Blending, Curing and Reinforcement for Dissimilar Rubbers

DPI #356

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Background:

Conventional NR/BR tire sidewall compounds contain stabilization additives to improve the ozone resistance. The working of these antiozonants is not perfect for the whole lifespan (see Fig.1). Secondly, these additives have the disadvantage that most of them are staining and toxic. To solve this problem, EPDM blends may be used in the sidewall, because they inherently have a better resistance to ozone.
Because of differences in polarity and reactivity, inhomogeneity in filler distribution and curative distribution may be expected and diffusion of ingredients may also take place.

Fig.1: Degradation (cracks) because of ozone attack on rubber

Problem:

NR, BR and EPDM have inherent differences in saturation level. This gives differences in polarity of the polymers. As a result, filler and curatives show a certain preference for one phase and they may migrate from one phase to another. This leads to unequal reinforcement and unequal crosslink-density in the different phases and thus to worse performance of the blends.

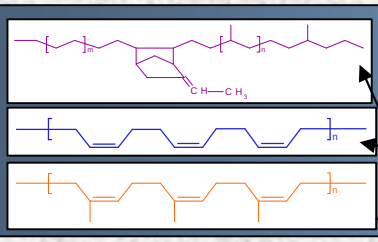


Fig. 2: differences in saturation in

Objective:

To solve cure incompatibility and uneven reinforcement for NR/BR/EPDM blends and improve mechanical properties.

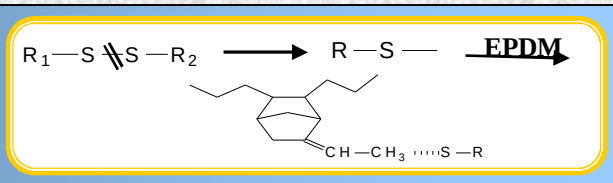


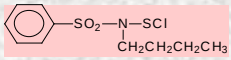
Fig. 3: Possible reaction for EPDM modification

Approach:

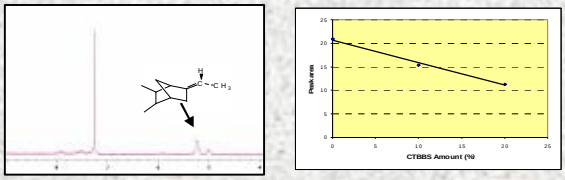
Modify EPDM by grafting unsaturation to increase its polarity and therefore to overcome the incompatibility problem (see Fig,3).

Modification agent 1:

N-chlorothio-sulfonamides: CTBBS



Ref.: R.J. Hopper, *Rubber Chemistry and Technology*, 1976. **49**: p. 341.



*) CTBBS concentration is calculated according to the unsaturation of EPDM.

Fig. 4 NMR spectrum for modified ENB-EPDM & Calibration curve for ENB peak area versus CTBBS concentration.*

Highest grafting efficiency can be reached for three types of EPDM:

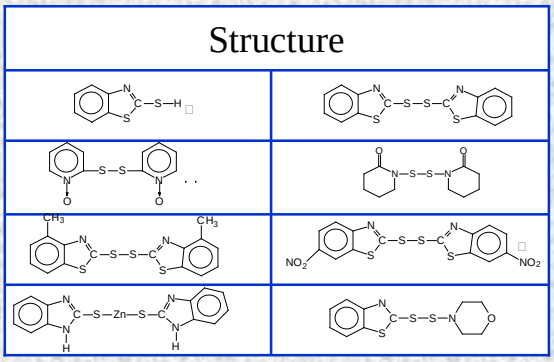
Hexadiene-EPDM**	60%
LENB-EPDM	20%
HENB-EPDM	10%

**) Not commercial anymore

Discussion and conclusion:

The highest CTBBS amount that can be used for modification of ENB-EPDM is only 20%, otherwise gelation will happen. As 20% modification of the unsaturation of EPDM is not enough to get improved properties, new modification agents need to be considered.

New modification agents presently under investigation:



Proved to work.

Ref.: K. Sahakaro, N. Naska, R.N. Datta, J.W.M. Noordermeer, *Journal of Applied Polymer Science*, 2007. **103**, Issue 4, p. 2538-2563

Carbon black coupling agent.

Ref.: Datta, Rabindra, Nath, 2001, Flexsys B.V.: PCT/EP00/08491

Acknowledgement:

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