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OPTIMIZATION MODEL FOR MAINTENANCE AND RECYCLED ACTIVITIES OF ASPHALT ROADS

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Abstract -- Bitumen, the sticky, gooey black stuff you sometimes see oozing out of hot road surfaces, is a valuable binding agent used in roads. What we do is collect old materials containing bitumen, most of this material comes from roads. Then, we shred it, heat it, drain off the molten bitumen, and sieve away all contaminants like glass fibers, wood and stones. We then mix the recycled bitumen with just a little bit of virgin bitumen and use the mixture to produce new roads of the same quality.

It was quite difficult to control the exact temperature of the melting process. Too high and the bitumen is separated into other chemicals. To low and it does not seep out of the solid materials. We also had a hard time sieving it since it is really viscous and sticky. But we resolved all that issue and the recycling plant has been in operation since 2008.

It is mostly a matter of money. And that leads to three possible solutions. First, our recycling process could be subsidized. This is attractive from our point of view. Second, recycling bituminous materials could be made compulsory. This would probably work, but then you need a controlling system and inspectors. That is expensive. So, probably, the taxpayers would have to come up with the funding. Third solution, land filling and burning bitumen in waste-to-energy plants could be taxed. Governments would undoubtedly like that, so policy makers will probably prefer this solution. But sadly it will make the relatively green energy from these plants more expensive. In recent years, applications of plastic wastes have been considered in road construction with great interest in many developing countries. The use of these materials in road making is based on technical, economic, and ecological criteria.

Keywords - Bitumen, RAP.

I. Introduction

PFC for a Porous Asphalt pavement less strength than the other pavements. To increase the strength in such pavements we are using the polyamides (polymers), this polyamides are increase the internal strength in a pavement structure. Here polyamides act as reinforcement in the flexible pavement to gain the compression stability with a elastic property in a flexibility pavement.

In this modern days RAP is highly growing pavement in rural and urban areas. Recycled aggregates are collected from olden days (up to 10-15 years old pavement). Pavement collect from the roads by paving mill machine, it directly collects its matter into truck.

RAP material is reduces the percentage of bitumen in a mix. Recycled aggregates are mixed in a Hot Mix Plant Asphalt (HMA) with a mixture of recycled aggregates and binder material (bitumen). This is process is known the Reclaimed Asphalt Pavement).

Construction of RAP (Recycled/Reclaimed Asphalt Pavement) takes much lesser than the other pavements; it saves the cost ranges from 14 to 34 % (approximate 1100/- per one ton mix). In 1996, 33% of all asphalt pavements are constructed with the recycled asphalt pavement in a United States, was recycled in HMA

II. Material used

A. Recycled Material

Our major ingredient is recycled material, recycling asphalt roads creates a cycle process of reusing materials that to make optimal use of a natural resources. Reclaimed asphalt pavement (RAP) is a useful alternative to virgin materials because of an economy, reduces to by virgin aggregates, etc. More % of RAP is gain with processing, and a production practice reduces cost and saves some energy. In United States evaluation of pavements contains 30% RAP through the LTPP (Long-Term Pavement Performance) program, it's been determined that the performance of virgin aggregate or materials is similar than the RAP materials.

FHWA (Federal Highway Administration) is supported to use recycled highway materials in laying road construction; it supports majorly by three reasons are: (i) the economy effect, (ii) friendly environmentally, (iii) good performance.

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Recycled flexible pavements are encouraged to use in the construction of new roads and pavement ways.

It uses for reducing cost and environmentally friendly to road construction by using RAP. Identities more benefits to the atmospheric condition and the economy condition can be perceived when assimilating into the new asphalt material.

It divides the pavement materials contains asphalt and aggregates. These materials are generated by removing of asphalt roads for new road construction, when it is crushed and screened, RAP consists of high-quality well-graded materials (aggregate) coated by asphalt cement. Asphalt roads are Americas most recycled material for a long time. While almost the entire recycled/reclaimed asphalt pavement (RAP) is recycled, a large piece is emaciated or down-graded when used in embankments, land-fills, and base layers.

III. Experimental Procedure

Aggregate Impact Test for Recycled Aggregate

Aim: To determine the impact value of given sample of aggregate.

Apparatus: Impact Testing Machine, Cylinder bowls, IS sieve brass (12.5mm, 10mm and 2.36mm), weighing machine.

Procedure:

- Collect test sample reclaimed aggregates up to 4kgs.
- Keep materials dried by placing aggregates in an oven for four hours at a 100^0C - 110^0C.
- Sieve the collected aggregates, should pass from 12.5mm size to retain at 10mm size sieve.
- The collected aggregate should be filled up to about $1/3^{rd}$ in cylindrical measure bowl and compact it by 25 blows with round headed tamping rod. And remaining material should be done by placing more two layers and similarly tamping is done 25 times.
- The exceed material (reclaimed aggregate) removed and weighed (W1) the material with a 0.01gm accuracy of weighing machine.
- Place the cylindrical cup carefully under a base plate of the testing machine.
- The impact machine hammer should be raised up at the height of 38cm away from the cylindrical cup. And give 15 blows which less not less than the 1 second.
- The crushed material should be sieved on 2.36mm sieve.
- The passing material from 2.36mm size should be weighed (W2) with accurate of 0.01gm.
- Repeat this experiment three times for accurate average values.

$$\text{Impact value} = \frac{Final\ passing\ weight\ (W2)}{Total\ weight\ of\ dried\ material\ at\ retained\ 10mm\ (W1)} * 100$$

Aggregates values should be noticed:

<10%---------exceptionally strong

10-20%------strong

10-30%------satisfactory

>35%--------weak for construction

Result; The average value of aggregate impact value is 10.91%. So it is moderately strong.

Marshal Stability Test

Mix design procedure for making bituminous pavement strength and flow vale carried out. Marshal stability measures the most load assist by the bituminous asphalt material at a loading rate will be 50.8 mm per minute, the test ends when it reaches maximum load. Note down the record when loading is decreasing to breakdown stage (given sample). The dial gauge is measures the specimen's flow and strength (in KN) by applying load. The flow value refers the vertical deformation to reached maximum load.

Marshal stability is relative shows deformation, displacement, shear stress and rutting. The stability mainly derived from internal friction and cohesion. Cohesion is the binding force acts at an internal binder material of sample to engage and frictional resistance of aggregates. Bitumen pavement is subjected maximum traffic loads from all the time (including peaks time), it is necessary to occur the material with a good stability (strength) and flow.

Test Procedure:

Marshall Stability test apparatus is described as following:

i. The specimen together comprises of a cylinder with a base plate, extension collars and 10.16cm diameter & 6.35cm height.

ii. A Specimen extractor is used in order to extract the compacted specimen from the mould. To transfer the load from extension collar to the upper proving ring attachment a suitable bar is used, while extracting the specimen.

iii. A flat circular compaction hammer having tamping face of 4.5kg sliding weight is constructed to provide a free fall from the height

of 45 cm.

iv. During compaction to hold the MS plate together the mould, compaction pedestal consisting of a 20×20×45 cm and wooden block capped with 30×30×2.5 cm are utilized. In order to hold the compaction mould in place on compaction pedestal, mould holder is provided with a spring tension device which is mainly designed to hold the compaction mould.

v. Breaking head is made up of two segments namely upper and lower cylindrical segments. Breaking head consists of test heads with an inside radius curvature of 5 cm. The longer segment is settled on a base which consists of two perpendicular guide rods that facilitate insertion in to the holes of upper segment.

vi. **Loading Machine**: It is provided with a gear system to lift the upward direction. On the upper end of the machine pre-calibrated ring proving 5 tones capacity is fixed. The specimen contained in this test is placed in between the base and the proving ring. A uniform vertical moment of 5cm per minute is produced on the load jack. This machine is capable for its movement reverse and forward moment.

vii. Flow meter is composed of a guide, sieve and gauge. Due to frictional resistance the activating pin of the gauge moves inside the guide sleeve. Least count of 0.025mm is adequate. At maximum load from initial position at zero loads, the flow value refers to the total vertical upward movement. Flow meter should contain a dial-gauge which measures the total upward vertical moment accurately.

Preparation of Test Specimen for BC (Bituminous Concrete):

Standard weight of aggregate should be collected for BC is 1200 gms, it should be heated, by keeping in an oven for 3-4 hours at 100-110°C.

According to MORTH (Ministry Of Roads Transportation and Highways) aggregate gradation should be done for Bituminous Concrete.

IV. Result

Below table shows about the Strength and flow value for Bituminous concrete (BC) for various percentages of polyamides added.

Table 1 Strength and Flow value for BC pavement

% of Polyamide	Normal Aggregate Kg Flow		Non-Porous recycled aggregate Kg Flow		Porous Aggregate Kg Flow	
0	1115	3.47	1096	3.34	935	3.2
10	1187	3.80	1115	3.57	1092	2.8
15	1246	3.27	1252	3.67	1161	2.5
20	1229	4.00	1344	4.00	1207	2.3

Below chart shows about the Strength for Bituminous concrete (BC) for various percentages of polyamides added.

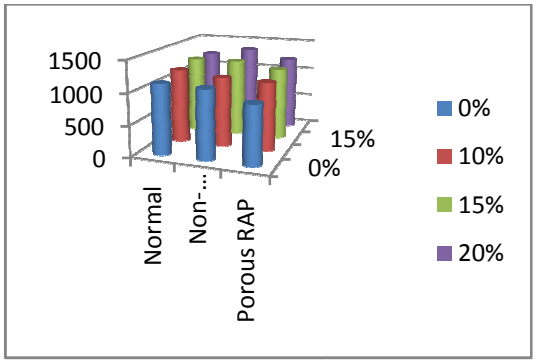

Fig .1 Strength variations in BC pavement

Below chart shows about the Flow Value for Bituminous concrete (BC) for various percentages of polyamides added.

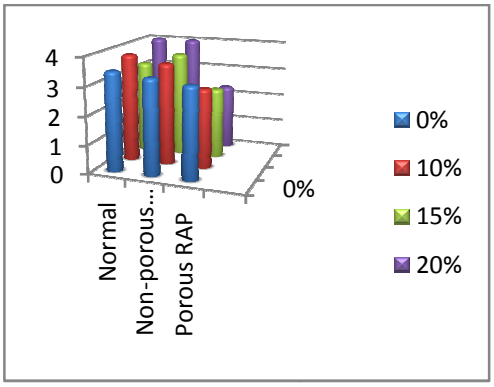

Fig.2 Flow Variations in BC pavement

- Above graph represents the various changes in addition of polyamides in different types of aggregate mode like Normal aggregate and recycled aggregate in porous and non-porous pavements.
- Strength is increased in 20% stage; due to addition of polyamides is increases the strength at various stages like pavement, fibres, plastic things, etc.

- Increasing of strength is a major advantage for pavements to carry more loads.
- Graph represents the difference in loads and flow values.

Fig.3 Specimens

Below table shows about the Strength and flow value for Dense Bitumen Macadam (DBM) for various percentages of polyamides added.

Table 2 Strength and Flow value for DBM pavement

% of Polyamide	Normal Aggregate Kg Flow		Non-Porous recycled aggregate Kg Flow		Porous Aggregate Kg Flow	
0	2302	3.37	2269	3.56	2158	3.15
10	2397	3.67	2370	3.37	2244	3.22
15	2485	3.63	2482	3.34	2204	3.29
20	2551	3.97	2508	3.90	2211	3.30

Below chart shows about the Strength for Dense Bitumen Macadam (DBM) for various percentages of polyamides added.

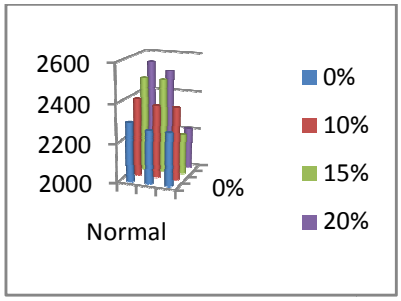

Fig.3 Strength Variations in DBM pavement

With all % of polyamides

Below chart shows about the flow value for Dense Bitumen Macadam (DBM) for various percentages of polyamides added.

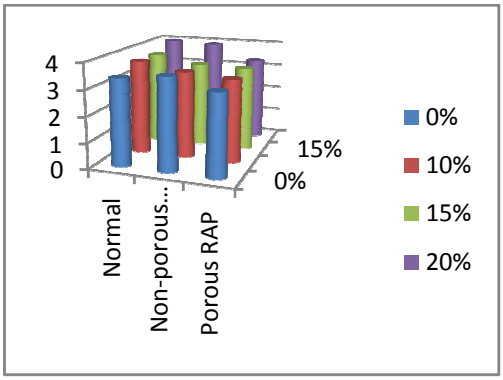

Fig. 4 Flow values variations in DBM pavement

With all % of polyamides

V. Conclusion

Polymers/polyamides are used to increase the strength of the pavement in porous or non-porous. The innovative technology in modern days is to implement the porous pavement as well as non-porous asphalt pavement with a reclaimed/recycled aggregate.

It helps to improve the environment and economic condition, with surface run-off water and wet weather.

Polymer is very harm-full to environment, so we are using it in a construction of pavement to increase the strength and stability.

In this project, we show a difference in porous and non-porous pavement by using recycled and non-recycled aggregate with effectiveness of strength and flow values.

The more strength occurs at increasing of polymers. And also we reduced the quantity of bitumen.

Reduction of bitumen is caused for more economical.

Finally we conclude with gratefully to success of this project by gaining the strength by using polyamide in recycled/reclaimed aggregates

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