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Effect of LDPE in Rutting Characteristics of Asphalt Concrete mixtures

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Abstract

In recent years, different kinds of polymers such as SBS, SBR, Sasobit, etc have been used to modify the properties of asphalt binders. These additives can change the mechanical properties of Asphalt Concrete (AC) mixtures to some extent but most of them are expensive and the blending process with bitumen requires special equipment and conditions. In this paper the use of low-density polyethylene (LDPE) in enhancing the AC mixture properties is discussed. In comparison with other polymer modifiers, the LDPE is relatively cheaper in the Iran market. It also does not require any special condition in mixing with bitumen. Based on the tests conducted and the model presented in this research, the results suggest that adding LDPE can improve the rutting characteristics of asphalt concrete.

Keywords: modified-bitumen, low-density polyethylene (LDPE), HMA, asphalt properties.

1. INTRODUCTION:

Most of the portion of urban and rural roads comprise of asphalt concrete. Actually, the increase in traffic loading and the number of vehicles together with the adverse environmental conditions, conduce to a rapid structural damage of pavements. In order to enhance the mechanical properties and the long term performance, a new generation of binder blends has been developed through the incorporation of different kinds of polymers [1–3]. On the other hand, the use of polymer-modified asphalts (PMA) allows the construction of safer roads and leads to an important reduction in maintenance cost [4]; these advantages compensate the major cost of the PMA obtained.

One of the main distresses in asphalt concrete pavements is rutting or permanent deformation of pavement layers. Rutting is caused by consolidation and/or lateral movements of the pavement layers under the traffic loading. It is categorized as a load induced distress and is resultant of the accumulation of small deformations due to change in volume of asphalt concrete and the underlying layers (i.e. densification) and rearrangement aggregate particles caused by shear flow. Rutting affects ride quality, safety and general performance of pavements [4, 5]. In addition of traffic load, it is proved that temperature has great effect on the rutting characteristics of hot mix asphalt (HMA). This effect is more critical in higher temperatures.

In the late 1970s, Europe was ahead of the United States in the use of modified asphalts because the European use of contractors, who provided warranties, motivated a greater interest in decreased life cycle costs, even at higher initial costs. The high preliminary expenses for polymer modified asphalt limited its use in the US [5].The polymers used for asphalt modification can be divided into three broad categories, namely, plastomers, elastomers, and rubber. Globally, approximately 75% of modified binders can be classified as elastomeric, 15% as plastomeric, with the remaining 10% being either rubber or miscellaneously modified [6]. Plastomers include ethylene vinyl acetate, polyethylene (unstabilized and stabilized) and various compounds based on polypropylene [7]. These products may require high shear mixing, which depends on the modification process. They increase the viscosity and stiffness of bitumen at normal service temperatures. Elastomers (rubbers) include natural rubber, polybutadiene, polyisoprene, isobutene-isoprene Copolymer, polychloroprene, styrene butadiene copolymer and styrene butadien styrene block copolymer [8]. These products are normally milled into the asphalt binder at temperatures above 160°C by a high shear mixer.

Many works have been done in assessing the laboratory performance investigation of the aforementioned modifiers. Tayfur et al examined the rutting characteristics of asphalt concrete specimens modified with Amorphous polyalphaolefin, cellulose fiber, polyolefin, bituminous cellulose fiber and styrene butadiene styrene (SBS) and showed that the SBS modified mixtures were the most rutting resistant among the others