

A REVIEW PAPER ON USE OF RAP WITH FLY ASH IN BITUMINOUS CONCRETE

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Abstract: The recycling of hot mix asphalt material results in a reusable mixture of aggregate and binder known as reclaimed asphalt pavement (RAP). Recycling of asphalt pavements is a valuable approach for technical, economical, and environmental reasons. Having recognized to be beneficial, gradually its application is picking up in India. However the optimum benefits are yet to derive and this is mainly due to lack of research work and proper guidance. Similarly Fly ash which is a combustion by-product has number of applications in civil construction. The use of fly ash in highway construction is increasing day by day and new applications have been developed. Fly ash is a finely divided residue that is generated in electric thermal power plant due to the combustion of the pulverized coal. The objective of this study is to understand the importance of using RAP along-with fly ash for the construction of bituminous pavements. From this study and from previous research papers it can be concluded that using RAP is advantageous as RAP mixes can yield results equal or even better than virgin mixes. If calculated and implemented appropriately RAP mixes with Fly ash have a constructive effect on various parameters like Marshall Stability, moisture resistance and density. This paper presents the importance of using RAP and fly-ash in bituminous mixes.

Index Terms- RAP, Fly Ash, Marshall Stability, Moisture resistance, Density, Bituminous Concrete.

I. INTRODUCTION

Reclaimed asphalt pavement (RAP) is defined as removed pavement materials containing binder and aggregates. These materials are generated when bituminous pavements are removed for reconstruction or resurfacing. When properly extracted and screened, RAP consists of high-quality, well-graded aggregates coated by bitumen. Using RAP material will lead to financial as well as environmental benefits. Although most of the produced RAP is recycled, a large portion of it is wasted or down-graded when used in landfills, embankment or base layers. A review of previous research paper shows that RAP of various percentages have been used in the construction of bituminous pavement varying from 10 to 70%. In rare cases up to 80% of RAP has been successfully used. The percentage of RAP used will depends upon many factors like source of the recycled material, residual binder content and the type of layer where it is going to be used. Use of 100% RAP will never be recommended. Recycling of asphalt pavements is a valuable approach for technical, economical, and environmental reasons. Though it is beneficial, the usage of RAP is gaining importance in India and need to build confidence by more research.

II. ADVANTAGES OF USING RAP MIXES

Reclaimed asphalt pavement has a variety of benefits both for the governments as well as for the contractors. The benefits can be further classified into two categories:

- a) Environmental benefits
- b) Economical benefits
- c) Technical benefits

They are explained briefly below:

a) Environmental benefits

It may reduce dependency on natural material like stone, binder etc. Reuse of RAP reduces the construction waste and reduces the stresses on the landfill sites. It also helps to reduce the consumption of natural resources, therefore conserve the natural materials. Excess consumption of aggregate resulted into heavy mining and have caused severe ecological problem in Rajasthan and other places.

b) Economical benefits

Taxpayer's money can be saved by recycling of asphalt, and contractors can save their money by saving on reducing energy and material requirements.

c) Technical benefits

An engineered approach to determine the optimum quantity of recycled material can in fact enhance the properties of bituminous mixes.

III. PROCESS ADOPTED FOR RECYCLING OF MATERIALS

Based on process adopted for recycling of materials, recycling can be done by four different methods:

- a) Hot mix asphalt (central processing facility)
- b) Hot mix in-place recycling
- c) Cold mix asphalt (central processing facility)
- d) Cold mix in-place recycling

They are explained briefly below:

a) Hot mix asphalt (central processing facility)

In this process hot mix using recycled material is produced at a central hot mix plant. The processed material is mixed with appropriate quantity of bitumen and aggregates under controlled heating conditions. After mixing the material is transported to the site, placed, and compacted in required thickness. The quality of produced mix is far superior to the other methods. This technique is suitable for our country as it doesn't require any additional specialized machinery, except a special feeder for recycled material.

b) Hot mix in-place recycling

In this process the surface of the existing pavement is softened with heat prior to the scarification. The scarified material is then mixed with new aggregates and compacted to the desired levels by using conventional compacting equipments. After compaction the recycled material is often covered with an overlay. This method is used to repair severely rutted pavements.

c) Cold mix asphalt (central processing facility)

This process is similar to that of hot mix asphalt central processing facility, the only difference between the two is in this process no need of heating, and therefore emulsion is used as a binder.

d) Cold mix in-place recycling

This process requires specialized plants or processing units, whereby the existing pavement surface is scarified. The scarified material is then mixed with suitable proportion of fresh aggregates and binder. Generally cold form bitumen cutback or emulsion is used.

IV. PROCESS OF USING RAP MIX

In early days pavements were scarified by excavators which gave huge blocks of RAP materials. Therefore it was difficult to use RAP materials in the construction of new pavements. Now with the development in technology, milling machines are available which scarify the pavement to desired depth thereby making the use of RAP materials much easier. The process of making RAP mix starts with the collection of RAP materials from the scarified pavement. The collected materials are then subjected to various tests like sieve analysis & residual binder content. The suitability of RAP is ascertained by blending it with virgin materials and then evaluating the performance characteristics of the mix by suitable test procedure e.g. Marshall Stability test. All the results of the tests of reclaimed materials along with virgin aggregates that have to be added are then analysed and an optimal percentage of RAP is defined. The process of construction of RAP is carried out as the same conventional method of construction of bituminous pavement.

Many researches performed on this topic revealed that:

- a) RAP can be successfully used for the construction of a new pavement as well as for rehabilitation of the existing pavement.
- b) Percentage of RAP depends upon the composition of reclaimed bituminous material and type of layer in which it is to be used.
- c) The optimum range of usage of RAP generally varies between 25-35% in bituminous mixes.
- d) In isolated cases RAP can constitute up to 70% of the material in new construction and even 100% RAP for rehabilitation work can be used. This however requires usage of Rejuvenator and recycled material relatively not too old.
- e) If it is processed and used appropriately RAP can fulfill the required standards either equal or higher than the conventional hot mix asphalt (HMA).

- f) Addition of fly ash up to 4% in Dense Bituminous Macadam (DBM) mix, by replacing conventional mineral shows a 7.5% reduction in optimum binder content compared to control mix.
- g) Utilizing RAP for the construction and rehabilitation work makes the project more economical and environment friendly. Reduction in the cost of project is directly proportional to the percentage of RAP used.
- h) Using Reclaimed Asphalt Pavement (RAP) conserve the natural resources.

V. SUMMARY AND CONCLUSION

Research will be carried out to find out the optimum percentage of RAP for wearing course, and to evaluate the strength and other engineering characteristics of RAP. Also, studies will be carried out to determine the optimum percentage of Fly ash that can be used as complete or partial replacement of the filler like stone dust. RAP is a new technology with the help of which bituminous pavements can be constructed at a reduced cost as it involves the usage of old bituminous pavement materials. Also it ensures optimization of resources and supports sustainable development. This study is important because the literature is unclear whether these two materials can be used in combination. Optimal percentage of RAP depends upon the composition of reclaimed bituminous material and type of layer in which it is to be used; though 20%- 50% can be adopted with 25%-35% being more common range.

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