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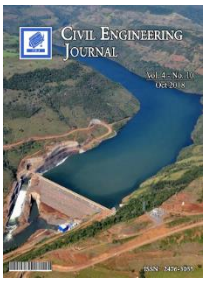

Deformation and Resilient Behavior of Hot and Warm Mix Asphalt Concrete

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Abstract

Development of hazardous gases emissions through the production and construction of Hot Mix Asphalt (HMA) have encouraged the transition to Warm Mix Asphalt (WMA) which is considered as one of the best choices of sustainable materials in asphalt pavement. The temperature reduction in the mixing, handling, and compaction of the mix gets in saving energy, cutting emissions and significant cuts in construction costs. In this investigation, two WMA mixtures have been prepared in the laboratory using medium curing cutback (MC-30) and cationic emulsion asphalt. HMA mixture was also prepared for comparison. Marshall size Specimens of (101.6 mm) in diameter and (63.5 mm) in height were constructed from these mixtures and subjected to repeated Indirect Tensile Strength test (ITS) to determine the effect of asphalt type and content on deformation and resilient behavior of asphalt mixture. Another group of cylindrical specimens of (101.6 mm) diameter and (101.6 mm) in height have been constructed from these mixtures and subjected to repeated compressive stresses test to determine the rutting resistance of asphalt mixture. Test results were analyzed and compared. It was concluded that, the permanent deformations for cutback and emulsion treated WMA was higher than that of HMA by (50 and 35) % respectively. The Resilient Modulus (Mr) at 25 ^{0} C under repeated (ITS) for cutback and emulsion treated WMA was lower than that of HMA by (39.95 and 27.94) % respectively. On the other hand, the (Mr) for cutback and emulsion treated WMA was higher than that of HMA by (43.75 and 5.47) % respectively under repeated compression load at stress level 0.138 (MPa).

Keywords: Warm Mix; Emulsion; Cutback; Indirect Tensile Strength; Rutting Resistance; Resilient Modulus.

1. Introduction

The general expression of WMA refers to the variety of mixtures which are produced at temperatures (20-30 °C) less than the typical production temperature for HMA. The lower temperature of the WMA offers sustainable and environmentally friendly mixture as compared with HMA by reducing the fuel consumption and greenhouse gas emission [1]. The fundamental concept of the WMA is to decrease the mixing and compaction temperatures of the mixture through reduction of viscosity of the asphalt binder. WMA principally does not differ from HMA. It still includes of asphalt binder, aggregates, filler and liquid asphalt, however, the difference precisely lies in the temperature applied to obtain appropriate mixing and workability [2]. The low production and paving temperature of WMA significantly reduce the emissions and fumes, [3]. Every 11^{0}C decrease in mixing temperature causes the emissions in the atmosphere, decreasing to half [4], this is a fundamental decline in the carbon footprint of the asphalt production plant taking into consideration the existing equipment can still be used, [5]. The energy consumption of WMA production is typically (60-80) % lower than HMA production, [6]. Lower production temperatures can also potentially

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