



Moisture Susceptibility of Asphalt Concrete Pavement Modified by Nanoclay Additive

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Abstract

Durability of hot mix asphalt (HMA) against moisture damage is mostly related to asphalt-aggregate adhesion. The objective of this work is to find the effect of nanoclay with montmorillonite (MMT) on Marshall properties and moisture susceptibility of asphalt mixture. Two types of asphalt cement, AC(40-50) and AC(60-70) were modified with 2%, 4% and 6% of Iraqi nanoclay with montmorillonite. The Marshall properties, Tensile strength ratio (TSR) and Index of retained strength (ISR) were determined in this work. The total number of specimens was 216 and the optimum asphalt content was 4.91% and 5% for asphalt cement (40-50) and (60-70) respectively. The results showed that the modification of asphalt cement with MMT led to increase Marshall stability and the addition of 6% of MMT recorded the highest increase, where it increased by 26.35% and 22.26% for asphalt cement(40-5) and(60-70) respectively. Also, the addition of MMT led to increase moisture resistance of asphalt mixture according to the increase in TSR and IRS. The addition of 4% and 6% of MMT recorded the highest increase in TSR and IRS for asphalt cement (40-50) and (60-70) respectively, where they increased by 11.8% and 17.5% respectively for asphalt cement (40-50) and by 10% and 18% respectively for asphalt cement (60-70).

Keywords: Moisture Susceptibility; Nanoclay; Montmorillonite (MMT); Tensile Strength Ratio (TSR); Index of Retained Strength (ISR).

1. Introduction

Moisture damage is a failure mode that have an effect on a great number of pavements around the world. The damages of moisture can be considered as a distresses that affect on society in different ways. Economically, moisture damage costs millions of dollars for maintenance and rehabilitation of the damaged pavements [1, 2]. In asphalt pavements which are exposed to moisture infiltration, detachment of the aggregate from the mix is usually the main problem [3]. The continuation the action of moisture with high traffic load cause weakening in the mechanical properties of asphalt mixture which causes a gradual dislocation of the aggregate and asphalt, in some cases, this type of damage becomes a Prevailing failure and a cause for diminish road safety [4]. The type of this damage is known as stripping or ravelling of the wearing layer of asphalt mixture. The damage caused by initial stripping can rapidly develop into a more intense disintegration of the wearing surface, and lastly lead to pothole formation as shown in Figure 1 [5]. The moisture damage in asphalt pavement can cause two types of failures: loss of asphalt-aggregate adhesion and loss of cohesion within the asphalt binder [6]. Figure 2 show the failures caused by moisture damage.

The use of nano-materials in asphalt mixtures presents one of the most attractive options [7]. According to the

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