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A REVIEW ON STATUS OF RECOVERED BLACK-TOP ASPHALT IN INDIA, INNOVATIONS AND ITS APPROPRIATENESS

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Abstract *- The conventional method of providing bituminous surface on flexible pavements requires considerable energy to manufacture bituminous mix at a hot mixing plant. Owing to economic factors and the need for environmental sustainability, the recycling of pavement construction materials has increased. One of the most commonly used recycled materials is Reclaimed Asphalt Pavement. RAP is produced by removing and reprocessing existing asphalt pavement. By using RAP, we can reduce waste production and resource consumption. The amount of the reclaimed asphalt added depends on the minerals and their homogeneity. Laboratory experiments were performed on asphalt mixtures with RAP content and their efficiency was contrasted with virgin asphalt mixtures. The primary objective of study is to examine the use of recovered asphalt pavement in the pavement industry in India evaluating the effects of partial and total replacements of bituminous concrete by RAP varying from 10 to 40% and virgin HMA mix on the mechanical properties of HMA mixtures. The virgin bitumen used in this study was of VG -30 grade and virgin aggregates from local quarry. The experimental process involves determination of characteristics of the materials procured. On samples prepared for both virgin and recycled mix, Marshall Stability, and Indirect tensile strength, flow tests, and Fatigue Life cycle Index were performed. All the characteristics were found to be within specified specifications as per MoRT&H and IS standards.*

Key Words: Reclaimed Asphalt Pavement[1], Bituminous concrete[2], Marshall Stability[3], Flow value[4], Indirect tensile strength[5], Fatigue Life cycle Index[6], Optimum Bituminous Content[7].

1.INTRODUCTION

On the other side, asphalt pavement recycling is a Nobel approach in terms of technical, economical, Preservation of natural resources and problems with the climate. Use of RAP in pavement rehabilitation project has advantages over virgin materials due to the Growing Asphalt Cost, insufficiency of quality aggregates and the need to preserve the atmosphere. Many state agencies have also reported when RAP is used, it results in significant cost saving and subside the amount of waste produced and hazards of disposal problems of highway construction materials particularly in large cities. In 1996, it was calculated that approximately 33% of all asphalt paving in the United States was recycled into HMA.

RAP (Reclaimed asphalt pavement) has become the most famous resource for new asphalt production, and is currently the world's most recycled commodity. For fresh asphalt paving, recycling asphalt uses old resources to cut costs and materials. RAP is constantly being used as RAP technology has increased. However, there are strict RAP requirements that restrict the quantity that can be used for each mix design. Latest surveys found that the national RAP averages used in new mixes range from 12% to 15%. The National Asphalt Pavement Association (NAPA) has set targets for increasing the average RAP content worldwide.

1.1 BITUMINOUS MIX DESIGN

Asphaltic Bituminous concrete The mixture consists of aggregates continually graded from a maximum size to a fine filler less than 0.075 mm, usually less than 25 mm. Enough bitumen is applied to the mix such that it is practically impervious to the compacted mix and has sufficient dissipative and elastic-properties. The formulation of the bituminous mix `design to assess the bitumen proportion, filler, fine aggregates and coarse aggregates to produce a workable, sustainable durable and cost-effective mix.

The objective of the mix design is to produce a bituminous mix by proportioning various components so as to have-

1. Sufficient bitumen to guarantee strong asphalt
2. Sufficient solidarity to oppose shear miss happening under traffic at higher temperature
3. Sufficient air voids in the compacted bitumen to take into account extra compaction by traffic.
4. Sufficient usefulness to allow simple position without isolation.
5. Sufficient protection from stay away from untimely splitting because of continued bowing by traffic.
6. Sufficient opposition at low temperature to forestall shrinkage breaks.

2 OBJECTIVE OF PRESENT INVESTIGATION

The main objectives of this study are as follows:

- To complete a thorough review of RAP and HMA literature.

- Study of Marshall Properties of BC mixes using different percentage of rap on comparison with virgin bituminous concrete mixes.
- To study the indirect static tensile strength of RAP containing bituminous concrete mix at OBC after Marshall Stability testing. To evaluate the fatigue life cycle index ration of RAP after determination of OBC by Marshall Stability testing.
- To evaluate the engineering characteristics of RAP for example aging, grading, residual binder content etc.
- To ascertain strength of bituminous mix for use as bituminous concrete using different percentages of RAP.
- To establish a cost comparison of RAP and fresh bituminous concrete mix for construction of new flexible pavements.

3. MATERIAL AND METHODS

3.1 PRODUCTION OF RAP MATERIALS

3.1.1 Coarse Aggregates

The coarse aggregates is made of stone pieces, up to 4.75 mm IS sieve scale, obtained from a local source. Its specific gravity was found as 2.75.

3.1.2 Fine Aggregates

A local crusher with fractions moving 4.75mm and maintained on 0.075mm IS sieve. fine aggregates consisting of stone crusher material. Its specific gravity was found as 2.6

3.1.3 Binder

Here VG 30 penetration grade bitumen is used as binder for preparation of Mix, its specific gravity was found as 1.01.

4. METHODOLOGY

4.1 Determination of Binder Content

RAP was calculated from the following empirical formula:

Pb= 0.035a+0.045b+Kc+F

Where,

a= % of mineral aggregate retained on 2.36mm sieve,

b=% of mineral aggregate passing on 2.36mm sieve& retained on 75 µ sieve,

c=% of mineral aggregate passing on 75µ sieve,

K=0.15 for 11-15%passing 75µ sieve , 0.18 for 6- 10 %passing 75µ sieve, 0.2 for 5% or less passing 75µ sieve,

F=0-2% based on absorption of light or heavy aggregate, 0.7 for other aggregate.

4.2 Rap Bitumen Extraction:

For the reference bearing coarse mixtures containing RAP, the bitumen extraction is carried out by means of the extraction formula:

% Extraction = ((W1-W2)\W) x 100

Where,

Wt. of the sample (W) gm.

Wt. of the sample+ bowl (before extraction) (W1) gm.

Wt. of the sample+ bowl (after extraction) (W2)

4.3 PROPORTION OF BITUMEN PRESENT IN RAP

Percentage of bitumen decided using centrifugation method. The removal of RAP was done using excavator. The fabric is 4 year old. RAP being mixture of base and old surface layer, the binder content found in RAP was 4.8% and therefore the original percentage at the time of construction was 5.5%. For this study, aggregates of 20mm, 10mm, 6.7mm and Stone Dust were used.

4.4 PREPARATION OF MIXES

Four level of RAP material for example 10%, 20%, 30% and 40%. Here Optimum Binder Content (OBC) was found by Marshall Test where fastener content is vary from 0% to 6%. The temperature of the mineral totals was kept up to a temperature 10°C higher than the temperature of the cover. The mix was then poured into Marshall Molds pre-warm and the examples were prepared using a comp-active attempt of 75 blows on either hand. For the time being, reserved for cooling to room temperature. At that point, as per the normal testing method, the examples were extracted and tried at 60 °C.

4.5 TESTS ON MIXES

For this study, the aggregate were obtained from a hot mix plant. A blend using these aggregates was prepared and samples prepared at different binder content and tested to determine the optimum binder content. Thereafter the same aggregate blend was used and replaced by RAP percentage of 10%, 20%, 30%, and 40% were selected and used samples prepared. Various parameters like Marshall Stability, flow value and density were studied at four different percentages of bitumen 5.4 %, 5.6%, 5.8% and 6% three samples by preparing at each bitumen percentage.

4.6 MARSHALL STABILITY TEST

The construction of the Marshall Mix can be a common laboratory methodology record the strength and flow characteristics of bituminous mixes. This test method is widely accepted due to its simplicity and low of cost. It was agreed to use this methodology to figure out the optimum binder content (OBC) of the mixes and also to study different Marshall Characteristics such as Marshall Stability, flow value, unit weight, air voids, given the various advantages of the Marshall process etc.

5. EXPERIMENTAL WORK

5.2 JOB MIXES FORMULA FOR BC USING RAP- 10 %, 20%, 30% & 40%

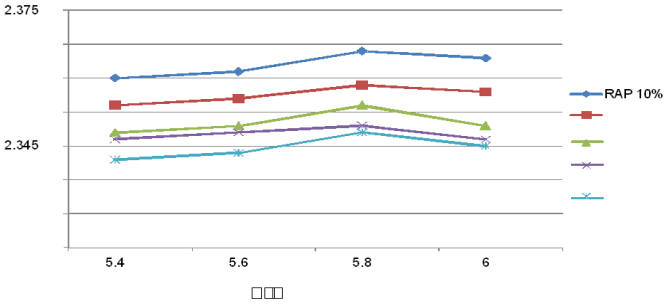
Table 1 : Table for grading of BC using RAP 10%, 20%, 30% & 40%

IS Sieve size	% passing (required)	Grading of mix with RAP 10 %	Grading of mix with RAP 20%	Grading of mix with RAP 30%	Grading of mix with RAP 40%
19mm	100	97.96	97.58	97.21	96.84
13.2mm	79-100	83.25	81.88	80.51	80.03
9.5mm	70-88	77.00	74.94	72.85	72.08
4.75mm	53-71	56.96	56.07	55.18	56.12
2.36mm	42-58	55.25	46.34	46.07	46.84
1.18mm	34-48	36.07	35.97	35.86	36.48
600µ	26-38	27.96	27.91	27.87	28.39
300µ	18-28	21.40	21.41	21.42	21.84
150µ	12-20	13.05	13.1	13.14	3.41
75 µ	4-10	8.34	8.55	8.57	8.72
Ratio		6%,8%,15 %, 43%, 25% and 3%	5%,7%,13%, 42%, 30% and 3%	4%, 6 %, 11%, 41%, 35% and 3%	2%, 3%, 11%, 41%, 40% and 3%

6. RESULT AND DISCUSSION

6.1 DENSITY Vs BITUMEN %

The general variation of maximum Density is between 2.357 to 2.364 which are again slightly quite density of RAP 20 interested by 0.21%.



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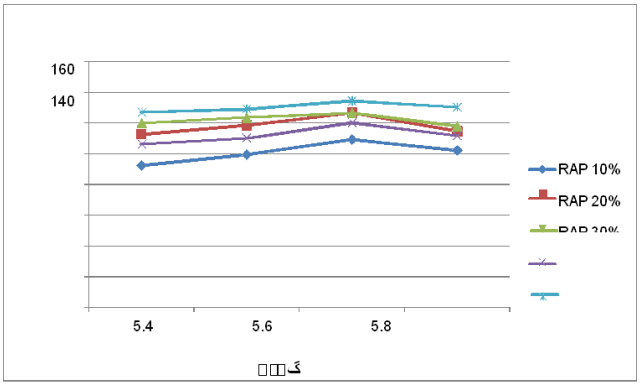
6.2 MARSHALL STABILITY Vs. BITUMEN

From the test results performed it's observed that the Marshall Stability values for virgin bituminous mix are quite any of RAP mixes. RAP 30% has values nearly adequate to that of fresh bituminous mix and has best density values amongst other RAP mixes. At 5.8% binder content the Marshall Stability value of fresh bituminous mix was found to be 1461 kg as compared to 1431 kg which was the utmost value determined correspondingly to RAP content 20%. This difference is negligible. The general variation of maximum stability was between 1189 kg to 1431 kg,



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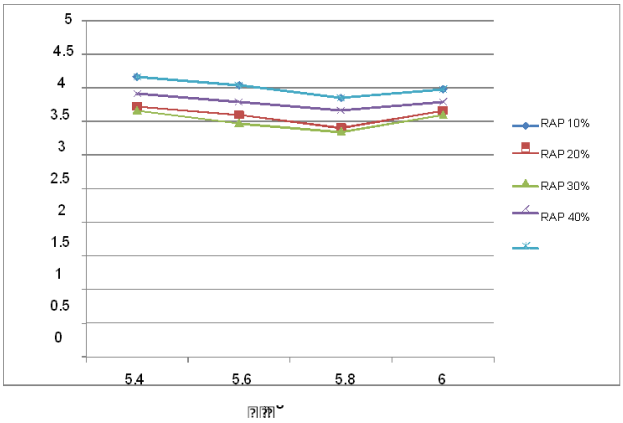
6.3 FLOW VALUE

At 5.8% binder content the flow value of fresh bituminous was found to be 2.9 mm as compared to 3 mm which was the minimum value determined correspondingly to RAP content 20%. This difference is extremely less.



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7. CONCLUSIONS

- As BC made of from the entire four types RAP % satisfies above requirements we can use them for Pavement construction.
- Density of virgin mix were slightly higher than that of RAP 30 % (2.364g/cc) by 0.21% followed by RAP 20 % (2.361g/cc), RAP 40% (2.358g/cc) and RAP 10 % (2.357g/cc).
- The Marshall Stability values of virgin mixes were found to be greater than RAP 30% (1431 kg) followed by RAP 20% (1376 kg), RAP 40% (1308 kg) and RAP 10% (1189 kg).
- At optimum binder content it is observed that RAP 10 % (3.8 mm) had the maximum flow values followed by RAP 40% (3.5 mm), RAP 20% (3.1 mm), RAP 30 % (3 mm) and fresh bituminous mix. Fresh bituminous mix had minimum values out of all mixes.

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