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AN INVESTIGATIONAL STUDY OF WARM MIX ASPHALT CONTAINING HIGH PERCENTAGE OF RECLAIMED ASPHALT PAVEMENT

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ABSTRACT

The topic of my dissertation is "Study of warm mix asphalt containing high percentage of reclaimed asphalt pavement". The main purpose is to use the reclaimed asphalt pavement other than natural/virgin aggregate because nowadays normal aggregate are not easily found. Various tests are conducted on the RAP mix and compared with the virgin asphalt mix.

Mining of aggregates of includes dust, noise and water pollution, the dust spreads in and around and creates disturbance to the natural wild life and human beings and also dust decreases the pollination of the plants that leads to the decrease in the production, noise affects the human people ears. By looking this entire RAP has evolved.

When coming to economy RAP is good as it is decreasing the cost of the project by decreasing the usage of fresh aggregates. This study has found that the stability value increases from 0 to 75% RAP and then it decreases the flow value also increases up to the 75% RAP and decreases. By this stability and flow value the optimum RAP content is 75%. Voids filled with the bitumen increases from 0 to 100% RAP content. By increasing the strength the durability of the pavement increases.

Keywords: Recycled Asphalt Pavement, stability, flow value, durability.

I. INTRODUCTION

Hot mix asphalt was first of all developed in Europe in 1995.It is called HMA because of the temperature at which it occurs. In the United States 90percent of the roads are built with hot mix asphalt. While regular asphalt is produced at a relatively high temperature. HMA is produced at a temperature of -100 degrees F to 35 degrees F below normal. Hot Mix Asphalt basically reduces the flow of asphalt cement at particular temperatures and fully coated aggregate, temperature output lesser with traditional hot mix asphalt that significant advantages over traditional asphalt concrete mixtures. Compaction of asphalt hot mix is performed in the temperature ranges of 250 degrees F-275 degrees F hot mix asphalt was presented by the National Asphalt Pavement Association in 2014.The basic technique of asphalt hot mix is set paving material at lower temperature than normal. This reduction in temperature leads to lower fuel consumption, lower emissions of carbon dioxide, low viscosity of the mixture of asphalt and decreasing aging binder and extend construction season climate

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temperature. It will give the permission to the asphalt pavement material to lesser the temperature in which the material is placed and mixed. The basic function of technologies WMA function is to lesser the flow of binding material at lesser temperature to permit good coating of aggregates. It is also used to maintain good workability and durability.

Warm Mix Asphalt is manufactured by boiling the binder material and to lower the flow and to dry the aggregates and to erase the moisture from the body. Warm Mix Asphalt is the part of pavement of asphalt concrete commonly used in high-traffic main roads, racetracks and airfields. Compaction and paving aggregates should be done when the asphalt is hot. The mixture is made with the addition at 300 degrees F for virgin asphalt and 330 degrees F for polymer modified asphalt and 200 degrees F for asphalt cement. For the majority nations the clearing will be confined on the middle of the year as a result for winter the compacted base black-top excessively cool when it has the ability should a chance to be stiffed to the needed thickness.

HMA is produced by adding zeolites, waxes, asphalt emulsions or water to the asphalt binder when mixed. This results in the mixture and the lowest temperature setting and resulting in a lower consumption of fossil fuels, thus releasing less carbon-dioxide, aerosols and vapours. The lowest temperature which leads to faster availability of the surface for use and it is important that construction with critical times. In the hot mix asphalt it gives easier compaction and allows the cold weather paving on long hauls. The use of warm mix asphalt is increasing rapidly today.

Cold mix asphalt is produced by dissolving the binder in kerosene or lighter oil before mixing with aggregates fraction. In its state of dissolution of cold mix asphalt is less viscous and the mixture can be compacted as easily mix the lighter fraction will be evaporated was placed.

Reclaimed asphalt pavement

Reclaimed asphalt pavement is widely used today to reduce the use of virgin materials and conserve landfill space. Reclaimed and recycled asphalt pavement is the same as recycle materials that optimize the use of natural resources. It reduces the amount of construction and energy saving. A cycle of reuse natural resources is created.

1.1 APPLICATION

Hot Mix Asphalt is manufactured in a manufacturing plant. It equals, mixes heated material or structure that formed from a loosely compacted mass of fragments or particles and liquid natural cement and to manufacture a particle which combine design work. This makes certain that Warm Mix Asphalt is manufactures and available for use the performance characteristics of particular mix design.

1.1.1 Plant batch and drum mix plant: Today two sorts for plants, high temp blend blacktop utilized. Clump plants prepare high temp blend black-top clinched alongside singular lots, same time those drum blend plants process hot blend black-top clinched alongside you quit offering on that one constant operation. Picking an clump blending plant or drum relies ahead business variables for example, buy price, operating costs, handling prerequisites and the have for adaptability over neighborhood businesses.

1.1.2 Drum Mix Plant:- Drum blend plants transform hot blend black-top ceaselessly What's more by and large offer higher rates from claiming plant processing clump. Processing rates to plants drum fluctuate from over 100 metric tonsils for every hour through 900 metric tonsil for every hour, contingent upon those outlines

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of the drum. Because of its system for operation previously, blending plants by drum in general; you could fuse higher levels from claiming reused plants clump.

1.2 TYPES OF HOT MIX ASPHALT

1.2.1 Dense-Graded Mixes

This will be those a large portion basic consolidation utilized today. Its great impermeable qualities permit water with flee starting with those surface zone. It will be subdivided or ordered concerning illustration fine alternately coarse ordered as stated by mossy cup oak aggregates in the last item. This kind from claiming black-top will be Perfect for at movement conditions, Also need incredible execution clinched alongside structural conditions, rubbing What's more for lining and repair shed necessities.

1.2.2 Stone Matrix Asphalt

Stone grid black-top might have been made for Europe, it might have been formed will boost heat imperviousness What's more bring helter smelter solidness. Because of those creation processes, those black-top mixtures maybe that's only the tip of the iceberg unreasonable over dense classified consistently. Due to its secondary cost, it will be proposed should a chance to be utilize within secondary volume interstate highways with profit from its sturdiness Also quality. It will also expand the security of the driver because of the great rubbing competencies for tires, as well as diminish tire commotion Furthermore decrease reflecting split.

1.2.3 Open-Graded Mixes

The Contrast between those two sorts is the qualities of permanganic corrosive. This HMA may be planned main for pounded stone Furthermore a little measure about sand in the mixture

A. Open friction course − graded 15% from claiming air voids required, and no greatest air void rate is specified. This mixture may be utilized main to surface layer. It need an smooth birch surface complete of the – graded thick. Blockage or seal those pore. Also diminish drastically lessened black-top execution Also soundness.

B. Asphalt treated permeable base- It will be utilized low, thick graded mixture for stone or Portland bond cement for waste.

1.3 ADVANTAGES OF WARM MIX ASPHALT

1.31. Easy to compact: It's easy to compact where a mixture rigid design.

1.3.2. Reduce consumption of vegetable fuel: He will give 15% of the fuel consumption during the execution of the plant from 35 to 100 degrees F.

1.3.3. Gas and odour reduction: -The major source of emission of an asphalt plant is the result of the combustion of fuels during the process of drying and heating.

The decrease in fuel consumption is directly correlated with the emission reduction.

1.3.4. Better working environment: -The reduction in temperature behind the paver makes it more comfortable for employees and government workers environment.

1.3.5. Increased recovered asphalt pavement design reducing the viscosity of the asphalt mix allowing hot facilitate coverage of the recovered asphalt pavement.

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1.4 DISADVANTAGES OF WARM MIX ASPHALT

1. The more level temperature utilized within hot blend black-top might bring about inadequate drying of the aggravator.
2. The water trapped in the covered aggregates utilized cam wood cause dampness harm.
3. Additional cost is involved in the use of hot mix asphalt as modifying equipment, patent rights or the cost of the additives.
4. The field trial was initiated asphalt hot and 3-8years before and therefore its long-term performance improvement yet.

II. RESEARCH METHODOLOGY

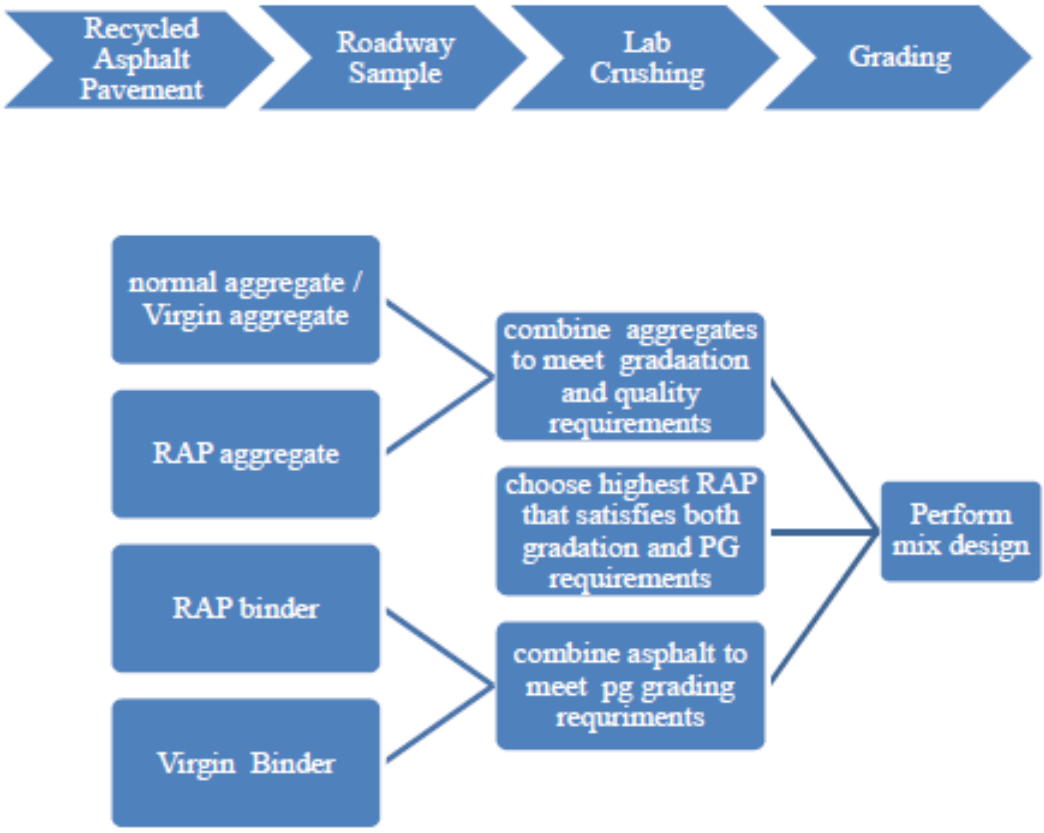

Figure 1. Stepwise procedures for project execution.

III.EXPERIMENTATIONAL SETUP

3.1. Aggregate Testing

3.1.1 BImpact Value

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Repeated loads generate more effect. To estimate the toughness under the repeated loads the impact test is done. The impact value of the recycled aggregates is less than that of the fresh aggregates. The aggregates are collected near the recycled plants and pass them through 12.5 mm take the aggregates which are retaining in the 10mm sieve. The aggregates are compacted in the mould in three equal layers with 25 blows of tampering each layer. Weight the mould separately and mould plus aggregates separately then we get the weight of aggregates filled in the mould. Gently release the hammer for the 15 times after completion take the sample, sieve through 2.36mm sieve and calculate the amount of material passing through the sieve from this impact value is calculated.

Figure 2.Impact testing machine.

Weight of aggregates passing through 12.5mm=580g (W1)

Weight of aggregates passing through 2.36mm=20g (W2)

Impact value = (W2/W1)

Recycled aggregate impact value=3.44%

3.1.2. Crushing Value

The strength of aggregates can be inversely proportional to the aggregate crushing value. If the value is high, the strength is less. For the giving the good pavement/good quality the crushing value should be less. Take the sample of nearly 5kg of passing 12.5 and retaining on the 10mm sieve and compact the aggregates in three equal layers of 25 blows of tampering each layer. Apply the load after completion of applying the load remove the aggregates from the crushing mould and pass them through 2.36mm sieve. The load applied is 40tonnes for the 10minutes i.e., 4 tonnes per minute.

Weight of aggregates passing through 12.5mm=3870g (W1)

Weight of aggregates passing through 2.36mm=400g (W2)

Crushing value = (W2/W1)

Recycled aggregate crushing value=10.34%

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Figure 3. Crushing Test Moulds

3.1.3 Abrasion

Principle of this test is to find the percentage of wear due to the rubbing between the two different things like aggregate and the steel balls. The aggregates are graded according to the table shown below and the charge balls also depend upon the size of the aggregates that going to be used in the test. The revolutions are given according to the size of aggregates, which are 500 for the grades A, B, C, D and the remaining grading is given 1000 revolutions.

Ball sizes are 4.8cm and weight is ranging from the 390 to 445 grams, the total weight due to the steel balls should be 2500 grams. After completion of the test the aggregates are passed through the 1.7mm sieve.

GRADING	Weight in grams of each test sample in the size range, mm(passing and retained on square holes)										abrasive charge	weight of charges
	80-63	63-50	50-40	40-25	25-	20-	12.5-	10-	6.3-	4.75-		
A	-	-	-	1250	1250	1250	1250	-	-	-	12	5000±25
B	-	-	-	-	-	2500	2500	-	-	-	11	4584±25
C	-	-	-	-	-	-	-	2500	2500	-	8	3330±20
D	-	-	-	-	-	-	-	-	-	5000	6	2500±15
E	2500	2500	5000	-	-	-	-	-	-	-	12	5000±25
F	-	-	5000	5000	-	-	-	-	-	-	12	5000±25
G	-	-	-	5000	5000	-	-	-	-	-	12	5000±25

Table 1. Gradation chart for the Abrasion Testing.

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Figure 4. Los Angeles abrasion testing machine

Weight of aggregates passing through 12.5mm=5000g (W1)

Weight of aggregates passing through 2.36mm=929g (W2)

Abrasion value= (W2/W1)

Recycled abrasion value= 18.58%

3.1.4. Specific Gravity

- **Coarse aggregates**

In this the fine aggregates are removed and the remaining coarse aggregates are immersed in water and weighing of aggregates with basket and also weigh the empty basket , also weigh the weight of oven dry aggregates.

Weight of basket and aggregates suspended in water (W1) = 2020g

Weight of empty basket (W2) = 800g

Weight of Surface dry aggregates (W3) =2004

Weight of Oven dry aggregates (W4) = 1995

1) Specific gravity = 2.55

(2) Apparent specific gravity = 2.57

FIGURE 5. Specific Gravity Test With Help Of Mesh Bucket

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3.1.5 Fine Aggregates

Specific gravity of the fine aggregates can be carried with the help of the pycnometer .

Weight of pycnometer W1 = 640g

Weight of pycnometer and aggregates W2 = 1243g

Weight of pycnometer , aggregates and water W3=1910g

Weight of pycnometer and water W4 = 1528g

Apparent specific gravity = 2.73

Figure 6. Pycnometer

Tests	Fresh aggregates (%)	Recycled aggregates (%)
Impact value	17.3	3.44
Crushing value	23.983	10.34
Abrasion value	30.56	18.58
Apparent Specific gravity A) Coarse aggregates	2.46	2.57
B) Fine aggregates	2.69	2.73

Table 2. Comparision B/W Fresh Aggregates and Recycled Aggregates.

3.1.6 Bitumen

A. Ductility

Heat the bitumen at the temperature 1000C and pour in the moulds after 30-40minutes transfer the moulds in the water bath maintain the 270C temperature for half an hour remove the moulds and trim them with the knife and put the moulds in the water 80 minutes and conduct the experimentation.

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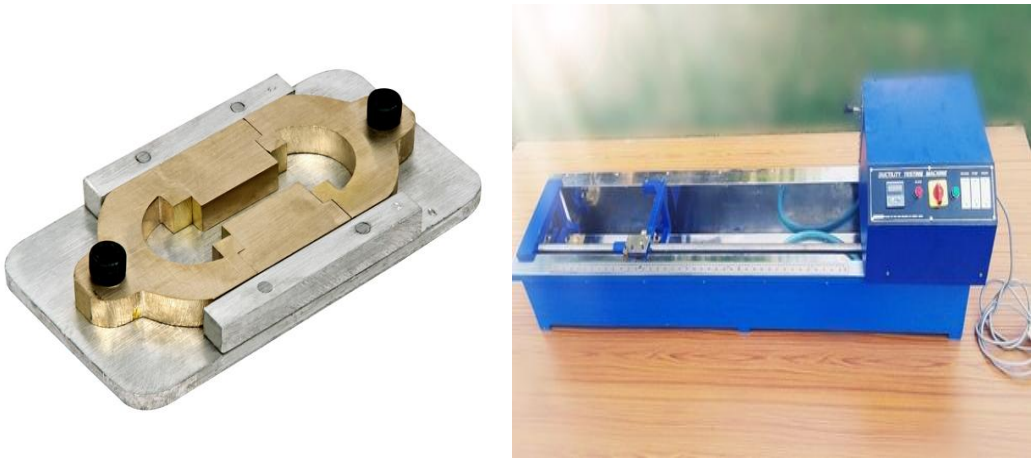

Figure 7. Ductility Mould and Ductility Testing Machine

TIMES	1	2	3
Initial reading	0	0	0
Final reading	44.3	44.5	51.7

Table 3. Observation readings for the ductility test

Ductility value =46.833

B. Softening Point

The softening point and penetration test are use full to recognize the grade of the bitumen. The bitumen is heated and poured in the ring like arrangement, but the arrangement in the water bath and start heating the water should be replace with the glycerine when the softening point is above 80 Degree Celcius.

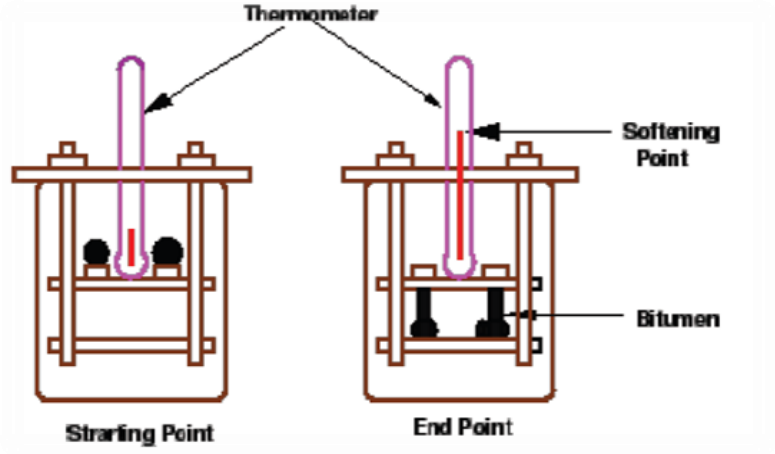

Figure 8. Ring and Ball Apparatus

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	1	2
Temperature when the ball touches bottom, °C	54	57

Table 4. Values of Temperatures in Softening Point

Average = 55.5 Degree Celcius

C. Penetration Test

Heat the bitumen at the temperature of 900C and pour in the mould and put the mould in the water bath. The depth of the mould should be 10mm more than the actual penetration the temperature at the testing should be 55-60 Degree Celcius.

Penetration dial reading	Test 1	Test 2	Test 3
Initial Reading	195	180	175
Final Reading	257	230	220
Penetration Value	62	50	45

Table 5. Penetration Values

Average penetration =52.33

Figure 9. Penetrometer

IV.CONCLUSION

- The observed bitumen content for 0%, 25%, 50%, 75%, 100% RAP are 4.6%, 4.8%, 4.5%, 5.05% and 4.9%. OBC is increased by 1.7% from 0 to 25% RAP and 0 to 100% OBC is increased by 9.8%.
- The stability values are continuously increasing up to the 75% RAP due to the aggregates are coated with the bitumen and they are very hard than the fresh aggregates this can be indicated with the help of the tests conducted on the aggregates.

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- The flow values of the mix decreases from 0 to 75% RAP and again it starts increasing from 75% onwards.
- Percentage of air voids, voids in the mineral aggregates is increasing from 0-75% and voids filled with bitumen are increasing from 0 to 100%.
- Cost of the material can be decreased by using RAP material and effect to the environment can be decreased by decreasing the mining operations for the fresh aggregates. The price for the fresh aggregates can be decreased by decreasing the demand for the aggregates.

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