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Study of micro-texture and skid resistance change of granite slabs during the polishing with the Aachen Polishing Machine

Dawei Wang [a,*], Xianhua Chen [b], Markus Oeser [a], Helge Stanjek [c], Bernhard Steinauer [a]

[a] Institute of Road and Traffic Engineering, RWTH Aachen University, D52074 Aachen, Germany
[b] School of Transportation, Southeast University, Nanjing 210096, China
[c] Institute of Clay and Interface Mineralogy, RWTH Aachen University, D52072 Aachen, Germany

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ABSTRACT

In this paper, massive granite slabs were cut from lumps of rock using a diamond saw. The surface of the stone slabs was then retreated so that the slabs were characterized by different degrees of roughness. On the other hand, the slabs had no macro-texture, so that the skid resistance depended exclusively on the micro-texture. The prepared slabs were polished under various polishing conditions using the Aachen Polishing Machine. Changes of the micro-texture were studied on the basis of both texture level measured by spectral analysis and skid resistance measurements measured by the British pendulum tester. The results showed that micro-texture and skid resistance changes of the slabs are related to the applied polishing agent, initial roughness and mineralogical compositions of the granite slabs. The contribution of micro-texture to the skid resistance can be described with a function of the two texture parameters.

1. Introduction

Skid resistance of road surfaces is essential to ensure traffic safety. Statistics show that the risk of skidding crashes decreases with an improvement of skid resistance [1]. Skid resistance mainly depends on the road surface texture, which is characterized by two scale levels: micro-texture and macro-texture. Micro-texture is defined as “the amplitude of deviations from the surface plane with wavelengths less than or equal to 0.5 mm in length and depth” [1,2]. Furthermore, the roughness of an aggregate has a decisive influence on the magnitude of micro-texture of a road surface [1,2]. The macro-texture is characterized by surface irregularities whose dimensions range between 0.5 and 50 mm horizontally and between 0.1 and 20 mm vertically [1,2]. The micro- and macro-texture of a road, which have a significant impact on the activation of the frictional force between vehicle tires and road under wet condition, are influenced by the roughness, choice, grain size, arrangement and grading of the aggregates [2–5].

The skid resistance of roads generally decreases with the polishing process of aggregates due to traffic loads [2,5]. During the polishing process, the micro-texture of aggregates changes due to a gradual removal of mineral components [6,7]. Different test methods, for example the polished stone value (PSV, EN 1097-8:2009) [2,8–11], were applied to determine the polishing resistance of coarse aggregates (for example 8/11 mm in Germany). Furthermore, with the Wehner/Schulze test [12,13] the friction after the polishing test can be measured for the grain sizes 0/2 mm, 2/5 mm, 5/8 mm and 8/11 mm at a velocity of 60 km/h according to the draft EN 12697-49. Based on these aggregate tests for a given set of laboratory conditions, many prediction models for asphalt roads have been developed [14–19].

The changes of aggregate surface textures due to the rubber tire polishing action in PSV or W/S tests have been investigated quantitatively to micrometer level [6,20–23]. In order to characterize the roughness of a road surface, different texture parameters were developed which describe how a tire interacts with different types of asphalt surface. However, experiences have shown that the roughness parameters are scale-dependent [6,23–24]. Chen et al. have studied the development of aggregate-surface height profiles in the polishing process with the W/S machine using fractal and spectral analysis [6,23]. It has been demonstrated in [24,25] that the development of the power spectrum for the surface roughness could be directly correlated with the development of skid resistance.

In the standard tests to determine the polishing resistance of aggregates, such as the PSV and W/S tests, the samples are made

* Corresponding author. Tel.: +49 241 8026742; fax: +49 241 8022141.
E-mail address: wang@isac.rwth-aachen.de (D. Wang).

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