Evaluation of nano SIO2

effects on Self-Healing asphalt mixture using taguchi method

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Abstract

Nano particles include some specific properties such as a high specific area and present an inherent potential to improve bonding of bitumen materials. Nowadays, the technology of producing nano-sized particles is developing and the application of them in various aspects of civil engineering is becoming more cost effective. In this study, the effect of some parameters such adding nano SiO_2 particles on improving of Self-Healing asphalt concrete were investigated using the Taguchi method. To simulate traffic-damaging loads and to determine the Healing Index (HI), Superpave Indirect Tensile Fatigue Tests (IDT) was applied in a system with two phases; damage and healing. For all specimens, an IDT test was carried out which led to the creation and propagation of micro cracks until reaching specific damage level (20% decreasing resilient modulus). Next, the specimens were unloaded (the healing phase; recovering resilient modulus) and during two phases the resilient modulus was measured. The Healing Index (HI) was introduced using the resilient modulus variation.

Key words: nano SiO2, Healing Index, Taguchi method, hot mix asphalt, resilient modulus

Introduction

Nowadays, because of their inherent properties such as high specific area, nano particles are used in a wide range of applications. It has been proved that due to the purity and size of nano particles, they enjoy fewer defects in comparison with bulk materials. So, it can be said that these particles are much stronger than bulk materials. Moreover, the bonding strength would be increased using nano particles [1]. When a micro-crack is created in asphalt concrete, nano particles act as a bridge and prevent the crack from widening and propagating [2]. Adding nano particles to bitumen increases its adhesion to the aggregates, so crack initiation and propagation are delayed [3].

Asphaltenes particles (solid parts of asphalt) are nano sized and floated as colloids in Malten (liquid parts of asphalt) [4]. If using nano-sized fillers improves the