TRIBOLOGICAL INVESTIGATIONS USING A LINEAR FRICTION TESTER (LFT)

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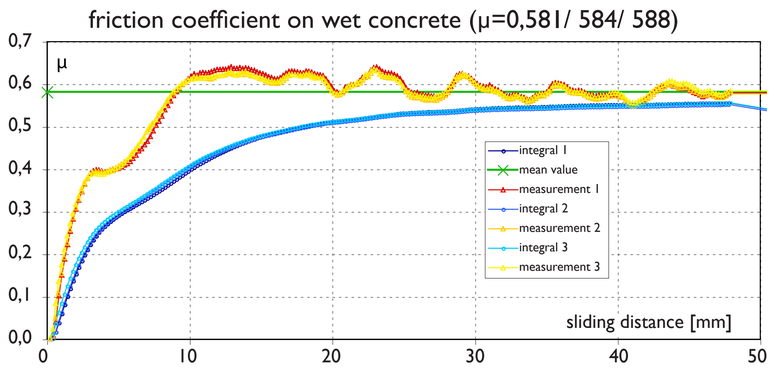
INTRODUCTION

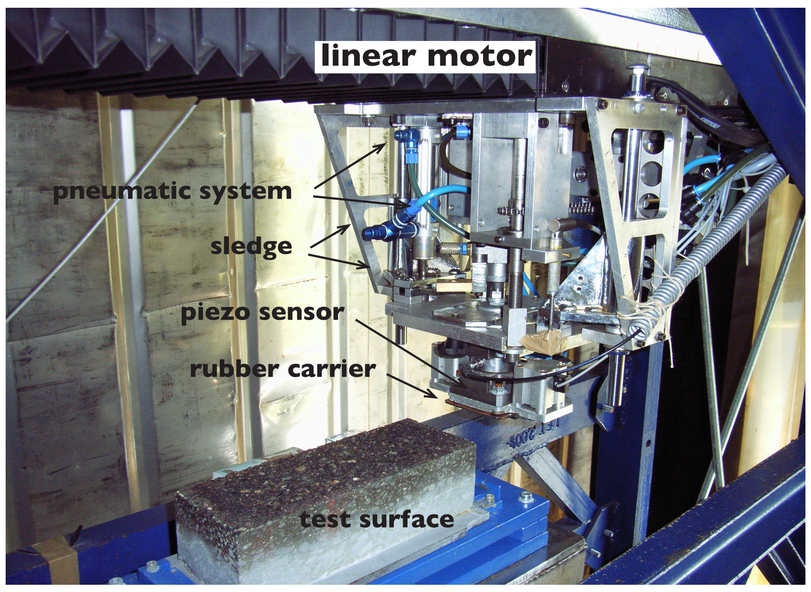
Sliding friction is a very common and manifold phenomenon, which plays an important role in many technical applications. In field tests it is hard or expensive to achieve reproducible results for friction behavior. For this reason at the Institute for Mechanics of Materials and Structures a testing device, the so-called Linear Friction Tester (LFT) was developed [1], which has been used for a wide range of experimental friction investigations under easy and precisely controllable conditions. Helpful for the realization of these projects were numerical FEM-based simulations and theoretical reflections on the friction process. Several applications are presented on this poster. More results and a detailed description can be found in [2], an overview in [3].

[1] **Schwaiger, H.:** *Entwicklung einer Prüfeinrichtung zur Untersuchung des Traktionsverhaltens von Gummiproben auf verschiedenen Oberflächen*; Diploma thesis, TU Wien 1996.
[2] **Lahayne, O.:** *Experimentelle Reibungsuntersuchungen und Modellrechnungen zum Verhalten von Reifenmaterialien;* PhD thesis, TU Wien 2007.
[3] **Lahayne, O., Eberhardsteiner, J.:** *The experimental investigation of frictional behaviour of rubber materials*. Advances in Experimental Mechanics, CD-ROM Proceedings of the 12th International Conference on Experimental Mechanics (ICEM12), McGraw-Hill, 2004, 8 pages..

THE LINEAR FRICTION TESTER

The LFT is placed in a container with air-condition and monitored temperature and humidity. The core of the device is a linear drive that pulls a sledge with a mounted rubber test specimen over an interchangeable friction surface. A pneumatic system apllies the vertical load; the resulting forces are recorded and analyzed. Of main interest is the friction coefficient $\mu = F_{Horizontal}/F_{Vertikal}$.

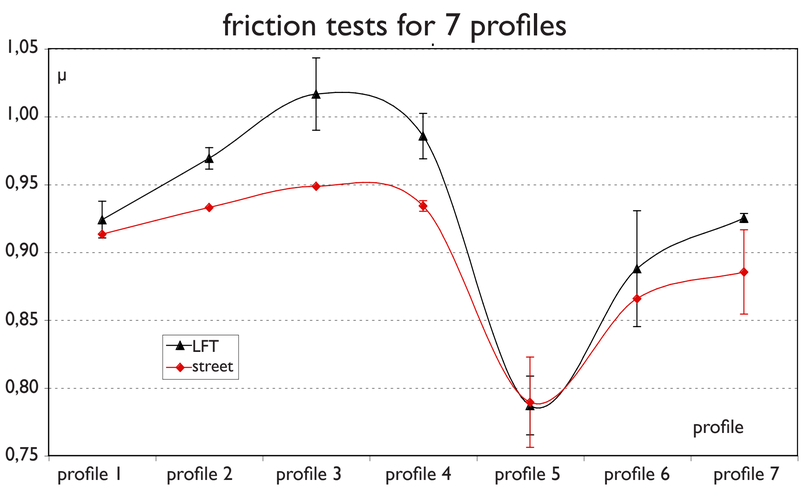




RUBBER FRICTION TESTS

The main application area of the LFT is testing of tire materials. Because of the differences in the dimensions, it is not possible to compare results of street tests with LFT results directly. Nevertheless, by choosing matched test parameters and analysis methods, the comparision is possible to a certain degree.

In the Figure shown below, the influence of the sample geometry is addressed. For the LFT samples and for the tires used for street tests the same seven geometries have been used. The match between the two series is satisfying. Usually the standard deviation for such tests is between 1 % and 3 %. Compared to street tests, the LFT results are more accurate, and experiments by means of the LFT are of course much cheaper.

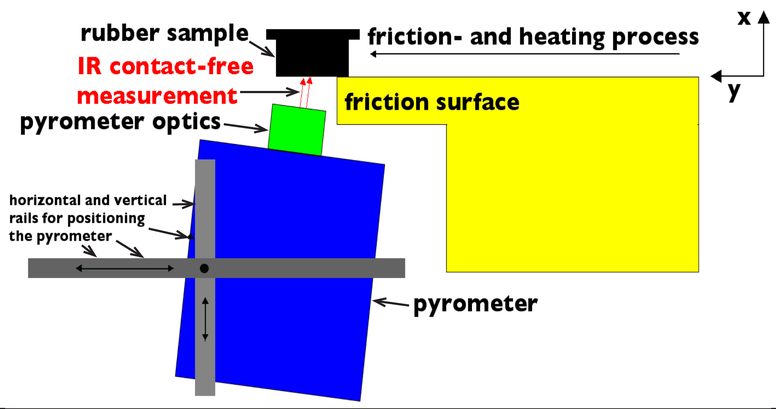


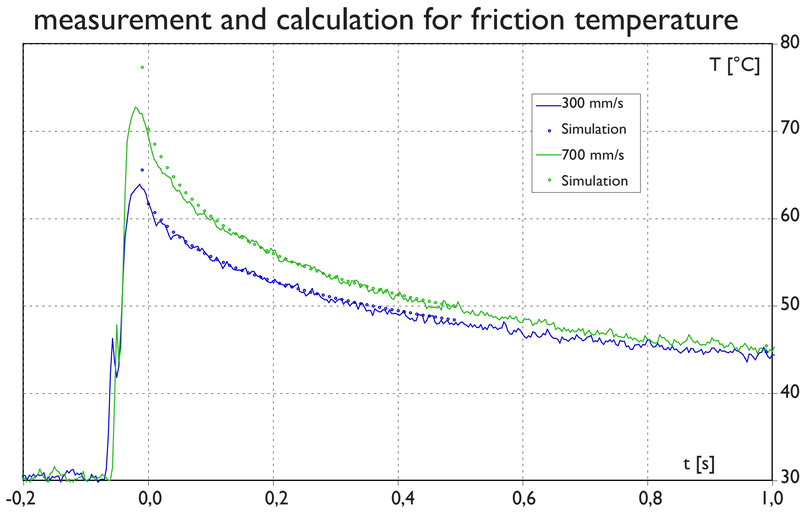
TEMPERATURE TESTS

For the analysis of the results of tribological experiments it is very desireable to know the temperature changes of the samples during the friction process. For this purpose a pyrometer was used to measure the temperature at the contact surface (see the layout below). The temperature data within the samples were recorded by means of thermocouples (as in the photo). The figure down right shows the increase and decline of the temperature at a certain point of the specimen's contact surface for two test series with different sliding velocities. The measurements are represented by solid lines, the circles indicate results of associated calculations. The latter are based on Fourier's law of heat conduction:

$$\dot{T}(x,t) = \frac{\lambda_R}{c_R \rho_R} T''(x,t) = a_R T''(x,t)$$

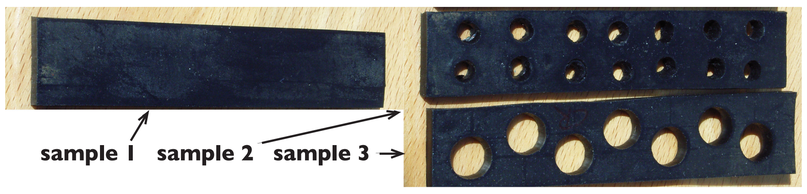
The model is a rough one, but the good agreement demonstrates its significance.

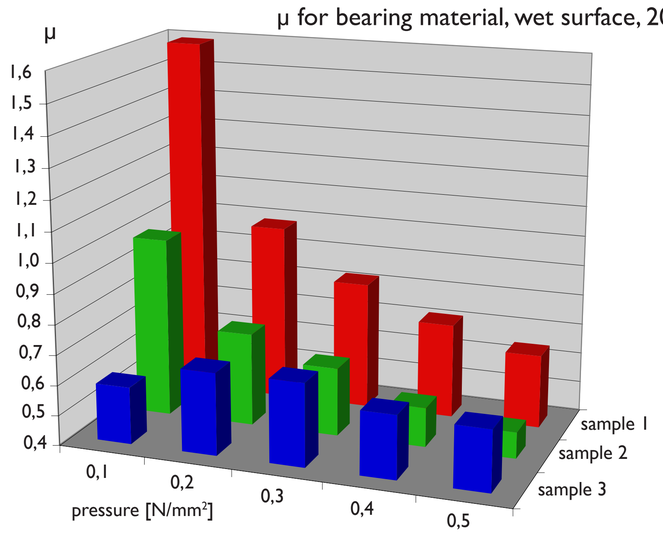




DESIGN TESTS FOR WIND TURBINES

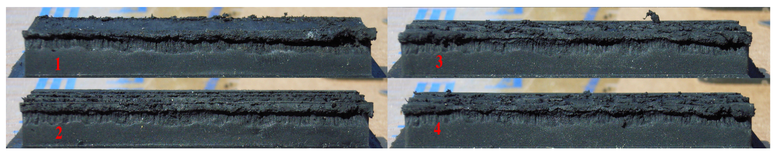
For the construction of wind turbines materials for bearings are needed, which show an optimal performance (i.e. high friction coefficient μ) for a wide range of conditions. For that purpose LFT tests were performed with samples of different materials and designs, simulating different construction conditions. Similar tests have been done with materials for conveyor bands or with wheels for inline skates. For the latter use wear was also an important aspect..

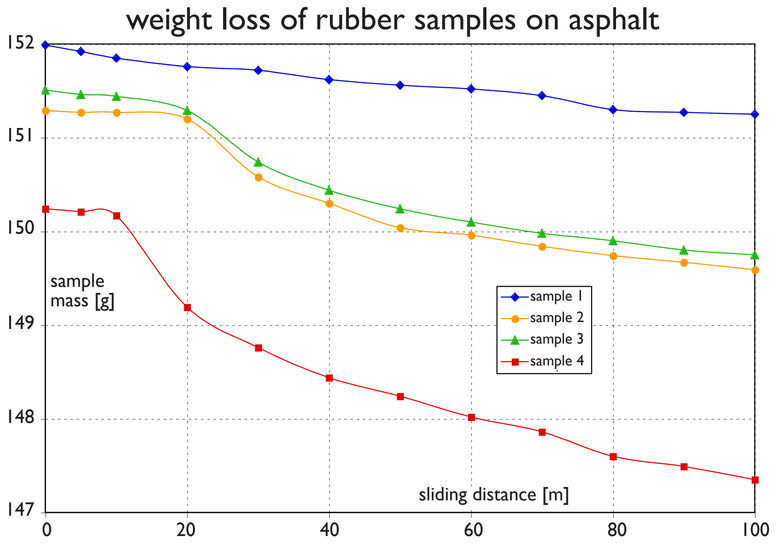




WEAR TESTS

In friction processes wear plays often an essential role. Quantification of wear is of high interest. The photo shows the abrasion of four samples of different tire materials under the same conditions, the diagramm the weight loss. The total weight loss of the four samples varies between 0.75 and 2.9 g. This might be relevant, if material with good friction performance can feature a low lifespan, as in this example.





PROSPECTS & ACKNOWLEDGEMENT

As an instrument for friction tests the LFT is by now a well-established test facility. Several other applications have been realized for specific test series. Some further types of investigations using the LFT are:

1. Long-term tests to investigate the influence of the aging process on the friction behaviour.

2. Acoustic tests regarding the noise caused especially of tire materials on road surfaces.

3. Investigation of the influence of temperature differences between the friction partners and/ or water, which is coating the Friction interface.

Acknowledgement

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