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Utilization of reclaimed asphalt pavement in bituminous road

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ABSTRACT

This paper aim to study various properties, parameter of RAP (Reclaimed Asphalt Pavement) and use it in construction of flexible pavement. RAP mainly constituted with scrap material received from flexible pavement due to increment of granular sub base and base course as per latest IRC code. In this the scrap material is recycled as RAP so the construction cost will considerably decrease. This RAP may be used as sub base course or base course with cold in place recycling method or reclaimed with additional binder or aggregates and use in base course as bituminous layer. This will also help to save valuable natural resource in huge quantity. This paper also contains a case study of RAP and analysis of direct saving of construction cost.

Keywords— *Reclaimed Asphalt Pavement (RAP), Hot in plant recycling*

1. INTRODUCTION

Reclaimed Asphalt Pavement (RAP) is using now a day to decrease construction cost of highway and minimising environmental impact as a sustainable solution. Due to exterior exposure the RAP has 1m high creep, permanent deformation, 1m bituminous content and 1m higher size material. After proper testing of RAP deficient quantity of bitumen and higher size aggregate are blended with RAP which has lost the service life, for preparation of fresh mix in HMP and relay on pavement as a base course. Asphalt pavement which have at the end of their service life are frequently revitalized by milling the existing pavement surface replacing the mild particle with new HMA. RAP has been used since 1930 which reduce the cost of construction. RAP can be used as a granular base material in paved and unpaved roadways, parking areas, bicycle paths, gravel road rehabilitation, shoulders, residential driveways, trench backfill, engineered fill, and culvert backfill. Now qseal emphasis is given for sustainable and eco-friendly technology to construct highway. Recent investigation shows that the waste can be reduced by using RAP as base and sub-base aggregate material to enhance CBR of the layer.

Using RAP as base material would preserve non-renewable aggregate as made as reduce the amount of space needed to store millions of tons of RAP in each year. In cases that 100% could not produce base course of much quantity due to 2/3 significant rate dependency and high deformation and creep. Several researchers have suggested that high quality base coarse could be obtained by blending RAP with virgin aggregate establishing RAP with chemical additives such as cold lime, fly-ash fibre. Fly-ash is a fine glass powder like material recovered from coal fired electric power generation plant. Stabilizing RAP with fly ash is an attractive and sustainable solution because fly ash traditionally has been disposed landfills.

Stabilizing RAP with fiber such as Recron3s is also an option to be considered. Recron3Sfibre is a modified polyester fiber. It is generally used as secondary reinforcing material in concrete and soil to reduce their performance.

2. KEYWORDS OF THE PROPOSED EXPERIMENT

Here we will be discussing the major keywords used in the paper.

2.1 Recycling of Reclaimed asphalt pavement (RAP)

Recycling of Reclaimed Asphalt Pavements (RAP) must be used for technical, economical, and environmental reasons. Use of RAP has been favoured all over the world over virgin materials in the light of the increasing cost of bitumen, the scarcity of quality aggregates, and the pressing need to preserve the environment. The use of RAP also decreases the amount of waste produced and help store solve the disposal problems of highway construction materials. Reclaimed Asphalt Pavements contain best quality aggregates and they can be effectively improved with foamed asphalt/bitumen emulsion along with/without fresh aggregates and crusher dust to impart necessary strength for durable pavements. If only the surface layer is weathered or damaged, hot recycling can be an attractive proposition.

Several recycling techniques, such as hot mix plant recycling, hot in-place recycling, cold mix plant recycling, cold in-place recycling, and full depth reclamation, have evolved over the past 35 years. Hot In-plant recycling method not only reduces the use of new materials but also reduces emissions, traffic, and energy associated with the transport and production of these materials. Hot In-plant recycling is the most common method of recycling n most of the countries.

2.2 Recron3sFibre

Research and development work in Fibre Reinforced Concrete (FRC) composites began in India in the early1970s. Fibre reinforced concrete was developed to overcome the problems associated with cement-based materials such as low tensile strength, poor fracture toughness and brittleness of cementations composites. In the beginning, FRC was primarily used for pavements and industrial floors but now a day FRC composite is being used for a wide variety of applications including bridges, tunnel and canal linings, hydraulic structures, pipes, safety vaults and structural members.

3. SOME TYPICAL PROPERTIES OF RAP

S. No	Parameters	Values
1.	Unit Weight (kg/m^3)	1900-2250
2.	Moisture Content	Max 3-5%
3.	Asphalt Content	5-6%
4.	Asphalt penetration (%) at 25°C	10-80%
5.	Compacted Unit	1500-1950
6.	California Bearing Ratio (CBR)	100% RAPP:20-25%

Fig. 1: Bituminous R.A.P

4. LITERATURE REVIEW

Alex K. Apeagyei et al., (2012)- Studied for the production of high RAP mixes (i.e., mixes with more than 20% for surface and intermediate) to evaluate the stiffness characteristics of asphalt concrete mixtures containing various RAP amounts to achieve a better understanding of high RAP affects the mixture performance properties that are important for more hard-wearing and cost-effective asphalt. The use of higher RAP proportion with locally available binders was adopted as acquire to decrease the demand on specialty more expensive modern binder and modern aggregates. Recent testing has established that RAP substitution at proportion above 50% is achieve to produce new HMA mixtures procure reasonable results in mechanical properties.

Dulal Chandra Saha, J.N Mandal in (2017) conducted a lab investigation on reclaimed asphalt pavement for using it as base course of flexible pavement. According to this study during capacity augmentation of existing national highways (NH) projects, grade separated structure in terms of fly overs, vehicular underpass (VUP), pedestrian underpass (PUP) cattle underpass (CUP) are proposed at regular intervals. Accordingly, existing road levels at approaches of these structures are required to be raised making the existing pavement materials redundant. Existing pavement are also obtained due to milling of existing pavement surface before laying for strengthening.

H. Ziari et al., (2005) Department of Civil Engineering Iran Science and Technology, Tehran - Economic and ecological contemplations have provoked the reusing of steel, aluminium, plastic, and numerous materials. One of these recyclable materials is hot blend black-top. This paper presents look into discoveries from the Investigation of Recycled Asphalt Pavement blends venture. The examples contained from 0 to 40 percent RAP from a street of Tehran. RAP material was mixed with new total to such an extent that all examples tried had around a similar reviewing. Tests were analyzed for strong modulus. The flexible modulus test gives a proportion of the versatile properties of the blend.

Robert Locander et al., (Feb. 2009) The Colorado Department of haulage reclaimed asphalt pavement (RAP) as a base for many projects in rehabilitation strategy. CDOT stipulation allows RAP to be alternative for aggregate base course (ABC). RAP may be constructed during cold milling of existing hot mix asphalt (HMA) pavement. A Colorado procedure and a project special condition to govern the macro-texture of cold planned HMA pavement were executed in the 2007 paving season to certify satisfactory surface texture for the placement of HMA overlays. RAP produced during cold milling of HMA pavement appears to be persistently well-graded as a result of the new procedure Stiffness, strength and permeability are the areas of concern with respect to the use of Reclaimed Asphalt Pavement material one more purpose of the study is to compare the stiffness, firmness and permeability of milled RAP and firm aggregate or base course material. The alternative study objective is to establish appropriate fault design input values to be pre-owned by pavement planner when using RAP as an alternate for crisp aggregate, base course or sub-base material.

Dr. N. C. Shah, Uka Tarsadia University Maliba Campus Bardoli, Surat presently working as an engineer of road department at Surat in Gujarat. He saw level of bituminous road was increased due to repairing and maintenance of road. Wearing course of bituminous road was become more thick than desired thickness. So, he and his team decided to dig the wearing course of road, after digging the wearing course he found bituminous aggregates then after Dr NC SHAH realized that this scrap material could be reuse. Then he started some experiment work on this scrap material and he succeeded in his plan. He made bituminous material again for reuse with similar property that new bituminous material have.

5. MATERIAL USED

Many waste materials like fly-ash, ss2, engine oil can also use for improving the quality of R.A.P. Use of these products can reduce the dumping problem of waste as well as cost of construction. These materials are as follows-:

5.1 Reclaimed Asphalt Pavement (R.A.P)

In this study of investigation, we will be using non-bituminous RAP. The RAP used is of the W.M.M layer of pavement.

(a) Bitumen: Bitumen is also known as Asphalt. Bitumen is a black and highly viscous material made from petrol. Bitumen is used as a binder material that helps to bind the concrete.

(b) Fly-ash: Fly-ash can be obtained by the burning of pulverized coal. It is a fine powder material that is a by-product of an electric power-generation plant on the basis of economical point of view when fly-ash mixed with water and lime, it gives similar property as Portland Cement.

(c) Used engine oil: Engine oil can work as a binder material that can found any mechanical instrument that has engines for operate old engine oil shows some similar properties as fly-ash, cement.

6. METHODOLOGY AND EXPERIMENTAL METHOD

There are several techniques used for Reclaimed Asphalt Pavement, these are as follows:

(a) Cold in place recycling
(b) Cold in plant recycling
(c) Hot in place recycling
(d) Hot in plant recycling

(In this project we have adopted Hot in plant recycling method)

7. METHODOLOGY

7.1 Hot in plant recycling

Hot mix recycling or hot recycling is a method in which the RAP is combined with new aggregate and an asphalt cement or recycling agent to produce hot mix asphalt (HMA). Both batch and drum type hot mix plants are used to produce recycled mix. The RAP is obtained from pavement milling with a rotary drum cold planning machine and may be further processed by ripping and crushing operations, if needed. The mix laydown and compaction equipment and procedures are same as for conventional HMA. The ratio of RAP to new aggregates depends on the mix design, on the type of hot mix asphalt plants, and on the quality of stack emission generated. Typical RAP to aggregate proportions vary between 10:90 to 30:70, although a maximum of 50:50 have been reported for drum mix plants. The use of microwave technology has allowed the use of a higher amount of RAP, because the RAP can be preheated.

Hot mix recycling is the most common method of recycling road pavements. It involves combining of old/existing pavement with new or virgin aggregate to produce recycled material or RAP. It also helps to reduce the cost of pavement construction. It is not only proven, cost effective but environmentally friendly process that helps to conserve our natural resources and revitalize our existing pavement. During the road surface repair and maintenance these asphalts are removed to correct the deformities or upgraded.

The removed asphalt forms a valuable source of hot-mix asphalt produce called RAP. The asphalt pavement is generally removed either by milling, excavating, ripping and crushing or full depth removal. To begin the recycling process the stock pile of RAP from milling roads or excavated pavement are fed to asphalt granulator, this will crush the RAP without affecting the original aggregate size, after the pulverization process screening is conducted prior to the stockpiling of the processed material. The processed RAP is stocked or located away from other material to avoid contamination from other material having different size of stockpiles. The feed hopper is first to initiate the function from stock pile it will be transported to the feeder it has two hoppers equipped with a continuous belt feeder running with the speed of variable speed motor. RAP materials are being channeled out by the collection belt to the recycling drum. Its head pulley is fitted to the fixed speed and shaft mounted gear motor provide minimum maintenance.

RAP materials are heated into a drum that is drying capacity ranging from 80 to 120 tons per hour at 35 moisture and minimum heat temperature about 150 degree Celsius. Heated RAP material will be kept inside the fully insulated buffer silo with storage capacity up to 20 tons. The heated RAP is then discharged and weight at RAP was equipped with double outlet gates operated with two pneumatic cylinder weight by proportion, the processed RAP is channeled through a conveyer belt into the twin shaft mixture to integrate with virgin aggregate, filler and bitumen.

The processed material will be mixed together with new aggregate the mixture then becomes RAP. After the mixing process of material in twin shaft mixture is completed the new hot mix is discharged into transfer bucket is poured into the silo having maximum heat retention capacity or directly transfer to the trucks for subsequent delivery and immediately set for pavement and compaction at the construction site. The RAP is recycled and ready to paved for the road again. The asphalt pavement that was once waste material can turn into useful material.

8. ADVANTAGES OF HOT IN-PLANT RECYCLING

- Significant structural improvements can be obtained with little or no change in thickness by improving the existing asphalt materials.
- Additional right-of-way is not needed.
- Surface and base distortion problems can be corrected
- Performance of recycled mix is as good as conventional HMA mix.

9. CONCLUSION

Reclaimed asphalt pavement 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 reclaimed asphalt pavement depends upon the composition of reclaimed bituminous material and type of layer in which it is to be used Numerous transportation agencies have been recycling RAP in unbound base and sub-base layers for many years, however, there is a lack of literature on actual field performance. Because of concerns related to lower shear strengths and excessive permanent deformations resulting from large strains as RAP content increases, there is a general trend of using up to 50% RAP content by weight in virgin aggregate base and sub-base layers.

There is a general lack of uniformity among the RAP use specifications adopted by various transportation agencies. RAP for use in base and sub-base layers can be characterized by performance-related parameters and properties including those needed for pavement design, such as grading, resilient modulus, shear strength beneath static tri-axial loading and permanent deformation under repeated tri-axial loading, and those identifying material durability, such as frost susceptibility and abrasion resistance as measured by performing test. When the nuclear density gauge is used for wet/dry density measurements, the compaction acceptance criteria need to be modified to account for the RAP content. Current pavement design course of action does not account for RAP material properties.

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