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The Effect of Low-Density Polyethylene Addition and Temperature on Creep-recovery Behavior of Hot Mix Asphalt

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Abstract

Industrial and domestic plastic waste is second harmful products to the environment. Considering the technological development and the current way of life, this non-biodegradable waste and its enormous quantities threaten the balance of the ecosystem and human health. The present study was an attempt to investigate the effect of Low-density polyethylene "LDPE" plastic waste, used us asphalt additive, on creep-recovery behavior of Hot Mix Asphalt (HMA). This technique is a contribution to the improvement of the quality and cost of HMA, for alternate materials. In this experimental study, two mixes of asphalts were prepared, basic and modified asphalts, and tested in four points bending test at two different temperatures, medium (20°C) and high temperature (50°C). The use of 5 % of LDPE gave a better thermo-mechanical performance. As well as, a decrease in total deformation by 51 % and 13 % at 20°C and 50°C respectively. A clear improvement of the resistance to the creep permanent deformation, rigidity and lasted in life. This modification serves a powerful, economic and environmental solution for road construction of hot Saharan areas at medium and high temperature of service.

Keywords: Creep-recovery Deformation; Hot Mix Asphalt; Plastic Waste; Modification; Temperature; Performance.

1. Introduction

Hot mix asphalt (HMA), is a type of highway flexible pavement material, formed by mixing of aggregate and bitumen at certain ratios and compacting the resulting mixture at a certain temperature [1]. Researches have cited various factors that affect flexible course performance like the component properties (binder, aggregate, as well as additive) and their proportion in the mix [2]. Asphalt pavement is exposed to a variety of destructive factors, which lead to reduction of their shelf life over time. Considering the high cost of pavement building operations, some necessary measures should be taken to avoid asphalt destruction and mitigate pavement failures [3].

Given the rapid development in various activities, Today plastic is everywhere in our way of life. The use of such non-biodegradable material show that plastic can remain unchanging for 4,500 years in the earth and has generated large volumes of domestic and industrial plastic waste that threaten our environment and the life of humanity, flora and fauna [4]. It is the intention of scientists and researchers, as well as people in authority, to explore waste material recycling for environmental, economical advantages and also the possibility of solid waste reuse in road construction. Reusing waste materials can make a significant contribution to the environment and economy from different aspects, [5, 6].

The first patent registration of asphalt modification processes with both synthetic and natural polymers date back to 1843. Furthermore, experimental projects had already commenced across Europe in the 1930s .The use of modified

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