A Review Study on Use of Reclaimed Asphalt Pavement (RAP) Materials in Flexible Pavements

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***Abstract*: The increasing amount of waste all over the world has shown that effective measures have to be implemented to reduce their negative environmental impact. Land filling of waste is not a solution, due to danger of leaching and soil impregnation with potential subsequent contamination of underground water. On the other hand, there is important sustainability benefits associated with the use of recycled material in pavement industry. Recycling helps the environment by reducing resource extraction and the use of virgin material, thereby reducing energy and water use, reducing harmful gas emissions and helping reduce waste to landfills. Buying recycled products also in some cases can reduce cost. Therefore, the utilization of recycled material for aggregate will represent an important opportunity to save virgin material and divert material away from landfills. Because of the large amount of construction waste generation around the world, using recycled construction aggregate (RCA) in asphalt mixtures appears to be an effective utilization of RCA. However, as aggregate plays an important role in the final performance of the asphalt mixture, an understanding of their properties is essential in designing an asphalt mixture. This paper presents a review study to utilization of Reclaimed Asphalt Pavement (RAP) Materials in Flexible Pavements.**

***Keywords*: Reclaimed Asphalt Pavement (RAP), Flexible Pavements, Environment**

1. INTRODUCTION

Large quantities of Reclaimed asphalt pavement (RAP) materials are produced during highway maintenance and construction. A part of this can be used in new hot mix asphalt concrete and rest is available for other uses. If these materials could be re-used in base and sub-base of the roads, resulting in minimization of environmental impact, reduce the waste stream and also transportation costs connected with road maintenance and construction activities. The properties of RAP materials can be improved by blending of aggregates and by addition of chemical stabilizers. In recent years there was a gradual increase in construction and demolition wastes. It has resulted in waste disposal problem due to shortage of available landfills. Reuse of these materials after proper recycling can be the right solution for the same. There will be a reduction in cost about 25 to 30% by reusing the recycled road aggregate generated at same site. Before using such materials the mechanical properties must be tested and suitable blending is done if required. The most used recycled materials are Reclaimed asphalt pavement (RAP) materials and recycled concrete aggregate (RCA). The generation of RAP and RCA result in an aggregate of high quality and grading. Due to coating of asphalt on the aggregate of RAP it reduces the water absorption in aggregates.

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2. LITERATURE REVIEW

Md. Akhtar Hossain et al studied the Effect of Water Submergence on the Characteristics of Bituminous Mixes Using Reclaimed Asphalt Pavement. The main purpose of this study is to investigate the effect of water on the use of reclaimed asphalt pavement materials in bituminous mix and to determine the optimum percentage of reclaimed asphalt pavement materials with virgin pavement materials and optimum days of water submergence according to the Marshall Mix design criteria based on medium traffic condition. To achieve the objectives of this study the basic properties tests were performed on the studied materials and then Marshall Test was conducted on asphalt mixtures with different percentages of reclaimed asphalt pavement materials with optimum

bitumen content determined for 100% fresh aggregate. The different percentages of reclaimed asphalt pavement material in asphalt mixtures are 0%, 10%, 20%, 30% and 40%. Marshall Criteria was satisfied up to 20%. Then the specimen prepared with 20% reclaimed asphalt pavement material was submerged in water at 0, 5, 10, 15 and 20 days. Optimum days of water submergence were 15 days on the basis of Marshall Mix design criteria.

Brajesh Mishra et al studied the Use of Reclaimed Asphalt Pavement (RAP) Materials in Flexible Pavements. In this study sample of Reclaimed asphalt pavement (RAP) materials were collected and analysed for suitability of their usage in flexible pavements. Their characteristics including gradation, California Bearing Ratio(C.B.R).Aggregate Impact value, Aggregate Crushing value, Specific gravity, Flakiness & Elongation Index, Loss Angles Abrasion value, Water absorption and soundness were determined and compared to the MORTH specifications. Form the study it was found that the RAP materials can be effectively used in the soil sub-grade, sub-base and base of the flexible pavements resulting in reduction of the construction cost. The main objective of the study is to find out suitability of Reclaimed asphalt pavement (RAP) materials to be used in construction of flexible pavements. To perform experimental investigations to assess the values of related parameters and their technical viability.

Siksha Swaroopa KAR et al studied the impact of recycled asphalt pavement on properties of foamed bituminous mixtures. This study presents results from a study where foamed bitumen mixtures conforming to Indian specifications were evaluated. For this purpose, foamed bitumen mixtures using a different percentage of reclaimed asphalt pavement and bitumens were prepared. Initially, the foaming characteristics of virgin bitumens were evaluated to optimize for optimum water content and foaming temperature. In the second stage, mixture design was conducted to optimize for foamed bitumen content in foamed bitumen mixtures containing a different percentage of reclaimed asphalt pavement. Finally, these foamed bitumen mixtures were evaluated for their mechanical properties. The results from this laboratory study indicated properties of foamed bitumen and foamed mixtures are significantly influenced by properties of bitumen, the quantity of bitumen, and reclaimed asphalt pavement. Among the different mixtures, a mixture containing 50% reclaimed asphalt pavement exhibited best results in resilient modulus and resistance to moisture damage tests. A mixture containing 80% reclaimed asphalt pavement also shows acceptable strength and resistance to water susceptibility. Thus, it is possible to design high-quality bituminous mixes using higher reclaimed asphalt pavement percentages, which meet the required volumetric and desired performance criteria.

Burak Sengoz et al stated the Performance Evaluation of Warm Mix Asphalt Mixtures with Recycled Asphalt Pavement. This paper shows the feasibility of utilizing four different WMA additives (organic, chemical, synthetic zeolite and natural zeolite) with different rates of RAP. Following the determination of optimum RAP content corresponding to each WMA additive, Marshall Analysis, indirect tensile stiffness modulus and fatigue behavior of HMA and WMA involving RAP were analyzed and compared with control specimens. Hamburg wheel tracking device was also utilized to evaluate the permanent deformation characteristics of mixtures containing optimum RAP content. In this research, RAP has been used (at contents of 10–50%) within both HMA and WMA mixtures. Each type of WMA mixture has been prepared with an optimum rate of WMA additive that is based on the recommendation of manufacturers (organic additive at a rate of 3%, chemical additive at a rate of 2% and two types of water containing additives at a rate of 5% by weight of the bitumen). The mechanical performances of the samples were evaluated by Marshall Stability test. Following the determination of optimum RAP content regarding each mixture involving four different types of WMA additive, indirect tensile stiffness modulus (ITSM) and fatigue behavior of WMA and HMA containing optimum RAP content were analyzed and compared with control specimens. Hamburg wheel tracking device was also used to determine the rutting properties of mixtures involving optimum RAP content.

Maulik Rao et al studied the utilization of recycled asphalt pavement in the Urban Area at Surat, Gujarat, India. The main / primary objective was to justify the cost of milling and to make it viable option so that the same can be used effectively. Some practical options to use the RAP material in urban areas are discussed in this study and thereby achieving economy in the construction besides solving the raised level of roads, effective disposal of RAP and above all using the principles of environment friendly Green technology that is: Reduce, Reuse and Recycle. The practical study shows the definite impact on replacement of virgin material for various road constructions. The CBR values increasing to 2, 3.8 and 6.8 % respectively by 20, 40 and 60 % RAP mixing in black cotton soil surely work for improved sub-grade.

CONCLUSION

Based on various literature reviews study, Following conclusions are drawn:

1. The aggregate interlocking effect results in a rut resistant layer with high stability and high skid resistance.
2. The percentage of air voids is decreased as the reclaimed asphalt content increased.
3. The voids filled with bitumen increases with increase in the bitumen Content.
4. Stability and flow also increase with increasing reclaimed asphalt
5. The use of RAP in road base and subbase layers is technically viable.
6. There is a general lack of uniformity among the RAP use specifications adopted by various transportation agencies.

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