Influences of temperature and load on the dry friction behaviour of tire tread compounds in contact with rough granite

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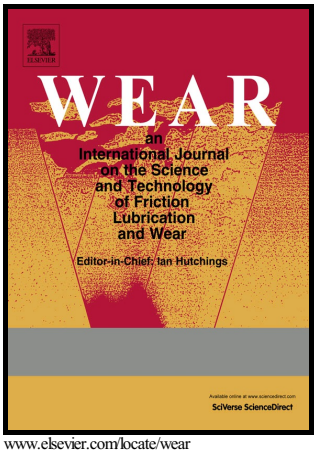

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PII: S0043-1648(16)30324-6
DOI: http://dx.doi.org/10.1016/j.wear.2017.02.047
Reference: WEA102101

To appear in: *Wear*

Received date: 19 September 2016
Revised date: 20 February 2017
Accepted date: 26 February 2017

Cite this article as: Andrej Lang and Manfred Klüppel, Influences of temperatur and load on the dry friction behaviour of tire tread compounds in contact wit rough granite, *Wear,* http://dx.doi.org/10.1016/j.wear.2017.02.047

Influences of temperature and load on the dry friction behaviour of tire tread compounds in contact with rough granite

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Abstract

The temperature and load dependence of the sliding friction behaviour of a racing tire tread compound on coarse and fine rough granite substrates is analysed by experimental and theoretical techniques. Based on dry friction measurements at different temperatures, friction master curves are constructed by shifting the data horizontally on the velocity axis using the same shifting factors as found from viscoelastic master curves. The obtained isothermal friction curves increase rapidly with increasing sliding velocities and show a more or less pronounced plateau over a broad velocity range, which decreases with increasing load. For analysing this behaviour, the Klüppel and Heinrich theory of rubber friction and contact mechanics is applied, which considers the multi-scale contacts and excitations of the rubber sliding on rough surfaces in the frame of a linear viscoelastic approach. The extension of this theory to more realistic surfaces with two or more scaling ranges is described in some detail. It takes adhesion and hysteresis contributions into account referring to the viscoelastic response of the rubber on different frequency scales. The theory predicts that under isothermal conditions the coefficient of friction decreases with load, which is more pronounced for the adhesion than for the hysteresis contribution. This result is found to be in fair agreement with the measure friction curves confirming the contact mechanical approach of the theory.

Keywords:

rubber friction on rough surfaces, load dependence, friction master curves, hysteresis friction, adhesion friction, viscoelastic master curves, time-temperature superposition

1. Introduction