# In-situ observation of the friction/water depth relationship

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## 1. Introduction

Accidents are more likely on just wet roads than on flooded ones. Research has been conducted in laboratory to better understand the thin film traction process [1]. Additional works are needed to investigate the effect of factors like the surface macrotexture and the tire characteristics.

The purpose of this paper is to analyze results of friction tests performed at the Ifsttar test track and their comparison with laboratory results [1][2].

## 2. Experiments

Two friction monitoring devices are used. The Adhera machine measures locked-wheel friction coefficient. The Griptester machine measures friction coefficient with a slip ratio of 15%.

Tests are realized on road surfaces, covering a wide range of macrotexture and microtexture, and some special surfaces (resin, painted surfaces).

Surfaces are wetted by means of sprinklers. Water film thickness varies from 0.25 mm to 1.75 mm by 0.25 mm. These values are determined by considering the road as a smooth surface and adapting the flow of the watering system of the machines.

## 3. Results

Typical results are shown in figure 1. Stribeck-like curves are observed. The role of surface microtexture can be seen: friction on surface G1 (same asphalt mix as G0, but covered by plain painting) drops as soon as the surface is wet; G2 (same asphalt mix as G0, but covered by painting mixed with small glass beads) acts as G0 but with lower friction coefficient (less microtexture).

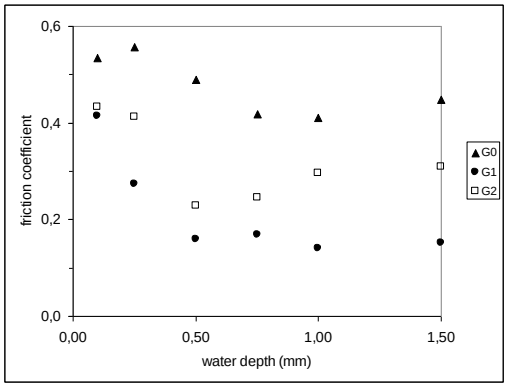


Fig.1 Adhera test results

Results are similar to those obtained in laboratory, but present some different features: hydrodynamic regime can be seen while this regime is not seen in laboratory [1].

Comparison between smooth and patterned tires is also made. Stribeck-like curves can be observed for smooth tires whereas patterned tires show almost small variations of friction with water depth. Discussions are made in terms of water drainage due to both the tire pattern and the road surface macrotexture.

Comparison between Adhera and Griptester machines help to better see the effect of tire size and slip.

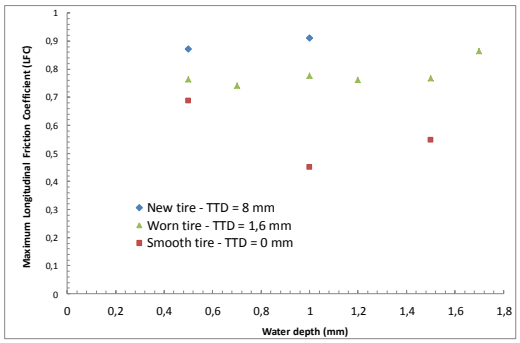


Fig.2 Tire effect on µmax

A mathematical model is used to fit experimental results:

$$\mu = \Delta\mu \cdot e^{\left(-\frac{h}{h_0}\right)^{\alpha}} + \mu_F \qquad (1)$$

where µ: friction coefficient; h: water depth; $\mu_F$: final friction coefficient; $\Delta\mu$ = difference between µ(0) (µ at h = 0) and $\mu_F$; and $h_0$, $\alpha$ = constants.

A so-called critical water depth is defined as the transition between boundary and mixed lubrication regimes. Effects of road surface and tire characteristics (size, pressure, tire tread depth) on the model parameters and the critical water depth are investigated and results are discussed.

## 4. References

[1] Do, M. T., Cerezo, V., Beautru, Y., Kane, M., "Modeling of the Connection Road Surface Microtexture/Water Depth/Friction", WOM Conf., April 14-18, 2013, Portland OR, USA.

[2] Veith, A. G., "Tires – Roads – Rainfall – Vehicles: The Traction Connection. Frictional Interaction of Tire and Pavement", ASTM STP 793, W.E. Meyer and J.Reichter Eds., ASTM, pp. 3-40.