MODIFICATION OF MINERAL FILLERS WITH AMINOFUNCTIONAL DERIVATIVES.

M. Sc. (Polymer Technology)

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By Ms. Inoka Sharmen Thambawita

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This thesis was submitted to the Department of Chemical and Process Engineering of the University of Moratuwa in partial fulfillment of the Degree of Master of Science in Polymer Technology.

> Department of Chemical and Process Engineering University of Moratuwa Sri Lanka December, 2003



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Abstract.

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Effect of mineral fillers modified with amino-functional derivatives on properties of natural rubber compounds was studied.

To improve the performance of rubber compounds, three types of locally available mineral fillers; kaolin, kaolinite and quartz were modified through ion-exchange process and used as reinforcing fillers. The clays were thus modified with three types of organic quaternary ammonium ions. They were thiourium, ammonium succinimate and para ammino phenolate.

Sieve fractionating and sedimentation analysis were performed to find the particle size distribution of the tested fillers.

Cation exchange capacities of tested fillers were determined using Kjedhal experiment. Obtained results were used to perform the ion-exchange reaction keeping stoicheometrically balanced ratios of modifying exchangeable cations and kaolins Modified and unmodified fillers were compounded with rubber. Physico -mechanical properties of rubber compounds such as tensile, aging, resistance to flex cracking, crack growth, and abrasion were determined and analyzed.

To evaluate the interaction of rubber with filler surface bound rubber content and swelling tests were performed.

Differential Thermal Analysis (DTA) and Differential Thermal Gravimetric Analysis (DTG) were used to confirm the course of ion-exchange reaction. Microphotographs were taken to evaluate the quality of dispersion and distribution of fillers in rubber compounds.

Obtained results demonstrated advantages of rubber compounds filled with modified fillers. Better performance was achieved on account of improved compatibility and intensified interaction of modified fillers with rubber.

It was found that reinforcing effect introduced to rubber by thiourium cations modified clay was especially strong. Proposed mechanism of reinforcement of rubber with thiourium cations modified clay referred to formation of chemical links across rubber-filler interface.

Effect of particle size of the clay fines on cation exchange capacity and reinforcing capability of modified fillers was established. Larger contact area and increased cation exchange capacity of the small size filler particles permitted arrangement of increased number of active centers on the surface of the filler particles that resulted in strong reinforcing effect similar to that, achieved with carbon blacks.



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Nomenclature

CB - Carbon Black

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- CEC Cation Exchange Capacity
- DTA Differential Thermal Analysis
- IPPD N- Isopropyl -N- phenyl- p-phenylene diamine
- L Distance between bench marks at the breaking point
- L₀ Original distance between bench marks
- M_i Weight of the sample
- NMR Nuclear Magnetic Resonance
- PDG Diphenyl Guanadine
- RSS Ribbed Smoked Sheet
- TGA Thermo Gravimetric Analysis
- TMTD Dithio-bis-benzothiozole
- V_i Volume of the sample

