Sborník vědeckých prací Vysoké školy báňské – Technické univerzity Ostrava
číslo 1, rok 2009, ročník LII, řada hutnická
článek č. 1446

INFLUENCE OF MULTICOMPONENT SULFUR COPOLYMER BASED ON STYRENE OLIGOMERS ON PHYSICAL-MECHANICAL PROPERTIES OF VULCANIZATES

P. POČAROVSKÝ*, M. LACKO, J. ĎURFINOVÁ, J. JURČIOVÁ, V. MACHO

Faculty of Industrial Technologies, Alexander Dubček University of Trenčín; Púchov, Slovak Republic, contact author: pocarovsky@fpt.tnuni.sk, lacko@fpt.tnuni.sk , durfinova@fpt.tnuni.sk , jurciova@fpt.tnuni.sk

ABSTRACT: We inspected the influence of copolymeric sulfur, quantity and type of activators on vulcanization and physical-mechanical properties and selected butadiene rubber compounds. Sulfur copolymer compounds with styrene oligomer derivates have proved to be suitable vulcanizing agents. The content of oligomers of styrene in copolymeric sulfur was 15 % wt. and percentage quantity typed activator vulcanization was 2 %, 1 %, 0.5 % and 1 % wt. We used MgO and ZnO as activators of vulcanization.

KEY WORDS: vulcanization, multicomponental copolymer sulfur, activator of vulcanization, styrene oligomers

1. INTRODUCTION

In present time sulfur belongs to the most used vulcanization agents on vulcanization of unsaturated elastomers in rubber industry. For this reason we examined different manners, in order to obtain the best economic and technical reviews of sulfur for preparation of multicomponent copolymeric sulfur as vulcanization tanner. Here we present concrete results of preparations and use of multifunctional vulcanization agent produced by copolymeric cyclooctamer sulfur with oligomers of styrene and with different sort and quantity of vulcanization activators (MgO, ZnO). These copolymers proved to be suitable as new vulcanization agents.

2. FORMATTING

Sulfur (S_8) – cyclooctamer sulfur of Clausov process
– content of sulfur: min. 99.5 wt.%
– content of organic matters: 0.1 wt.%
– fusing point: 112-119 °C

Oligomers of styrene – mixture of styrene with 1 % sulfur (inhibitor of radical polymerization)
– molecular weight: 214 g/mol
– Bromic number: 44 g Br on 100 g matter

Activators of vulcanization: – **ZnO** (zinc oxide) – white dust
– content of ZnO: 99 %
– content of Mn: 0.001 %
– content of Cd: 0.05 %
– content of PbO: 0.4 %
– humidity: max 0.5 %

– **MgO** (magnesium oxide) – white dust

We observed the influence of styrene oligomers and different sorts and quantities of activators on physical-mechanical properties of vulcanizates:

- tensile strength,
- hardness,
- tensile,
- moduls 100, 200, 300.

2.1 Preparation of samples of multicomponental copolymeric sulfur A - J

Tab. 1: Reactive conditions preparation of multicomponent copolymeric sulfur

	Compound samples [%]	Reactive temperature [°C]	Reactive time [h]
A	Sulfur (99.5) (standard)	0	0
B	Sulfur (85) + oligomeres of styrene (15)	150±2	3
C	Sulfur (83) + oligomers of styrene (15) + MgO(2)	150±2	3
D	Sulfur (84) + oligomers of styrene (15) + MgO(1)	150±2	3
E	Sulfur (84.5) + oligomers of styrene (15) +MgO(0.5)	150±2	3
F	Sulfur (84.9) + oligomers of styrene (15) + MgO(0.1)	150±2	3
G	Sulfur (83) + oligomers of styrene (15) + ZnO(2)	150±2	3
H	Sulfur (84) + oligomers of styrene (15) + ZnO(1)	150±2	3
I	Sulfur (84.5) + oligomers of styrene (15) + ZnO(0.5)	150±2	3
J	Sulfur (84.9) + oligomers of styrene (15) + ZnO(0.1)	150±2	3

Tab. 2: Compound formulation

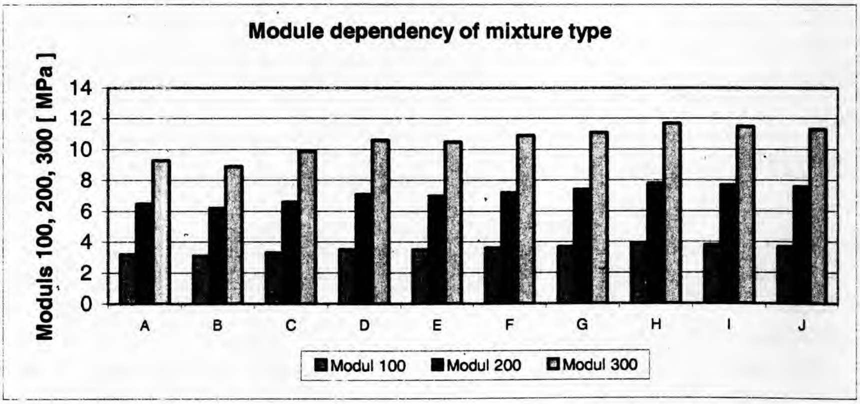
Compound I° side industry mixture		
Component	**Weight**	
Masterbatch No. 555	71.55 dsk	27.17 g
Polybutadien SKD - 2	49.98 dsk	18.98 g
Deawax HP 103	2.64 dsk	1.002 g
Stearine 18 RG flakes	1.27 dsk	0.482 g
Aromatic oil Furex 433	1.53 dsk	0.58 g
Zinkoxid ZnO S 6	2.33 dsk	0.885 g
Antidegradant Dusantox IPPD	2.64 dsk	1.002 g
Carbon black N 550	41.1 dsk	15.6 g
Flectol TMQ PST	1.62 dsk	0.615 g
Kolophonium	4.06 dsk	1.54 g
Koresin	1.78 dsk	0.68 g
Compound II° side industry mixture		
Sulphur N	3.01 dsk	1.1429 g
Sulfenax CBS	0.76 dsk	0.2886 g
Duslin G/80	0.11 dsk	0.0412 g

Compounds were prepared by using Plasti-Corder Brabender with cavity volume of 70 cm^3, with rate of 50 per min and temperature 110°C.

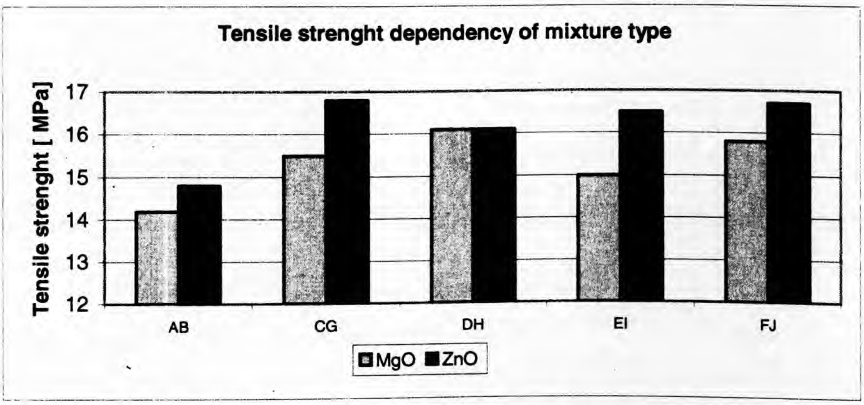
3. RESULTS

Tab. 3: Physical-mechanical properties of compounds with multicomponental copolymeric sulfur

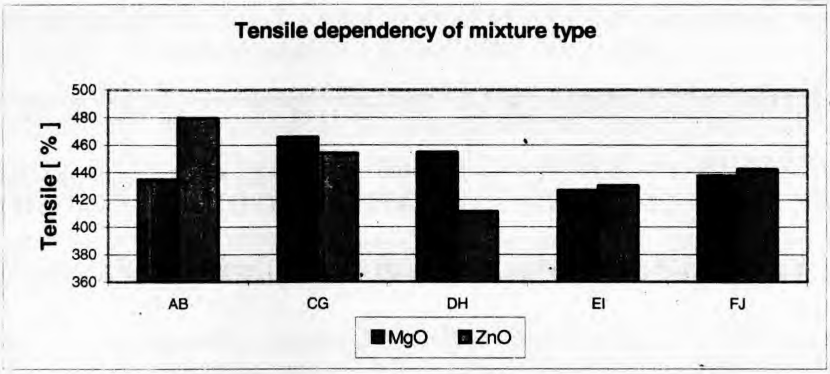
Mixture	Module 100 [MPa]	Module 200 [MPa]	Module 300 [MPa]	Tensile Strength [MPa]	Tensile [%]	Hardness [ShA]
A	3.2	6.5	9.3	14.2	435	59.6
B	3.1	6.2	8.9	14.8	480	58.2
C	3.3	6.6	9.9	15.5	466	62.0
D	3.5	7.1	10.6	16.1	455	62.5
E	3.5	7.0	10.5	14.9	427	63.0
F	3.6	7.2	10.9	15.8	437	62.5
G	3.7	7.4	11.1	16.8	454	65.5
H	3.9	7.8	11.7	16.1	411	63.0
I	3.8	7.7	11.5	16.5	430	62.5
J	3.7	7.6	11.3	16.7	443	64.0



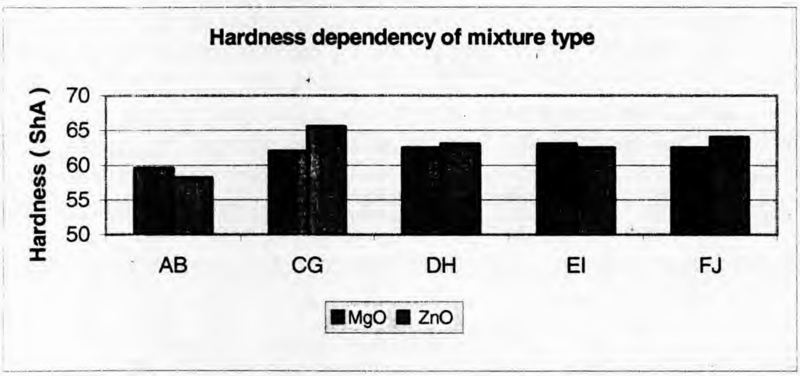
Graph 1: Module dependency of mixture type



Graph 2: Tensile strength dependency of mixture type



Graph 3: Tensile dependency of mixture type



Graph 4: Hardness dependency of mixture type

4. CONCLUSIONS

- From compared results it is evident, that applicative oligomers of styrene with activators ZnO and MgO improve most investigated physical-mechanical properties of rubber compounds.
- Use of styrene oligomers, especially in combination with ZnO, showed improvements of physical-mechanical properties in rubber compounds, especially for tensile strength.
- Oligomers of styrene with ZnO rise hardness, what is very important for side mixtures.
- Activators ZnO and MgO are very positive for properties mixtures, what can be seen on graphs 1-4.

5. REFERENCES

[1] MACHO, V., VAJDOVÁ, J., KRAJČÍK, J., KOMORA, L., ŠTUBŇA, M., MICHÁLEK, J.: Netradičná kopolymérna síra ako vulkanizačné činidlo. The 14th Slovak Rubber Conference 2002, Púchov 22.-23. May 2002.
[2] VORONKA, M.G. (red.) Reakci síry s organičeskimi soedinenijami. Izdavateľstvo "Nauka" - Sibirskoe otdelenie, Novosibirsk, 1979.
[3] MEYER, B.: Elementar Sulfur, N.Y., 1965.
[4] MEYER, B.: In: Elemental Sulfur Asterdam-London-New York, Elsevier Publ.Co., 1968, p.240.
[5] MEYER, B., Solid Allotropes of Sulfur-"Chem.Rev.", 64, 1964, 429.
[6] DUCHÁČEK, V.: Vulkanizačné činidlá, Česká společnosť prumyslové chémie – Gumárenská skupina Zlín, 2002.
[7] COLVIN, H., CHARLES, B.: Rubber Chemistry and Technology 68 (5), 1995, 79-88.