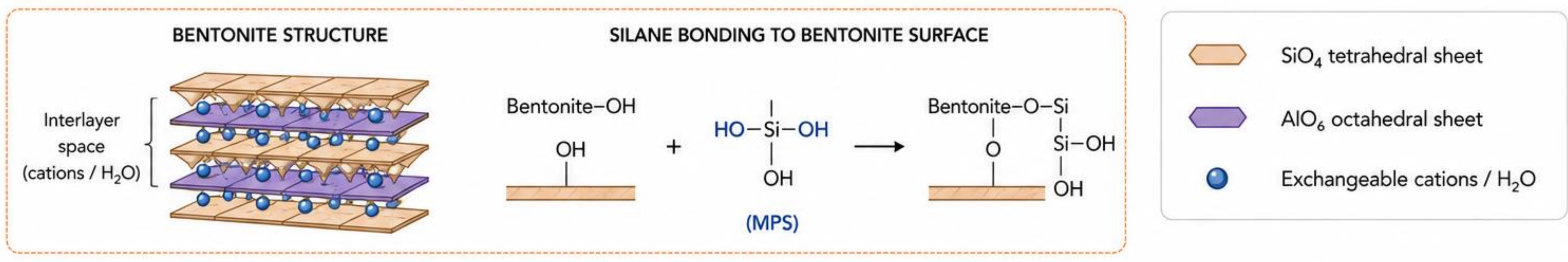
EFFECT OF MPS-MODIFIED BENTONITE ON FILLER NETWORK STRUCTURE, RHEOLOGICAL BEHAVIOUR AND CURE KINETICS OF RUBBER COMPOUNDS

Z. Mičicová, S. Božeková, I. Labaj, J. Vršková, P. Skalková, M. Pajtášová

Abstract

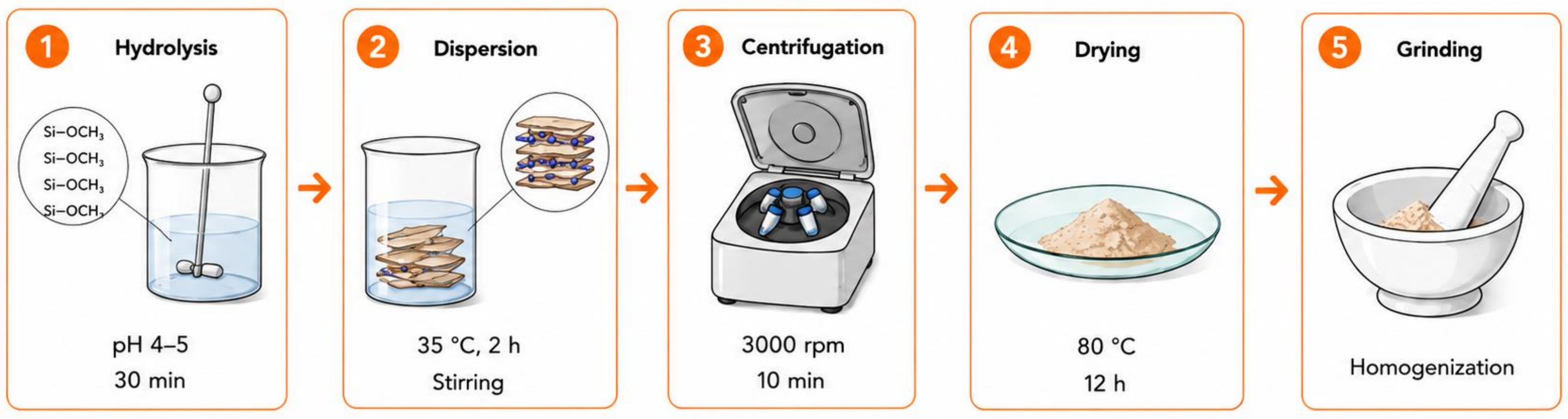
This study investigates the effect of bentonite modified with (3-trimethoxysilyl)propyl methacrylate (MPS) on the dynamic filler network, rheological behaviour, and cure kinetics of rubber compounds. The modification of bentonite was carried out to enhance filler–rubber interactions and to improve its applicability as a partial replacement for carbon black. The dynamic filler network was evaluated indirectly using strain- and frequency-dependent rheological measurements performed with a Rubber Process Analyzer (RPA). The Payne effect was used to characterise the strength and stability of the filler network, while complex viscosity and loss factor were used to assess the viscoelastic response and processability of the compounds.

Material



MPS concentration	Sample
Unmodified bentonite	Ben
0.5 wt.% MPS	M/Ben/0.5
2.5 wt.% MPS	M/Ben/2.5
5 wt.% MPS	M/Ben/5

Prepared of MPS- modified bentonite



Results

Characterization of MPS-modified bentonite

Tab. 1 EDX analysis of bentonite and its MPS-modified bentonites

Chemical composition, %	SiO_2	Al_2O_3	MgO	Fe_2O_3	CaO	SO_3	K_2O
Ben	68.16	21.62	2.70	2.67	2.29	1.22	0.84
M/Ben/0.5	68.66	22.10	3.10	2.40	1.67	0.85	0.79
M/Ben/2.5	68.85	21.89	2.82	2.49	1.70	0.92	0.84
M/Ben/5	68.79	21.76	2.74	2.56	1.80	1.05	0.84

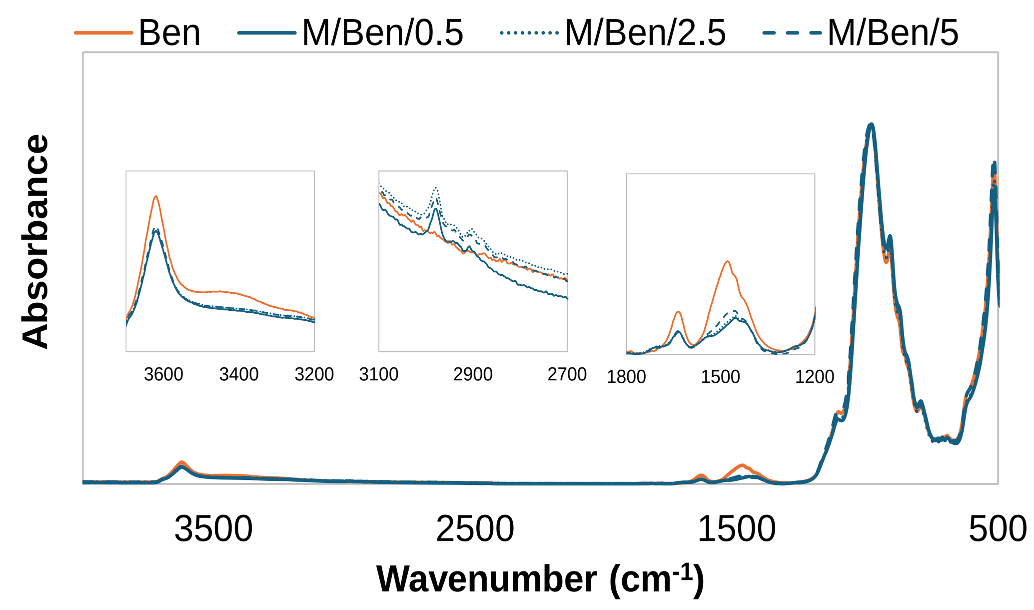


Fig. 1 FTIR spectra of Ben and its MPS-modified bentonites

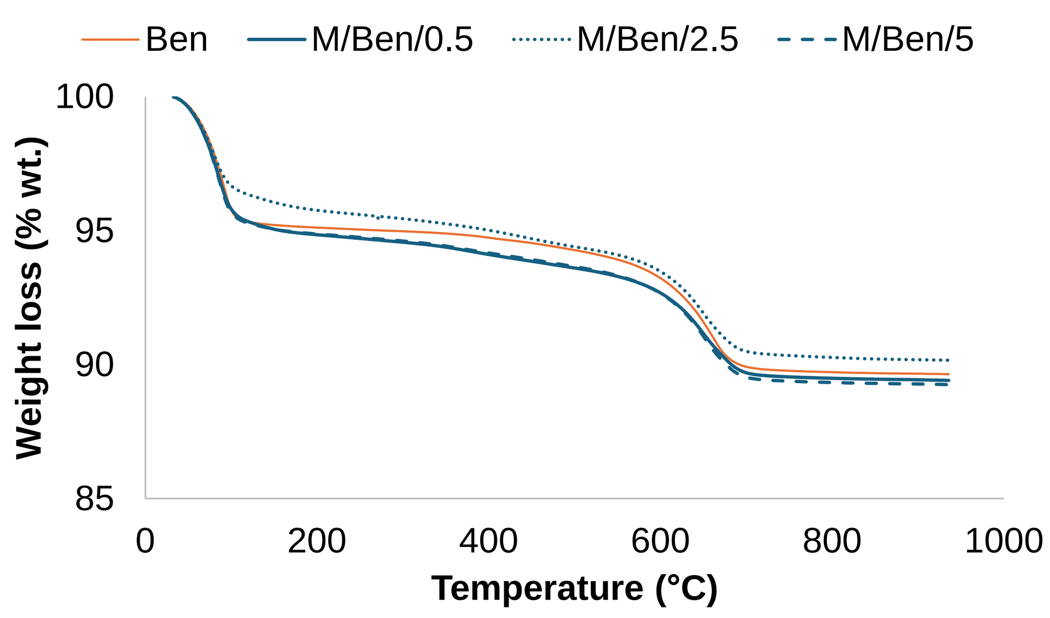


Fig. 2 Thermal decomposition of Ben and its MPS-modified bentonites

Rheological behaviour of rubber compounds

Tab. 2 Cure kinetic parameters of rubber compounds

Rubber compounds	m	Ea kJ/mol	R^2
U/NR	10412	86.565	0.98
NR	11609	96. 517	0.99
NR/Ben	11625	96.650	0.98
NR/M/Ben/0.5	12097	100.057	0.97
NR/M/Ben/2.5	11733	97.548	0.99
NR/M/Ben/5	11613	96.551	0.98

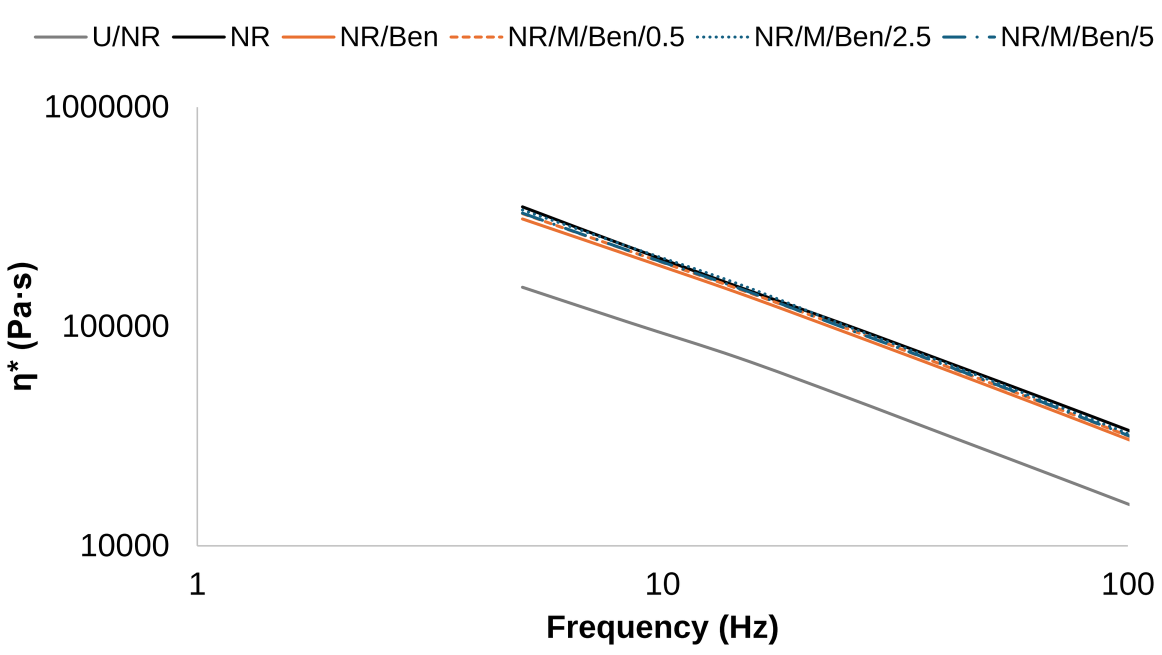


Fig. 3 Frequency-dependent complex viscosity of rubber compounds

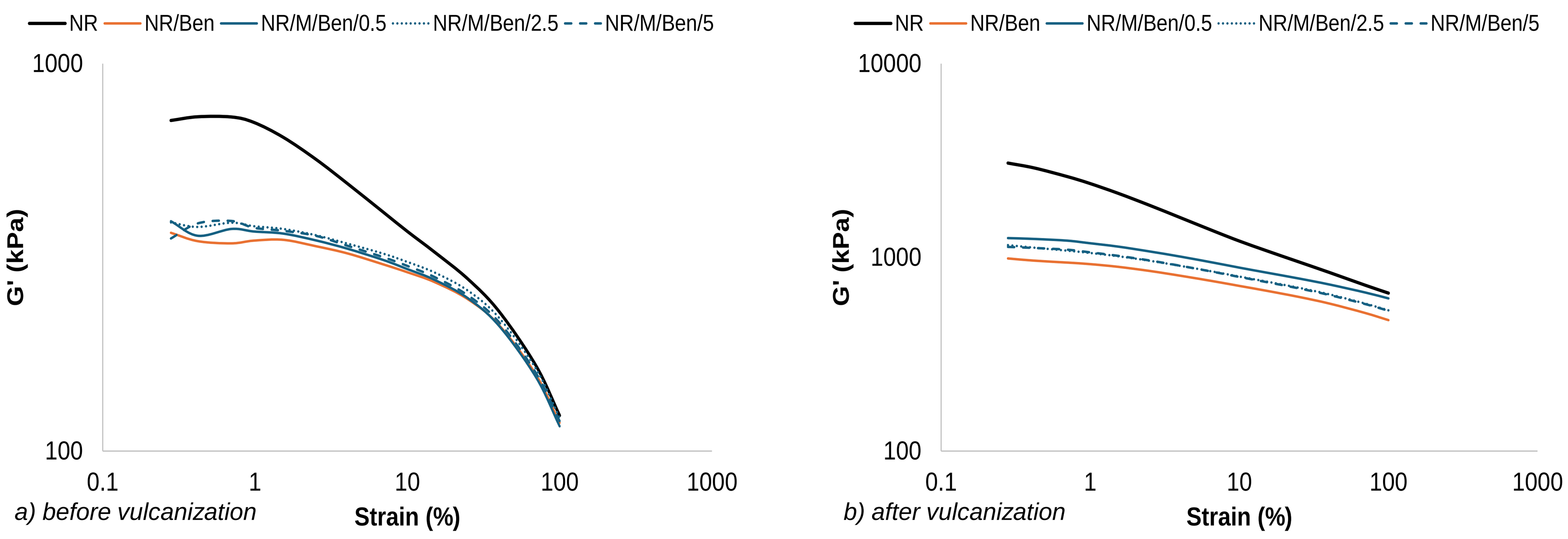


Fig. 4 Payne effect of rubber compounds before and after vulcanization

Conclusion

Overall, the obtained results confirm the significant influence of MPS-modified bentonite on the rheological behavior and curing characteristics of rubber compounds.

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Department of Materials Technologies and Environment
Faculty of Industrial Technologies
Alexander Dubcek Univerzity of Trencin
I. Krasku 1809/34 , 02001 Puchov
Slovak Republic
zuzana.micicova@tnuni.sk

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