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Assessment of Moisture Susceptibility for Asphalt Mixtures Modified by Carbon Fibers

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Abstract

Moisture induced damage in asphaltic pavement might be considered as a serious defect that contributed to growth other distresses such as permanent deformation and fatigue cracking. This paper work aimed through an experimental effort to assess the behaviour of asphaltic mixtures that fabricated by incorporating several dosages of carbon fiber in regard to the resistance potential of harmful effect of moisture in pavement. Laboratory tests were performed on specimens containing fiber with different lengths and contents. These tests are: Marshall Test, the indirect tensile test and the index of retained strength. The optimum asphalt contents were determined based on the Marshall method. The preparation of asphaltic mixtures involved three contents of carbon fiber namely (0.10%, 0.20%, and 0.30%) by weight of asphalt mixture and three lengths including (1.0, 2.0 and 3.0) cm. The results of this work lead to several conclusions that mainly refer to the benefits of the contribution of carbon fibers to improving the performance of asphalt mixtures, such as an increase in its stability and a decrease in the flow value as well as an increase in voids in the mixture. The addition of 2.0 cm length carbon fibers with 0.30 percent increased indirect tensile strength ratio by 11.23 percent and the index of retained strength by 12.52 percent. It is also found that 0.30 % by weight of the mixture is the optimum fiber content for the three lengths.

Keywords: Asphalt; Moisture Damage; Carbon Fiber; Compressive Strength; Indirect Tensile Strength.

1. Introduction

Asphalt pavements deteriorate over time because of the combined effect of traffic loading and the environment. The service life of asphalt pavements can even be cut short if quality materials are not used in the hot mix asphalt (HMA) design and manufacturing [1]. In recent years, researchers have used different types of additives to improve the performance of the asphalt mixture. Scientists and engineers are permanently trying to improve properties of asphalt mixtures, such as their stability and durability, by incorporating new additives either in the bitumen or in the asphalt mixture [2, 3]. The addition of polymers is a common method applied to modify the binder, although different types of fibers have been evaluated [4]. However, it has been claimed that among various modifiers for asphalt, fibers have gotten much attention due to their improving effects [5]. In asphalt concrete (AC), fibers have been added to prevent draindown or raveling of porous asphalt and stone matrix asphalt, and to improve resistance to cracking and rutting [6]. Adding fibers to the binder or the bituminous mixtures ensures their stability and mechanical strength [7].

The types of fibers that have been investigated to date are polymeric fibers (polyester, polypropylene, polyacrylonitrile), organic fibers (cellulose, lignin, date-palm, oil-palm), mineral fibers (asbestos, rock wool), waste

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