



10th International Scientific Conference Transbaltica 2017:
Transportation Science and Technology

Examination of the Effect of Superhydrophobic Coated Pavement under Wet Conditions

Ekinhan Eriskin, Sebnem Karahancer, Serdal Terzi*, Mehmet Saltan

Department of Civil Engineering, Engineering Faculty, Suleyman Demirel University, Turkey

Abstract

Accidents cause vital loss and property damage. The possibility of an accident when the surface is under wet conditions is an indisputable fact. In addition, drivers slow down when the pavement is wet and this affects the flow of traffic. Accidents occur on highways in wet weather either because of hydroplaning or reduced skid resistance. This paper studies the differences between surfaces with superhydrophobic (SH) coating and those without. To determine the differences, British pendulum numbers (BPN) from coated and uncoated samples were compared. The effect of the SH coating on temperature change was examined. Additionally, a small area was SH coated and what happens to the coating during driving was determined. As a result, SH coated samples had higher BPN values than uncoated samples. In addition, a decrease in temperature for SH coated samples is slower than uncoated samples. Last of all, after 100 drives on the SH coated pavement, the coating is not harmed by the contact angle. Therefore, SH coating would be useable especially on rural highways with low volume where accidents occur because of wet/iced/snow surfaces.

© 2017 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017

Keywords: superhydrophobic, british pendulum, contact angle, skid resistance, icing

* Corresponding author.

E-mail address: serdalterzi@sdu.edu.tr

1. Introduction

Traffic professionals around the world are on a knife-edge about accidents because accidents cause vital loss and property damage. The possibility of an accident when the surface is under wet conditions is an indisputable fact. Rain, snow, ice and wet highways have a very bad effect on driving [1]. Drivers slow down when the pavement is wet and this affects the flow of traffic as well.

Accidents that occur on highways in wet weather are either caused by hydroplaning or reduced skid resistance. Both are parameters to be considered by highway professionals [2]. The presence of water on the surface is one of the major reasons for both hydroplaning and reduced skid resistance. A superhydrophobic (SH) coating applied to the surface of the pavement could help to drain water from the pavement more easily. Besides, SH coating decreases the adhesion between the surface and ice [3]. There are some other methods for removing ice from the surface like electrothermal systems. However, these systems need an energy source and increase the operating costs [4]. In recent studies [5–10] SH coatings have shown potential anti-icing technology as a result of extreme water repellency.

This paper studies the differences between surfaces with SH coating and those without. To determine the differences, British pendulum numbers (BPN) from coated and uncoated samples were compared. Wet samples were located in a cold cabin to determine the behaviour against the conditions and either freezing occurs. Additionally, a small area was SH coated and observed to determine what happens during driving on the coating.

An introduction to superhydrophobic coating is followed by the specifications of the pavement after coating. Then British Pendulum Tests were done and given in the third section. Last, of all, the effect of the traffic loads to the coating was determined and shown in the Accelerated Pavement Test section and the results are discussed and listed as bullet points in the conclusion.

2. Superhydrophobic coating of the surface

A superhydrophobic (SH) two stage solution was sprayed on the samples for SH coating. The layer-by-layer coating method is used for the coating. The first was a base coat solution and the other a top coat. The first stage of the coat solution was applied for supplying the adhesion between the surface and the top coat, where the top coat is the main solution which provides repellency. Both of the solutions are sprayed onto the surface for 5 seconds long. Then water drops with a diameter interval of 5–6 mm (0.06–0.11 millilitres) have been fallen on the surface. As seen in Fig. 1, when the two-stage SH coating is applied on the surface the coated surface turns blue and the contact angle of the water between the surface increases tremendously.



Fig. 1. Contact angles of water on (a) uncoated and (b) SH coated surface.

Such a huge contact angle causes the water drops to roll so no puddles are formed while the uncoated surface holds the water drops and allows puddles to form which causes hydroplaning and also the water on the uncoated surface leaks into the asphalt surfaces which harms the pavement by the freeze-thaw cycle.

3. British pendulum tests on samples

Resistance to motion of a surface contacting another surface can be defined as friction. The resistance can be measured by a coefficient of friction. On a highway, traffic friction occurs between tires and the road which allows individuals to steer, brake, accelerate and stay on the road [11].

Download English Version:

<https://daneshyari.com/en/article/5027916>

Download Persian Version:

<https://daneshyari.com/article/5027916>

[Daneshyari.com](https://daneshyari.com)