7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

Skid Resistance Evolution due to Road Texture Polishing: Proposing a Model to Simulate the whole Phenomena

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This study aims to model the evolution of the road surface textures due to polishing phenomena induced by the traffic and its implications for the evolution of the tire-pavement grip capacity. The model considers the initial texture of the pavement, the nature of the aggregates (and particularly its mineralogical composition), the traffic conditions (truck, passenger cars), the pavement localization (rolling, braking, or acceleration zones), and is based on a rough-visco-elasto-hydrodynamic contact modelling coupled with a wear law. The model also considers the characteristics of the tire (geometry, tread pattern, viscoelasticity of the rubber material, and carcass stiffness).

Keywords : Roads, Skid Resistance Evolution, Texture, Polishing, Traffic, Model

1. Introduction

The safety of the road transportation system depends largely on the ability of vehicle tires to grip the road surface. Grip enables vehicles to minimize their braking distances and to follow desired trajectories. The generation of grip forces depends upon the road surface texture. Indeed, texture induces local deformation of the tire tread and thus causes hysteresis friction due to the viscoelastic nature of the tire. It should be noted that in wet conditions, the hysteretic contribution makes the sole contribution to grip, as adhesion is prevented by the lubricated tire-road contact.
The continuous wear of road texture by vehicle tires induces polishing effects. This study aims to model the evolution of the road surface textures due to polishing phenomena induced by the traffic and its implications for the evolution of the tire-pavement grip capacity [1-6].

2. Methods

The model considers the initial texture of the pavement, the nature of the aggregates (and particularly its mineralogical composition), the traffic conditions (truck, passenger cars), the pavement localization (rolling, braking, or acceleration zones), and is based on a rough-visco-elasto-hydrodynamic contact modelling coupled with a wear law. The model also considers the characteristics of the tire (geometry, tread pattern, viscoelasticity of the rubber material, and carcass stiffness).

3. Results and Discussion

The validation of the model is achieved via polishing and friction measurements on a set of pavements comprised of different aggregate (by their mineral composition) using the "Wehner-Schulz" machine, a device already proven in its ability to reproduce the traffic polishing and a high resolute profilometer "Stil" to capture texture changes. A comparison between the experimental and simulation results shows a comparable evolution trend of the pavement texture and friction even though a difference in their kinematics is noted at the first cycles of the polishing process (Figs 1 and 2). A similar agreement between the experimental and simulation assessment of the long-term skid resistance of the different pavements is also noted, with small differences in their absolute values potentially due to limitations in the wear law applied that is highlighted as a potential point of improvement for model results.

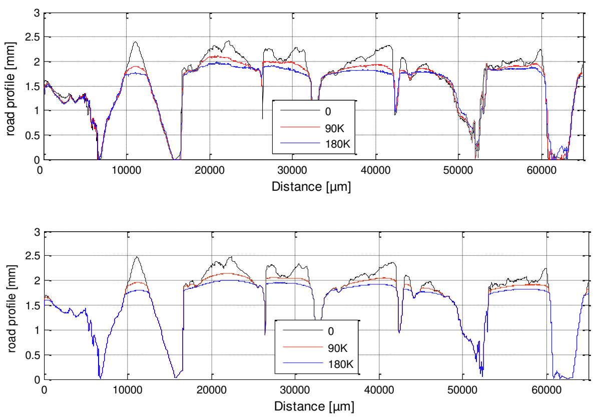

Figure 1: Direct comparison between the experiment (top) and simulation (bottom) of texture evolution of one of the pavement specimens made with limestone aggregates (K = 1000)

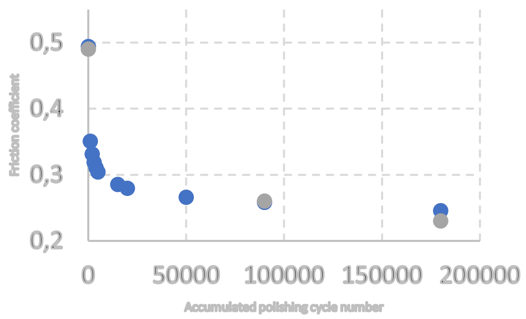

Figure 2: Direct comparison between the experiment (Blue dots) and simulations (Grey dots) of friction coefficient evolution of one of the pavement specimens made with limestone aggregates

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