

Surface coating of curing agents by plasma polymerisation and its application in rubber blends

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Introduction:

Rubber blends are always of interest for their successful performance in products. However, the desired combination of properties can only be reached when the different rubber phases are compatible, which includes thermal-dynamic compatibility, viscosity compatibility, and cure compatibility.

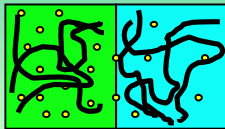


Fig. 1: Uneven dispersion of curatives in rubber blends

Cure compatibility is governed by the solubility and reactivity of the curatives (curing agent and accelerators) in the blending system. To have a homogenous distribution of curatives in all phases, the surface properties are vital.

Objective of the project:

The main objective of this project is therefore to apply the novel plasma coating surface-modification technique to the surface modification of vulcanisation ingredients (sulphur, accelerators and anti-degradants).

- To achieve co-vulcanisation in rubber blends, and consequently improve the properties of rubber blends,

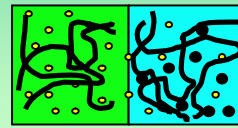


Fig. 2: Homogeneous dispersion of curatives mixture in rubber blends

- To avoid sulphur blooming.

Experiments:

Curing behaviour and mechanical properties of three different rubbers (SBR, NBR, and EPDM) were studied. The solubility data of curatives were obtained theoretically and experimentally. Comparison will be made between the behavior of curatives before and after modification. There are three parts included:

- Mechanical properties of SBR, NBR, EPDM, SBR/EPDM, NBR/EPDM
- Solubility of curatives
- Plasma coating on curatives
- Study on blends' properties Influence by plasma modified curatives

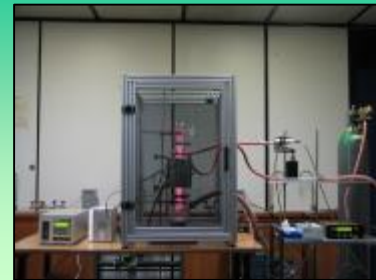


Fig. 3: Custom-made Plasma coating device

Results:

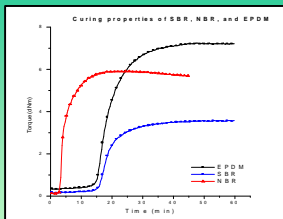


Fig. 4: Curing behaviour of SBR, NBR, EPDM

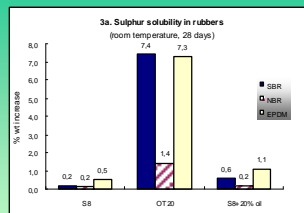


Fig. 5a: Solubility of sulphur in rubbers at room temperature

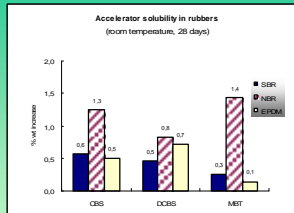


Fig. 5b: Solubility of accelerators in rubbers at room temperature

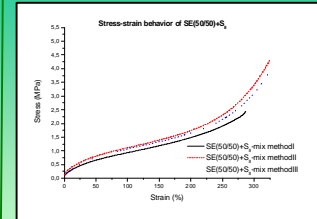


Fig. 6: Mechanical properties of S/E(50/50) influenced by mixing procedures

Conclusions:

- The solubility of curing agents (Sulphur) and accelerators is different from rubber to rubber, which originates an en-even distribution in rubber blends.
- The influence from the dispersion or distribution of curatives on rubber blends' properties are appreciable.

Acknowledgements