8th National Congress on Civil Engineering, 7-8 May 2014
Babol Noshirvani University of Technology, Babol, Iran

Laboratory evaluation of moisture sensitivity of warm mix asphalt containing steel slag

Saeid Hesami[1], Mahmoud Ameri[2], Hadi Goli[3]

1- Department of Civil Engineering, Noushirvani Institute of Technology, Babol, Iran
2- Department of Civil Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran
3- Department of Civil Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran

Hadig_66@yahoo.com

Abstract

In recent years, reductions on pollutant emissions, efficiency of energy consumption, and application of novel aggregates have been the most important goals for asphalt industries. Production of Warm Mix Asphalt (WMA) and steel slag (SS) asphalt were some of the efforts in this way. According to the importance of moisture damage in WMA and steel slag asphalt mixtures, moisture susceptibility of the WMA mixtures containing steel slag was evaluated in this research study. Two empirical methods (Tensile Strength Ratio (TSR) and Resilient Modulus Ratio (RMR)) were used to evaluate the moisture susceptibility of the mixtures. Results indicated that the application of steel slag aggregates in WMA mixtures reduced the moisture susceptibility of the mixtures. However, mixtures containing limestone aggregates showed better RMR results than mixtures containing SS. This difference in obtained results refers to the shortcomings of empirical methods for evaluation of moisture susceptibility in asphalt mixtures.

Keywords: Steel slag, Warm mix asphalt, Sasobit, Bitumen, Mixture

1. INTRODUCTION

In recent years, preservation of the natural environment and reducing the energy consumption is one of the most important challenges for scientists. Preservation of natural environment is a very important factor in sustainable development [1]. As one of the basic products in road construction, it is important to evaluate both environmental compatibility and performance of asphalt mixture [2]. Considering the compatibility of asphalt concrete construction with the principles of sustainable development, researchers are seeking for new ways to reduce construction cost, and lower emissions. The production temperature and aggregate cost are the factors that have significant effects on cost and environmental compatibility of asphalt mixtures [3,4]. As the production temperature increases, it results in greater the emissions and cost [5]. Therefore, scientists have developed a number of new technologies for asphalt materials generally referred to as warm mix asphalt (WMA), which produce asphalt mixture in the temperature range of 100 ºC to 140 ºC, without compromising the workability and mechanical performance attained [6]. There is also numbers of benefits in warm-mix asphalt production including: Environmental benefits (Lower plant emissions and fumes), Economic benefits (Reduced energy consumption and financial cost), Paving benefits (Improved workability and compaction efficiency, provision of longer haul distances, and quicker turnover to traffic due to shorter cooling time, and Production benefits (Increased Recycled Asphalt Pavement (RAP) content and location of plant site in urban areas) [6].

On the other hand to satisfy the need for natural stone materials, which is needed for construction, reconstruction, and repairs of road pavements, a wide range of industrial waste as secondary resources have been utilized [7].Among wastes used as road building material, steel slag (SS) is one of the most popular one, due to certain environmental saving properties including: preservation of natural ecosystem by means of reducing the amount of dumped wastes, and allowing reducing the consumption of natural aggregate in asphalt concrete production every year [8].

Resistance of the asphalt mixture to moisture damage is one of the most important characteristics of asphalt mixtures [9]. Presence of moisture in asphalt concrete can weakens bonds between the aggregate and bitumen leading to adhesive and also cohesive deterioration of the mixture and decrease in load carrying capacity of asphalt pavement [9,10]. Lower production temperature in WMA mixtures leads to the presence of moisture on aggregates and increases the moisture sensitivity of WMA mixtures [11].

In this research study after determination of the optimum bitumen content (OBC), four types of WMA mixtures and two types of HMA mixtures were evaluated for their moisture sensitivity. The Indirect Tensile