Characterisation of the interfacial bonding layer between treated reinforcing cords and vulcanised Elastomers

W.B. Wennekes, R.N. Datta, J. W. M. Noordermeer
University of Twente
Dutch Polymer Institute

University of Twente

DPI DUTCH POLYMER INSTITUTE

Introduction

Fibre reinforced compounds play a crucial role in high-pressure hoses, transmission belts, conveyor belts, tyres etc. A good interfacial adhesion between the fibres and the rubber is essential. At this moment the knowledge of cord to rubber adhesion is largely hypothetical.

The type of fibre of special interest in this project is poly-*p*-phenylene terephtalamide. Tests will be performed with a model for a standard carcass compound and a rubber compound used in belts.

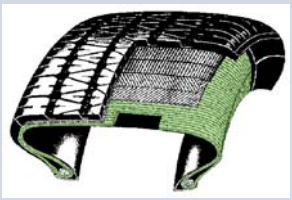

Figure 1, fibre reinforcement in the carcass of a tyre

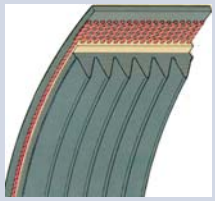

Figure 2, fibre reinforcement in a V belt

Objective

Standard treatment used since 1938 is dipping the fibre in Resorcinol Formaldehyde Latex (RFL) and covulcanising the dipped fibre with rubber. This treatment is sufficient for Nylon and Rayon.

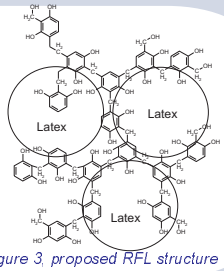

Figure 3, proposed RFL structure

The present day solution for this problem is the use of epoxy or isocyanate derivatives:

- in a two dip system
- in the spin finish
- mixed in the rubber compound

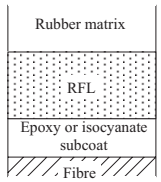

Figure 5, schematic representation of the two dip system

For high stiffness fibres like aramid, RFL treatment is not sufficient due to

- a high degree of crystallisation
- hindrance of the amide groups of aramid by aromatic functionalities.

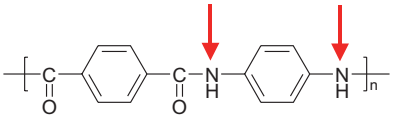

Figure 4, poly-p-phenylene terephtalamide

The standard adhesion system for aramid reinforced rubber is complex because of many interfaces. The chemical, mechanical and physical mechanisms in the interfaces are not well known.

Goal is to obtain a fundamental rather than empirical understanding of the factors influencing the adhesion between elastomeric compounds and reinforcing cords.

Setup of the project

1. Adjusting the standard two dip system and investigate the adhesive failure.
2. Develop a new system that can (partly) replace the standard system
3. Use model compound techniques for fundamental understanding

Methods for analysis:

- standard adhesion tests
  - T- test, H- test, Peel test, etc.
- recently developed surface analysis techniques
  - XPS, LEIS, SIMMS, AFM, etc.

List of literature

Takeyama, *Rubber Chemistry and Technology*, 1969. Vol. 42, p. 159- 257.

Iyengar, Y., *Journal of Applied Polymer Science*, 1978. Vol. 22, p. 801- 812.

Mahy, J., In *Mittal Festschrift*, W.J. Van Ooij and H.R. Anderson, editors. 1998

Acknowledgement

TEIJIN twaron

University of Twente,
Department of Science and Technology
Rubber Technology Group
PO Box 217, 7500 AE Enschede
The Netherlands