



## The Effect of Using Sustainable Materials on the Performance-Related Properties of Asphalt Concrete Mixture

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### Abstract

Sustainability is very important in this world at this time. One of the best materials used for sustainability in asphalt concrete pavements is the warm mix asphalt (WMA) as well as the reclaimed asphalt pavement (RAP). WMA technology has the ability to reduce production temperature to reduce the fuel usage and emissions. RAP is the old concrete asphalt mixture that is out of service and using it again leads to preservation of the virgin material. This search studied the viability of using WMA with different percentages of RAP (10%, 30%, and 50%) and compared them with control hot mix asphalt (HMA) and WMA. The Marshall properties, Tensile strength ratio (TSR), rut depth and fatigue life were determined in this work. The results showed that the tensile strength ratio (TSR) for HMA was better than that for WMA by 6%, rut depth for HMA was (4.37 mm) lower than that for WMA was (6.5mm), better fatigue life was obtained for WMA was (700 cycle) as compared to HMA was (500 cycle). In case of WMA with RAP (WMA-RAP), when the percentage of RAP increased with WMA, the moisture damage resistance improved by 2.5%, 13.3% and 15.4% for G1, G3 and G5 respectively, also the rutting resistance improved by 34.6%, 48% and 62.3% for G1, G3 and G5 respectively, but deteriorated of fatigue life by 45.8%, 74% and 88.5% for G1, G3 and G5 respectively.

*Keywords:* WMA; RAP; Marshal's Properties; TSR, Wheel Truck; Rutting Resistance; Flexural Beam Fatigue Testing; Fatigue Resistance.

### 1. Introduction

The Warm Mix Asphalt (WMA) is a novel method to save energy and environment-friendly protection by lowering the mixing and compaction temperatures, with relatively lesser consumption of energy and emission of exhaust when compared with the conventional hot mix asphalt (HMA). The WMA technologies have the ability to decrease production temperature (15°C to 40°C)[1]. As shown in Figure 1, in recent years, environmental protection is becoming an important factor in transport engineering, especially asphalt production. Even with the HMA used significantly in all the countries, some current researches recommend using different technologies that decrease the production temperature of asphalt mixtures. This technology is called the WMA, and it is generally used in the United States [2]. RAP is a method of reuse of materials from the existing asphaltic roads that has no ability to serve the future traffic. RAP can be used a sustainable technology, because it reduces emissions and reduces economic cost. When pavement mixtures deteriorate, they can be removed or recycled. The utilization of RAP can be considered environmentally friendly, because this technology reduces the use of natural resources and may perform better than the virgin asphalt mixtures [3].

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