The Use of Waste Plastic in Hot Asphalt Mixes

A Thesis
Submitted to the Public Works Department
Faculty of Engineering
Ain Shams University
for the Fulfillment of the Requirements of M. Sc. Degree
In Civil Engineering (Highways and Traffic)

Prepared by

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B.Sc. in Civil Engineering, July 2014
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DEDICATION

I would like to dedicate this work to ***My Parents; My Father and My Mother*** for their help, support, patience and encouragement to finish this work,

GOD BLESS THEM.

I would also like to thank both of my ***Brothers Hasan and Mohamed*** for their big support and help in my work.

Finally, I would like to dedicate this thesis to my ***Great Wife Ashrakat*** for her huge role in my life, for her support and encouragement which gave me all the reasons to complete this work.

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Statement

This dissertation is submitted to Ain Shams University, Faculty of Engineering, public works department for the degree of M. Sc. in Civil Engineering (Highways and Traffic).

The work included in this thesis was carried out by the author in the department of Public Works, Faculty of Engineering, Ain Shams University, from 2015 to 2018.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

Date ……. /……. /2018

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Abstract

Nowadays, plastics are used in almost every day of our lives. Every sector of the economy utilizes plastic starting from agriculture to packaging and building construction. Also, plastics are very versatile and almost applicable in every industry, the utilization of plastics causes a huge environmental problem as they are non-biodegradable as researchers found that plastics can remain on earth for 4500 years without degradation.

The issue of disposing waste plastics (WP) began to surface as they are usually disposed by landfilling or incineration. However, banning plastics is not economically feasible. Thus, it is very vital to reuse WP.

As a result of the urbanization and the huge industrial development, the traffic loads and volumes increased greatly which caused many distresses on the conventional flexible pavements. Thus, researchers began to modify the conventional hot mix asphalt (HMA) to face the new traffic demand. One of the ways to modify HMA was by including polymers in the HMA which improved the engineering characteristics of the HMA. However, virgin polymers are very expensive and increases the cost of HMA production. That is why, a tendency began to appear to use waste polymers instead of virgin polymers in modifying the HMA which is feasible from the environmental and the economic point of view.

This research studied the effect of incorporating WP into the HMA. Three different methods and two different WP materials were utilized to incorporate WP into a 4-C surface mixture. In the first and the second method five different percentages of WP were added to the aggregate blend then hot bitumen was added to the mixture, the only difference between the two methods was that the bitumen content was reduced by the weight of added WP in the first method.

In the third method five different percentages WP were added to the hot bitumen then aggregate was added to the blend. The modified mixtures were tested to evaluate their performance in accordance with the Egyptian Code of Practice (ECP 2008).

The results indicated that the third method was better and that the optimum waste plastic content is 4% for the first WP material and 3% for the second WP material. It should also be noted that the engineering characteristics of the mixture modified using the third method improved a significant improvement.

After determining the optimum waste plastic content for the modified mixtures, two specimens of the modified mixtures were prepared for each optimum waste plastic content and two specimens of the conventional mixture were prepared. Then, the dynamic modulus test was conducted on the prepared specimens to evaluate their performance.

Key Words:

Marshall, Indirect Tensile, Hot Mix Asphalt, Dynamic Modulus, Flow Number, and Waste Plastic

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