to create different morphologies of the filler in the elastomer matrix.

The structure of these composites will be analysed mainly by microscopic methods, and the mechanical and dynamic properties will be analysed. This work will be done in the ETE labs.

## Cooperation with the student at MSM

The two MSc students have to closely co-operate within these two assignments. The outcome of the ETE-study will be input for the MSM-student for the simulations. At a later stage, the ETE student can crosscheck the simulation by comparing the different composite materials and their morphology-related properties with the outcome of the simulation.

## Report

The graduation report comprises

- An overview of different filler systems for elastomers, the mixing technologies, and the related property profiles.
- The preparation of the elastomer composites
- The morphology and properties of the elastomer composites
- An evaluation of the trends found in the practical work and in the simulations.

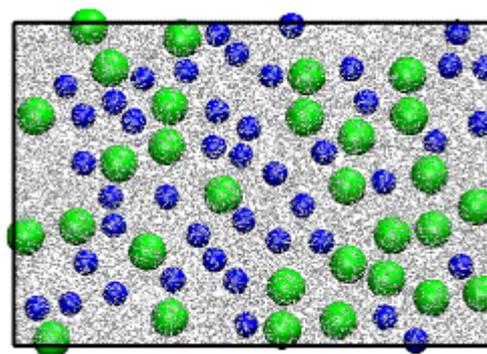


Fig. 1 : Simulation snapshot of bidisperse colloids, with radii of 40 (blue) and 60 nm (green), in a 10% solution of polymer (grey.)

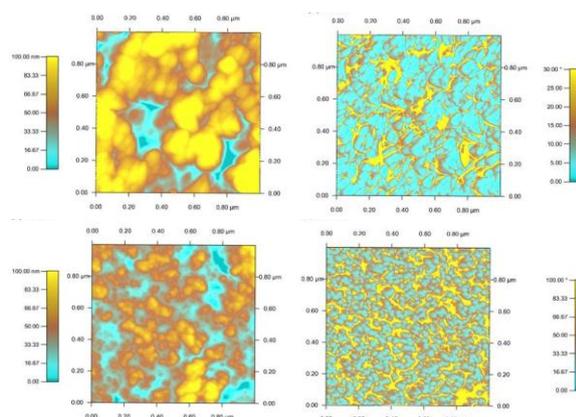


Fig. 2 : Micrographs of elastomers with different filler systems, upper: natural rubber / silica, lower: natural rubber / silica / coupling agent

## Partners

This project will be done in cooperation with the group Multiscale Mechanics, MSM (<http://www.utwente.nl/ctw/msm/>). However, all the work within this assignment will be done in the labs of ETE.

## Contact

ETE: Wilma Dierkes  
w.k.dierkes@utwente.nl  
BH204

MSM: Wouter den Otter  
w.k.denotter@utwente.nl  
Horstring Z-117