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RECLAIMED ASPHALT PAVEMENT USING CERAMIC WASTE

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Abstract— In recent years a lot of new Invention create opportunities to use or utilize waste material in various construction field. Reclaimed Asphalt Pavement is one of the material which is generated for surfacing reconstruction from full or partially demolition of any pavement. In past year this RAP is using as a waste material by using this material for land filling or as a some soil stabilization but few Research happen on this material and they reach at positive result After removing all dust from wearing surface and successfully extraction from fine aggregate to bitumen, this fine aggregate and bitumen are partially use in pavement construction and maintenance of pavement as well. This material easily decrease the total cost of construction project. There are direct and indirect benefits of this material , direct benefits is to reduction in cost of pavement and another one is environment factor. RAP is one of the most recycled materials in the world. In United states, studies have resulted that 80% of the recycled material is used in roadway construction. Recent researches have established that RAP replacement at proportions above 55% is feasible to produce new HMA mixtures, and also obtaining satisfactory results in the mechanical properties . In addition to this ceramic wastage is also used as a fine aggregate to pavement construction.

Keywords— Reclaimed Asphalt Pavement, Methods and Tests, Ceramic waste.

I. INTRODUCTION

This Reclaimed Asphalt Pavement (RAP) is recycling material which is generated from Rehabilitation or reconstruction of pavement. This material contains fine aggregate and bitumen binder. These are large quantities which produced during a highway reconstruction maintenance as well.

The reuse of old Asphalt in the production of new asphalt mixes in certainly one of procedures that enable a more rational and environment friendly construction of new asphalt pavement. An Internationally accepted name of reused asphalt is the RAP (Reclaimed Asphalt Pavement). It is the Asphalt obtained by tearing, crushing of the existing old pavement. That contains about 80% of good quality and well graded bitumen aggregate.

First serious study were conducted in the late 1970s by the start of pilot project in the USA, as a result of an increasing awareness of the need of recycle. There are many reasons why reclaimed was considered important at that time. The most significant was steep increasing price of bitumen and so it become important to find a way to use the old asphalt. The use of recycled asphalt in new mixes in now days considered as one of the most widest use of a waste material. In the USA the asphalt ranks first in terms of reuse when compared to their alternatives materials more then 80% of old asphalt is actually reused. In Europe the RAP is extensively used in Denmark, France, Sweden and Germany and a specially interesting example in the Netherland where the proportion of old pavement in the production of asphalt mix stands at 30 to 40%.

II. METHODS OF RECLAIMATION OF PAVEMENT

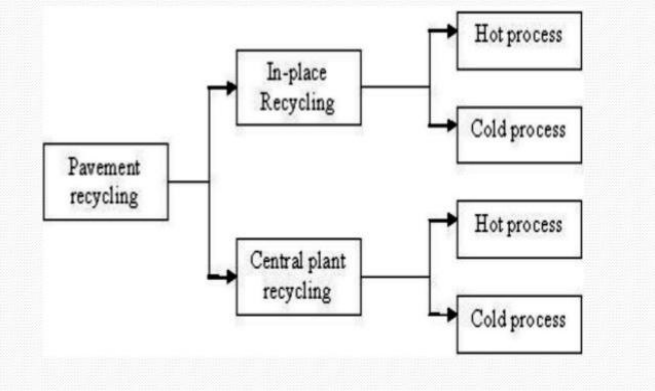
The reclamation of asphalt material can be done using hot or cold process. Hot process reclamation is applicable only in Hot in-place recycling (HIR) while Cold Process reclamation can apply to all other recycling processes (*IRC: SP:120-2015*). In Hot Processes reclamation, the existing pavement is heated by radiation and then milled or scarified as the hot bituminous surface is soft due to heating. Thus, the reclaimed material is used in place. In Cold Process reclamation material is reclaimed by cold milling, breaking or ripping. In cold milling, the pavement surface is milled to required depth, the reclaimed material is discharged into a tipper truck and stockpiled at some designated site.

II.I DIFFERENT ASPECTS OF RECYCLING

These Guidelines are framed to cover the following five aspects of recycling:
1. Reclamation (hot and cold processes)
2. Hot in-place recycling (HIR)
3. Cold in-place recycling (CIR)
4. Hot in-plant recycling (HIP)
5. Cold in-plant recycling (CIP)

II.I.I **Reclamation**

Hot process reclamation is applicable only in HIR, while Cold Process reclamation can apply to all other recycling processes. In Hot Process reclamation, the existing pavement is heated by radiation and then milled or scarified while the hot bituminous surface is soft due to heating. The reclaimed material is invariably used in-place. In Cold Process reclamation material is reclaimed by Cold Milling, breaking or ripping. In cold milling the pavement surface is milled to the required depth, the recycle material is discharged into a tipper truck and stockpiled at some designated site. The reclaimed materials are of the same size or lower compared to what had gone into in the original construction. Where ripping or breaking is done for reclamation, materials retrieved are in large chunks, which have to be crushed and then stockpiled. Before stockpiling material could be segregated and sieved and stockpiled into various size fractions. In any case, the dust produced by milling process should be separated. The milled material is stockpil at some designated place after further crushing (if the reclamation process is by ripping pavement instead of milling). Other reclamation processes, which are also cold processes, may involve ripping and pulverizing the non-bituminous bases/ sub-bases.



II.I.II **Hot in-place Recycling (HIR).**

In HIR, a train of equipment is used with capabilities to perform different functions such as infrared heating of the pavement surface to soften it, milling the softened hot pavement surface, transferring the milled materials into Pug mill mixer of the Recycling equipment through a belt conveyor, adding fresh mix/binder/rejuvenator as per requirements of design into the pug mill, discharging the remix material into integrated paving screeds for paving
the re-mixed output, rolling and compaction of the paved material. In HIR, 100 % of the reclaimed material is utilized. However, its limitation is that no more than 50 mm thick bituminous layer can be satisfactorily recycled (maximum 75 mm if softer binder was used in the original construction). If the pavement needs to be overlaid from structural consideration, a second layer of Hot mix overlay may have to be done on top of the recycled surface and in such situations (also called repaving), HIR has to be done in two layers (or multiple layers).

II.I.III **Hot in-plant Recycling (HIP)**

This process involve production and laying of hot mix material but not with fresh aggregates and binder but with a combination of reclaimed stockpiled aggregates already coated with binder and additional fresh aggregate and fresh binder to meet the requirement of the design. Usually, some rejuvenator is used to soften the old hardened binder in the reclaimed aggregates. Heating the reclaimed binder coated aggregates may release unacceptable fumes while feeding them cold directly into the pug mill may reduce the mixing temperature. The hot mix production process, therefore, has to be suitably modified. In all other respects, hot in-plant recycling is just like normal hot mix construction. Not more than 50% of the reclaimed material is used, though a widely accepted percentage is only 30) and the thickness in which it can be laid is typically 100 mm.

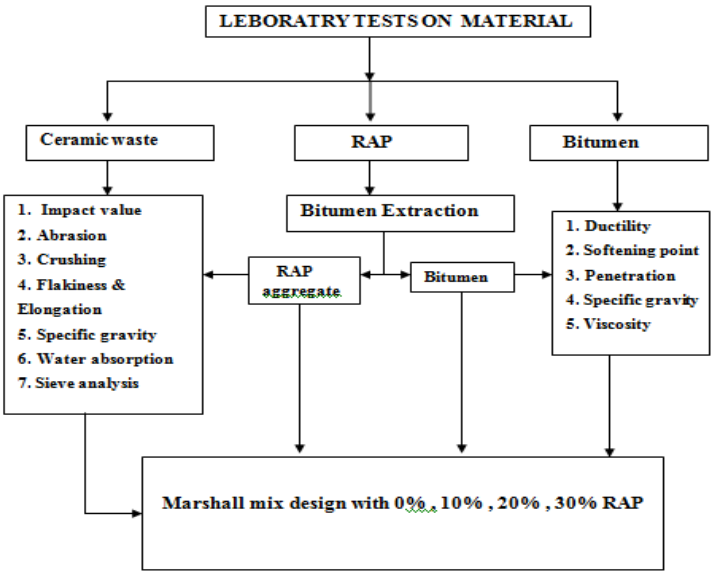
II.I.IV **Cold in-place Recycling (CIR)**

In this process, milling and mixing are simultaneous processes accomplished by a single equipment or a train of equipment capable of milling and conveying the milled material to be fed to a pug mill, with parallel supply line for feeding fresh aggregates also, and separate feeding lines to the pug mill for bitumen emulsion, and rejuvenator. Where foam bitumen is to be used, there has to be separate feeding line for hot bitumen and water to produce the foam bitumen and then feed into the pug mill. The mixed material is discharged into the paver hopper closely following the recycling equipment or train of equipment, then paved and compacted. This type of recycling is considered suitable for depth up to 150 mm and the use of reclaimed material is also of the same order (typically 30 to 50%) as in HIP. Another variant of CIP is Full Depth Reclamation, where the thickness of pavement to be recycled is greater than typically 150 mm. The pavement is ripped, the material pulverized and stabilized with lime, cement or cementations materials and compacted into base layer of the required strength.

II.I.V **Cold in-plant Recycling (CIP)**

The process involve production of the mix in a plant using either emulsion bitumen and laying and compaction in the usual manner. A rejuvenator agent is to be added in the mixing process to soften the hard binder in the reclaimed material. The application range in terms of depth of reclaiming and use of reclaimed materials is typically the same as for cold in-place recycling.

III. TEST TO BE CONDUCTED



IV. LITERATURE REVIEW

IV.I **Effect of Reclaimed Asphalt Pavement on the Properties of Asphalt Binders by Arshad Hussain and Qiu Yanjun (2013)**

In this research conventional and Superpave both methods were used to determine the virgin and residual binder properties. The residual binders obtained from two RAP sources using solvent extraction and abson recovery methods were blended with a virgin binder in different proportions. Ductility, Penetration, dynamic modulus, stiffness and viscosity of the different blends were compared. Viscosity Penetration, and PG grading blending charts were developed based on the corresponding test data. It was concluded that the properties of blends depend on the individual propertie of the binders. The stiffness of binder is increasing with increasing Reclaimed asphalt pavement binder. This research only pointed to the binder related study so to quantify RAP in asphalt mix design.

IV.II **Characterization of Reclaimed Asphalt Pavement (RAP) for Use in Bituminous Road Construction by T.Anil Pradyumna , Abhishek Mittal , Dr.P.K.Jain (2013)**

This paper presents the result of all such performance tests found out on asphalt mixes with RAP and virgin mixes. The laboratory result shows that the asphalt mixes with RAP and rejuvenating agent provide better performance compared to virgin mixes. The paper also recommended that the Accelerated Pavement Testing Facility (APTF) should be put to use to evaluate the actual field performance of recycled pavements in a faster and effective manner

IV.III **Recycled aggregate concrete for Transportation Infrastructure by Surya , Kanta Rao, Lakshmy, (2013)**

This research of a laboratory based exploratory study aimed at characterizing the properties of recycled aggregate and recycled aggregate concrete, to verify their utilization in civil infrastructure. Recycled aggregates used in this study were generated by crushing of concrete cubes tested in the laboratory. Five different concrete mixes were produced; three recycled aggregate concrete viz with 50%, 75% and 100% recycled aggregates with fly ash, and two natural aggregate concrete mixes with and without fly ash, respectively. Triple mixing method was adopted for making of recycled aggregate concrete. Compressive strength, split tensile strength, flexural strength, modulus of elasticity, water absorption and resistivity of the concrete were determined. It was observed that there was no significant variation in compressive strength, split tensile strength and flexural strength of concrete, while the modulus of elasticity and resistivity decreased and water absorption increased with increase in percentage of recycled aggregates. The findings from the study show that the recycled concrete aggregate may be useful for construction of transportation infrastructure such as pavements and bridges. However, further research is needed particularly on the long term field performance of the recycled aggregate concrete before it can be used with confidence.

IV.IV **An Experimental Study on Reclaimed Asphalt Pavement In Bituminous Concrete by Jashanjot Singh , A.K Duggal (Aug 2015)**

This search presents the optimization of the use of RAP in surface courses such as Bituminous Concrete. From the past research papers it has been observed that there is no specific optimum percentage for using RAP as it varies from project to project. Optimum percentage of RAP depends upon many factors such as RAP materials, binder content, and availability of RAP, viscosity of binder and extent of deterioration. In this study various properties like Marshall Stability, Flow value and Density of bituminous mixes using RAP with varying % age 25 to 40% were compared to that of fresh bituminous mix. One virgin bituminous mix and four different percentages of RAP were selected and samples

were prepared at four different percentages of bitumen at each bitumen percentage preparing 3 samples. Total 60 samples were prepared and tested. Test results showed that mix prepared with 35% RAP gave nearly same physical and strength parameters as virgin bituminous mix.

IV.V **A REVIEW PAPER ON RECLAIMED ASPHALT PAVEMENT (RAP) by Jaspreet Singh Singh ,et al (2015)**

The objective objective of this study is to understand the importance of using RAP for the construction of bituminous pavements. From this study and from previous research papers it can be concluded that using RAP is advantageous as reclaimed asphalt pavement mixes can yield results equal or even higher than virgin mixes mixes. If . calculated and implemented appropriately RAP mixes have a constructive effect on various parameters like Marshall Stability, moisture resistance and density. This paper presents the im importance of using RAP mixes. portance 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. Optimal percentage of RAP depends upon the composition of reclaimed bituminous material and type of layer in which i it is to be used. Though 20%- 50% are mostly adopt adopted.

IV.VI **Re-use of ceramic wastes in construction by Andres Juan*, Cesar Medina* et al (2010)**

Ceramic products are produced from natural material containing a high proportion of clay minerals. Following a process of controlled and dehydration firing at temperature between 700degree C and 1000 degree C, these minerals are acquire the characteristic properties of fired clay. Ceramic waste is not sorted according to the reason for rejection, which may include: breakage or deformation and firing defects. Construction and demolition waste principally consists of two fractions: the rest and the stony fraction (see Table). The most important fraction is the stony comprising ceramic materials (bricks, wall tiles, sanitary ware, etc.), concrete, fraction, gravel, sand and other aggregates.

MATERIALS	COMPOSITION (%)
STONY FRACTION	**75**
Bricks, wall tiles and other ceramic materials	54
Sand, gravel and other aggregates	16
Stone	5
Others	4
REST	**25**
Wood	4
Glass	0,5
Plastic	1,5
Metals	2,5
Asphalt	5
Plaster	0,2
Rubbish	7
Paper	0,3
Others	4

Composition of construction and demolition waste

As can be seen, more than half (55%) correspond to the ceramic fraction, representing the highest percentage of all materials shown, followed by concrete waste (13%). This illustrate the importance of the recovery and treatment of this kind of waste. In many situation, possibility of reuse or reclaiming will depend on the existence of previous studies into the viability of this waste fraction, such as that proposed by this present research

V. EXPECTED OUTCOMES

Form the study of literature reviews and preliminary study of the topic there are some remarks are concluded :-

- Overall from this study it was concluded that RAP 35% showed results similar to that of virgin bituminous mix and its performance was best amongst other RAP percentages. Also with the use of RAP 35% the cost of project was reduced by 50 %.
- The optimum asphalt content is decreased as the Reclaimed asphalt pavement percent increase.
- Stability of mixes decreases as the recycled aggregate percent increases. This may due to the fatigue of such material by aging.
- Increasing the recycling aggregate percent in the asphalt mixes decreases the air voids percent which may leads to asphalt bleeding.
- Increasing of RAP material percent increases the loss of stability of asphalt mix. However, the increasing in loss of stability of asphalt mix is more significant when the percent of Reclaimed asphalt pavement is higher than 30 %.
- Based on the study analysis and conclusions, the following recommendations are obtained:
- The RAP is recommended to use in the hot asphalt mixes to save the virgin aggregate for longer time and also to improve the environment.
- A percent of Reclaimed asphalt pavement may be 30% is suitable to be used in pavement.
- Advantages of RAP are given as below :-

Economical Benefits

Using RAP has many significant economical advantages without compromising with the performance of the pavement. The uses of natural aggregates can be reduced by using aggregates obtained from reclaimed asphalt

pavement. The binder from old aggregates can also be extracted and rejuvenated agent with the help of some rejuvenating agents so as to reduce the consumption of binder. As a result, there will be cost saving in using reclaimed asphalt pavement.

Environmental Benefits

Recycling of old bitumen pavement is a sustainable option of road construction. There is a considerable reduction in consumption and use of natural resources. The disposal of Reclaimed asphalt pavement material is an important issue. Thus, using these materials as a material for construction of new pavement addresses this problem. With Increasing use of RAP percent total bitumen content in mix can significantly reduce greenhouse gas emissions by eliminating significant fuel consumption required to acquire and process raw materials for fresh mix.

Benefits associated with repeated resurfacing

The construction of bituminous pavement is being done for a very long time. When an existing road reaches at its design life or deteriorates to a level which is not able to fulfill its functional aspects, a new construction is required. Due to repeated resurfacing as a maintenance, many pavements have reached to a higher raised level as compared to adjoining/ abutting properties in old urban areas. The raised level of pavement can be lowered down up to desired and feasible depth with sophisticated milling machines and then after the same can be resurfaced with suitable wearing coat.

Technical Benefits

Reclaimed asphalt pavement is a stiffer and more brittle material as compared to fresh asphalt mix. The studies were conducted on rutting and moisture resistance characterization. Results showed that introduction of RAP led to the increased resistance to moisture damage and permanent deformation

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