MODIFICATION OF MINERAL FILLERS WITH AMINOFUNCTIONAL DERIVATIVES.

M. Sc. (Polymer Technology)

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MODIFICATION OF MINERAL FILLERS WITH AMINOFUNCTIONAL DERIVATIVES.

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"I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a Degree or Diploma in any University and to the best of my acknowledge and belief it does not contain any material previously published, written or orally communicated by another person except where due reference is made in the text".

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"To the best of my knowledge, the above particulars are correct".

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Abstract.

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
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
Mᵢ - Weight of the sample
NMR - Nuclear Magnetic Resonance
PDG - Diphenyl Guanadine
RSS - Ribbed Smoked Sheet
TGA - Thermo Gravimetric Analysis
TMTD - Dithio-bis-benzothiozole
Vᵢ - Volume of the sample