Short-Aramid Fibres in Elastomers for Improved Tribology

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DPI #782 FINEFIT (2013-2018). The aim of the project is to study friction and wear mechanisms that occur in reinforced elastomers.

Introduction

Existence of a friction-modified surface layer and its contribution to the overall friction is studied both theoretically and experimentally for four SBR-based elastomers: (1) SBR rubber, (2) SBR matrix reinforced with aramid fibres, (3) SBR reinforced by aramid fibres and TESPT as coupling agent and (4) SBR reinforced with aramid fibres, using NXT as coupling agent. The structures of the coupling agents are given in Figure 1.

Table 1 Samples.

Sample	1	2	3	4
SBR	100	100	100	100
Fibre	0	3	3	3
TESPT	0	0	1	0
NXT	0	0	0	1
$E_{\|\|}$ (MPa)	2.08	2.34	2.74	3.01

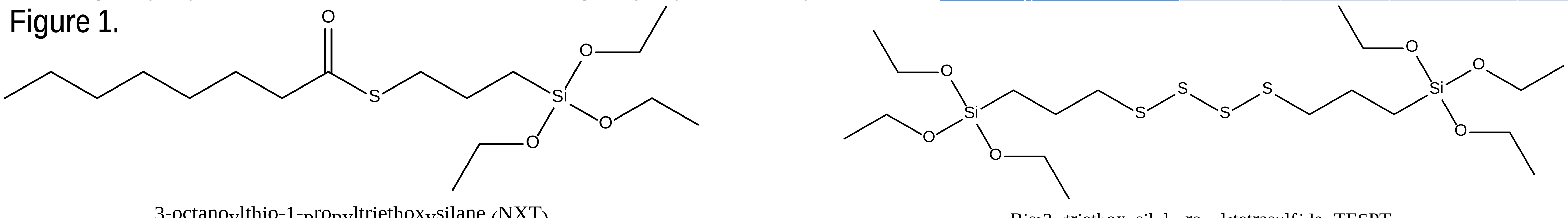

Fig. 1 NXT and TESPT.

Experiments:

Friction experiments are performed by a ball granite on rubber disk friction tester under controlled environmental conditions (T = 23ºC, RH = 50%) and sliding velocity v = 5 mm/s and a nominal contact pressure of 0.175 MPa.

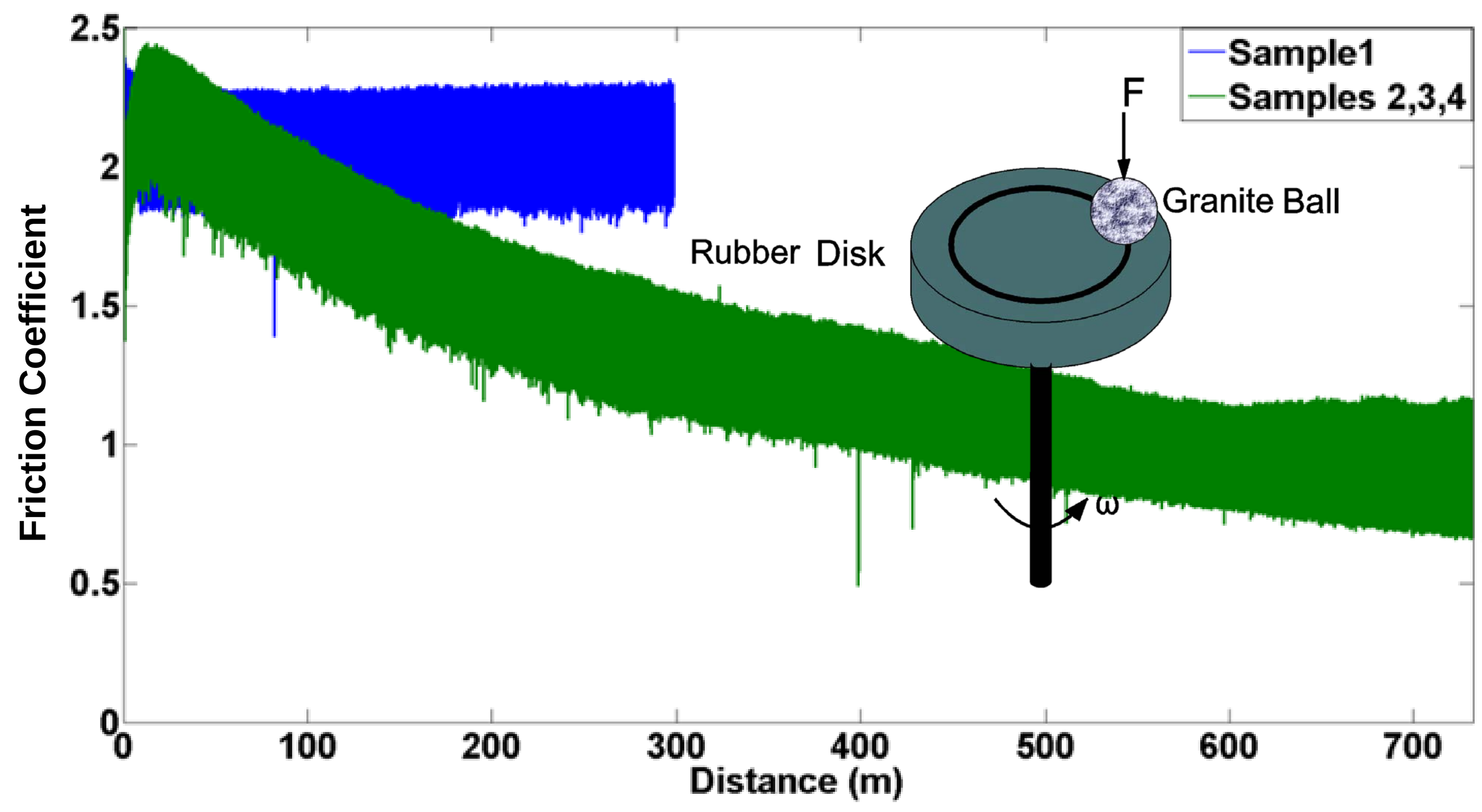

Fig. 2 Friction coefficient as a function of sliding distance. The reinforced samples show a considerable running-in distance.

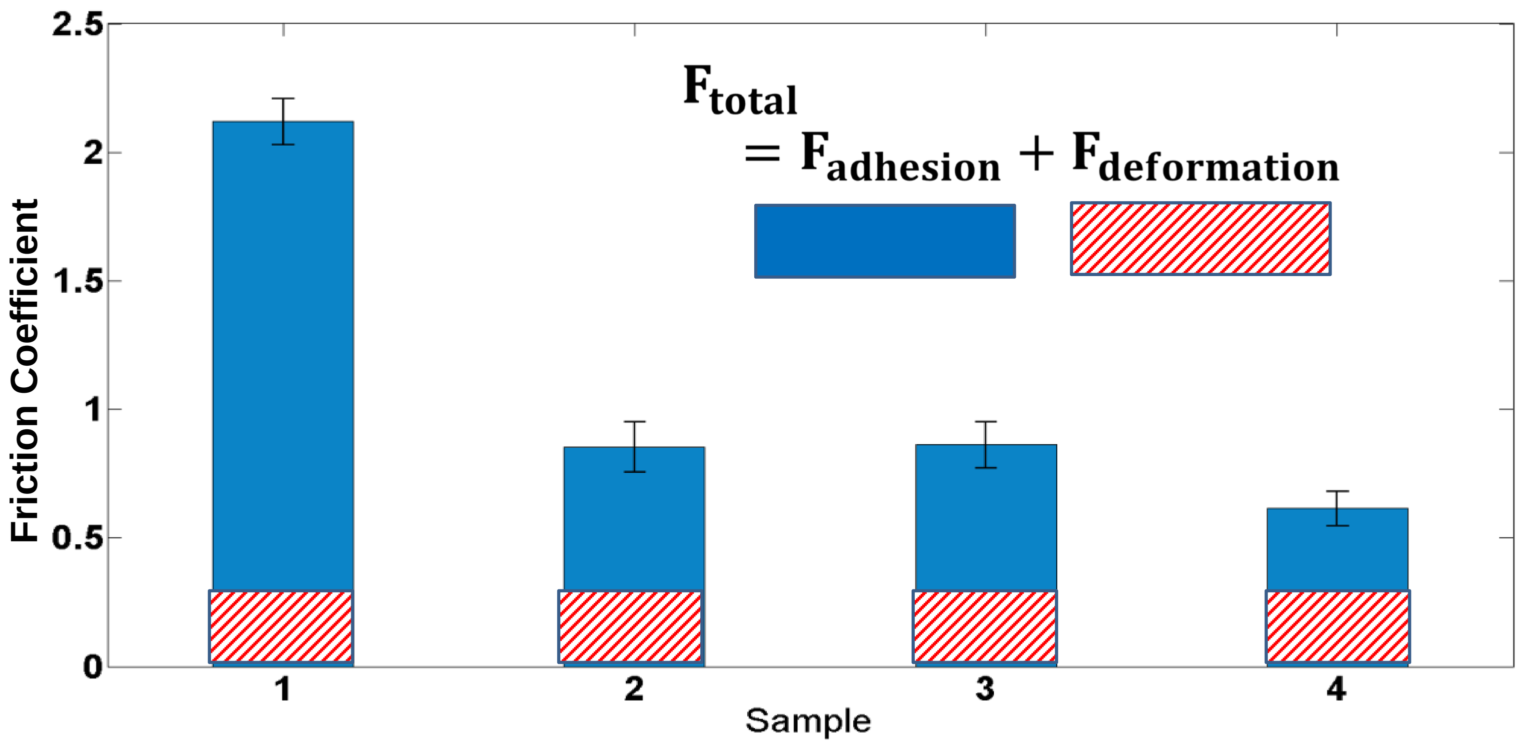

Fig. 3 Friction coefficient vs. samples, adhesion and deformation contribution.

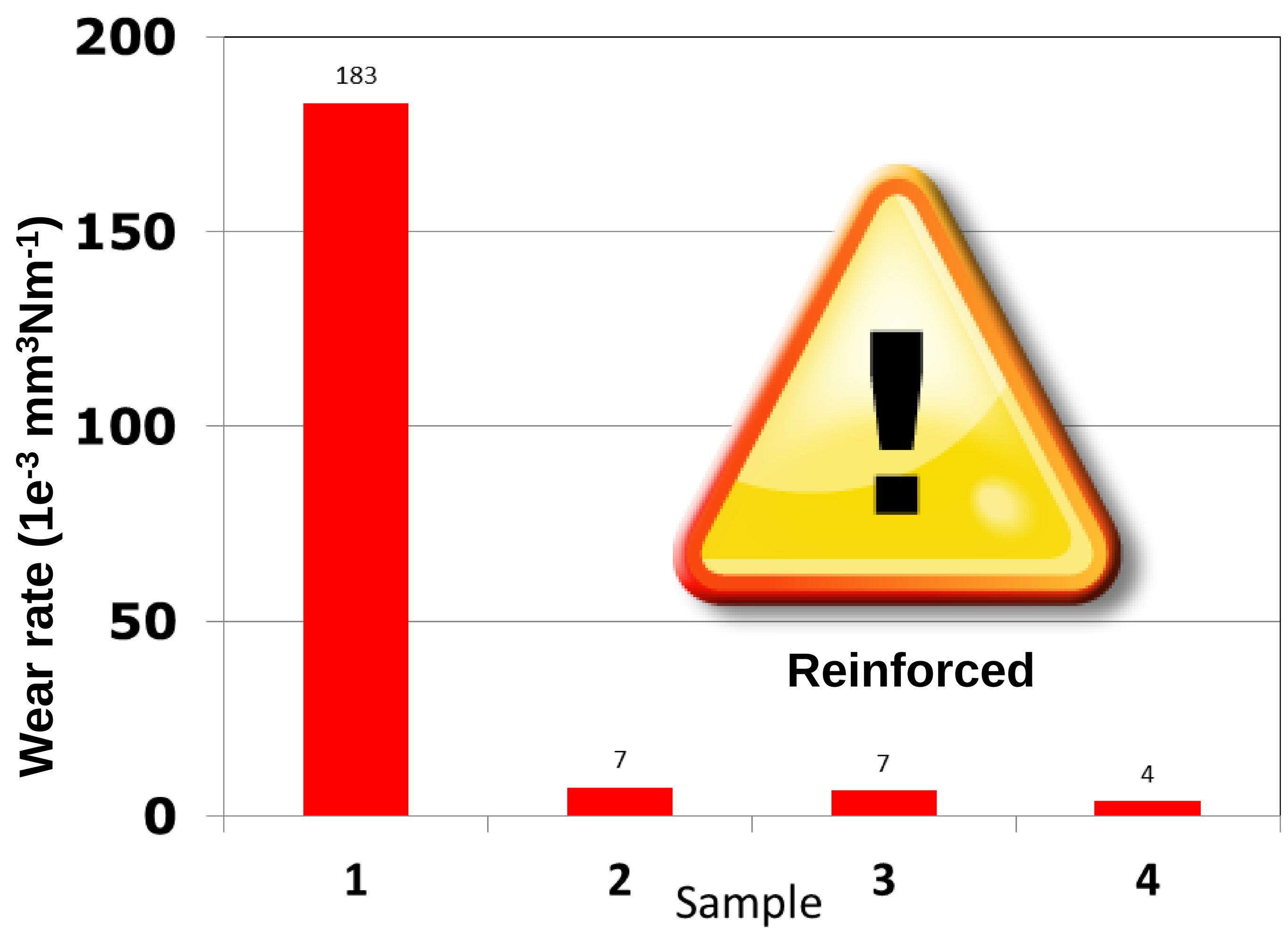

Fig. 4 Wear rate vs. samples.

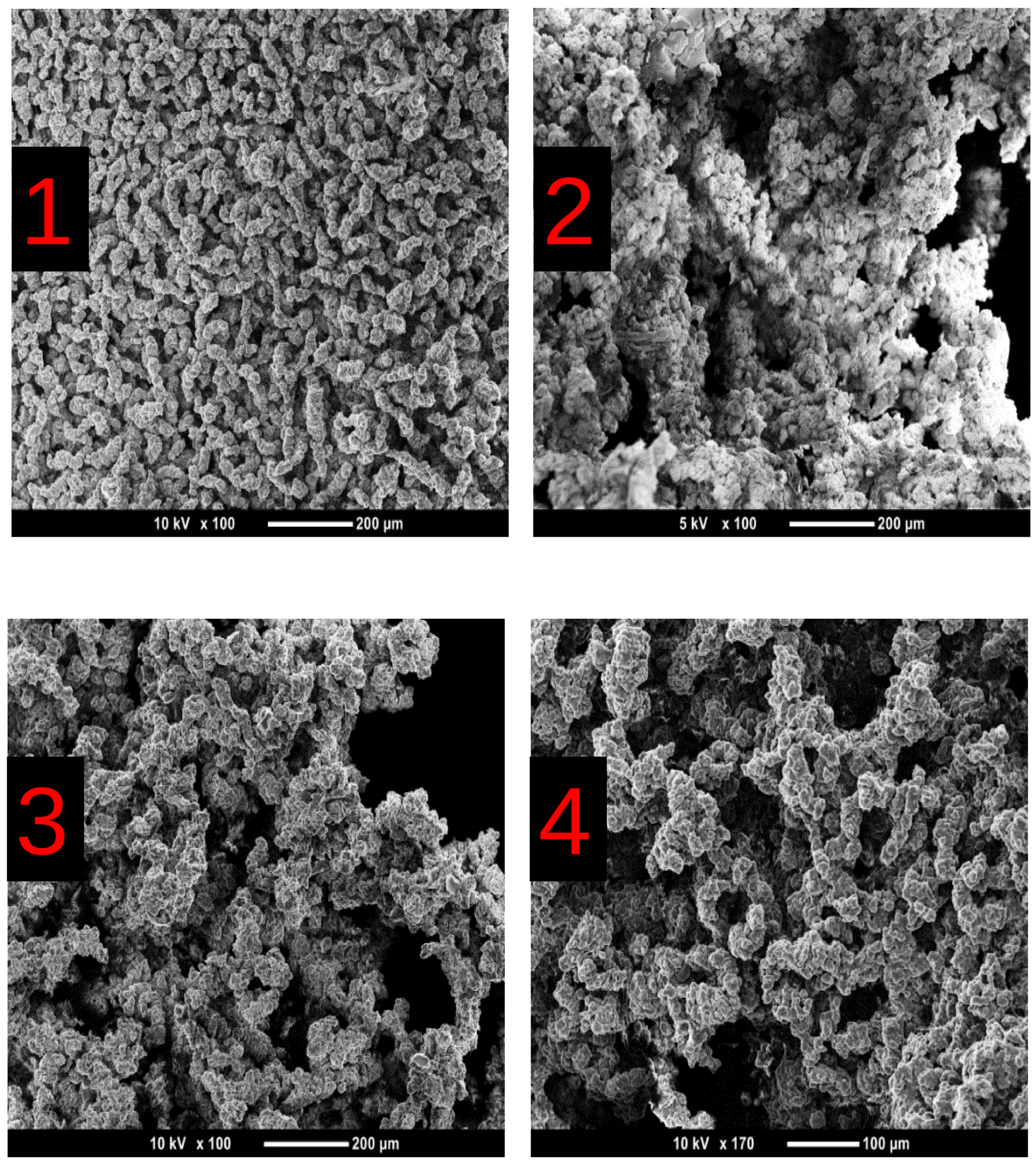

Fig 5 SEM of wear debris of ball on disk experiments for different compounds.

Conclusions

- Long run-in times for fibre reinforced samples: Fig 2.
- Friction coefficient is approximately 3 times lower for fibre reinforced samples: Fig 3.
- Contribution of the adhesion (surface layer) is dominant: Fig 3.
- Wear rate for reinforced samples is 25-30 times lower than for unreinforced samples, even in absence of a coupling agent: Fig 4.
- Slight contribution in friction coefficient and wear rate of fibre reinforced samples with coupling agents compared to the sample without coupling agent: fig 2/3/4. NXT has preference.
- Debris produced from sample 1 are dusty-like while others have the tendency to clog together and form a smear film. Differences in structure of worn debris: Fig 5.

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