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To Study the Effects of Partially Replacement of Aggregate with RAP Material in DBM Design in Flexible Pavement

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Abstract -*The road plays very important role in the development of a country. There are two types of road namely flexible pavement and rigid pavement. Former, flexible pavement is mostly used in world. The laid road loses its performance due to deterioration in the pavement and finally ends its useful service. The rehabilitation of road materials is needed for getting eco-friendly environment with reduced requirement of energy. In the research investigation the reclaimed asphalt pavement material is tried to recycle in the pavement with the help of different type of polymers and waste plastics generated from various sources. The waste material RAP, Aggregate, bitumen, shredded plastic size of 2.36 mm to 4.75 mm are used in this research as testing materials to simulate the physical performance in the field. The physical properties of the materials are characterized by investigating the results of stripping value, Marshall Stability of the bituminous mixture. Performance of the waste mixed is compared with the virgin material in the laboratory. The potential outcome indicates that the RAP can be used in the pavement with reasonable performance by using waste plastic as a recycling agent.*

Key Words: **GSB (Granular Sub Base), WMM (Wet mix macadam), Recycled Aggregate, Road Demolition Wastes, Road Dismantling Materials, Road Granular Waste**.

1. INTRODUCTION

Which is necessary for the development of civilizations. Transport infrastructure includes fixed installations including roads, airways, waterways, pipelines, terminals, and ports. Vehicles traveling on these networks may include automobiles, bicycles, buses, trains, trucks, helicopters, watercraft, spacecraft, and aircraft. Thousands of years before urban planning, motor vehicles were made. The first roads appeared on the landscape. Our first roads were built by humans walking similar paths to fetch water and find food. As a small group of people, the network of walking paths in villages, towns and cities became more formal roads. After the wheel's inception about 7000 years ago, large, heavy loads could be carried, turning into muddy paths when it rained. The earliest stone paved roads were built around 4000 BC. The road is categories in to two types:-

1. Rigid Pavement
2. Flexible pavement

2. LITERATURE REVIEW

Kumari et al, 2019 RAP materials with different lifetimes were used in the study, denoted as R1 (5 years) and R2 (15 years respectively). According to the manufacturer's recommendations, the optimal ratio of WMA chemicals considered was 0.1% the weight of the mixture. Through the study of the test performance, it was found that WMA chemicals have anti-aging ability to both natural and RAP mixtures, and it was found that WMA chemicals not only improved the performance-related parameters, but also had good anti-aging properties. **Farooq et al, 2018** Studied the material used raw aggregate alone and was used with 20%, 30%, 40%, 50% and 60% RAP materials. The rejuvenator was added at five concentrations, 10%, 12.5%, 15%, 17.5% and 20% by weight of the RAP pitch. As the proportion of RAP increases and the amount of rejuvenating agent increases, Marshall Stability, UCS and ITS decrease. The TSR and retention stability decrease with increasing

proportion of RAP material, but increase with increasing amount of rejuvenation agent. Therefore, the moisture sensitivity decreases as the amount of rejuvenator increases.

Harun et al, 2018 Studied untreated RAP material is not suitable for asphalt surface treatment because its stability value is 4.68 kN, which is less than 5 kN. The asphalt mixture in RAP material (containing 1% extra bitumen) provides maximum stability and Meet Marshall design standards. Although the stability of the asphalt mixture gradually decreases with the increase of the RAP aggregate with the addition of fresh stone, the properties of the mixture meet the Marshall Design criteria.

Shaikh et al, 2017 Studied, after addition the plastic reduce the aggregate impact value. After increase the plastic content the value of the Loss Angeles Wear is decrease. After increase the plastic content the specific gravity test value after increase the plastic content the specific gravity test value continuously increase. The water absorption test value is continuously decreased, increasing with the plastic content.

Baskandi 2017 The study of manufacturing costs of using recycled mixtures is economical compared to the original mixtures. Several studies have shown that recycled mixtures have similar structural properties and in some cases are superior to conventional mixtures. Recycling the road by

reusing existing materials will protect natural resources for the next generation. Recycling the road by reusing existing materials will protect natural resources for the next generation. Therefore, recycling is environmentally sustainable pavement construction.

Farooq et al, 2017 The use of hot mixing technology helps to increase the RAP ratio. This helps create a better working environment for workers and reduces fuel costs. The use of RAP to produce WMA mixtures helps improve various engineering properties such as workability, creep deformation, rutting, potential low-temperature cracking, and fatigue failure.

3 Test Result and discussion

3.1 Water absorption Test

Table 1 RAP Aggregate test results

Sl. No.	Determination		Trial I	Trial II
1	Wt of SSD Sample (gms)	W1	1440	1550
2	Wt of Sample in Water (gms)	W2	1422.5	1531
3	Wt of Oven dried Sample (gms)	W3	17.5	19
4	Water Absorption (%)	[(W1-W3)/W3] * 100	1.215	1.23

3.2 Stripping Test

Table 2 Virgin Aggregate test results

Determination No.	1	2
Type of Aggregate	12.5 mm retained	12.5 mm retained
Type of Binder	VG-30	VG-30
% Binder used %	5	5
Total Weight of Aggregate g	200	200
Total Weight of Binder g	10	10
Temperature of Water bath, oC	40	40
Stripping Value, %	96.5	98
Mean Stripping Value, %	97.25	

3.3 Aggregate Gradation Test

The specification of MORT&H Fifth Revision clause 500 gives guideline for design of dense bituminous macadam (DBM) is categorized in two types on the basis of aggregate gradation. The aggregate gradation for DBM is categorized in two type likewise grade 1 and grade 2. Grade 1 is used for layer thickness 75-100mm and layer 2 is for 50-75mm. The present project work has followed 2 type of aggregate gradation. The table 5 gives the details specification for these gradations.

Table 3 Aggregate Proportion of Conventional Mixture

Size of passing friction	Aggregate Proportion
26.5 – 16.0 mm	31%
16.0 – 6.3 mm	28%
6.3 – 3.0 mm	10%
3.0 – 00.0 mm	31%

3.4 Specific Gravity Calculation of Virgin aggregate

Table 4 Specific Gravity of aggregate

Size of Passing friction	Bulk SG (Oven Dry)	Apparent SG	Water Absorption
26.5 – 16.0 mm	2.642	2.647	0.08
16.0 – 6.3 mm	2.623	2.673	0.71
6.3 – 3.0 mm	2.616	2.665	0.71
3.0 – 00.0 mm	2.608	2.710	1.45

3.5 Specific Gravity Calculation of Virgin aggregate with RAP Material

Table 5 Specific Gravity of Aggregate with RAP Material

Size of Passing friction	Bulk SG (Oven Dry)	Apparent SG	Water Absorption
26.5 – 16.0 mm	2.642	2.647	0.08
RAP	2.623	2.673	0.71
26.5 – 16.0 mm	2.616	2.665	0.71
3.0 – 00.0 mm	2.608	2.710	1.45

3.6 Penetration Test

The penetration value test was performed to understand the hardness and stability of bituminous materials. The process is followed from IS: 1203–1978. The sample was taken as fresh bitumen collected from the site to prepare the bituminous mixture.

Table 6 BITUMEN PENETRATION TEST (As Per IS 1203)

Trail No.	1			2		
Specimen	A	B	C	A	B	C
Initial Reading	0	0	0	0	0	0
Final Reading	54	56	52	52	54	53
Average Value	54			53		

3.7 Marshall Stability Test

Table 7 Stability Correlation Ratio for Marshall Stability Value

Volume of Specimen cm3	Approximate thickness of Specimen (mm)	Correction Ratio
406 – 420	50.8	1.47
421 – 431	52.4	1.39
432 – 443	53	1.32
444 – 456	55.6	1.25
457 – 470	57.2	1.19
471 – 482	58.7	1.14
483 – 495	60.3	1.09
496 – 508	61.9	1.04
509 – 522	63.5	1
523 – 535	65.1	0.96
536 – 546	66.7	0.93
547 – 557	68.3	0.89
560 – 573	69.8	0.86
574 – 585	71.4	0.83

3.8 Marshall Mix Properties of Sample for Conventional Mix

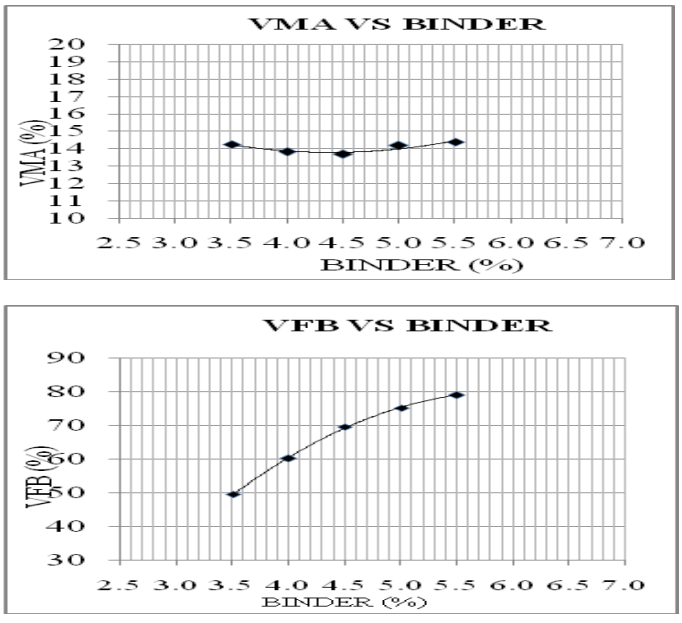

Figure 1 Marshall Parameter Graph for Conventional Mix

3.9 Basic Test of Fresh Bitumen

Table 8 Test and Specifications on Bitumen Material

Sr. No	Property	Test	MORTH V Specification VG – 30	Obtained Values	Method test
1	penetration Value	Penetration Test	Min. 45mm	54mm	IS:1203-1978
2	Softening point value	Softening point Test	Min.37°C	Min.54.1°C	IS:1205-1978
3	Absolute Viscosity Value	Viscosity Test	2400-3600 Poise	3238 poise	IS:1206-1978
4	Specific Gravity Value	Sp. Gravity Test	-	1.03	IS:1202-1978

3.10 Gradation Blending for Virgin Aggregate With 30% RAP Material

Table 9Aggregate Blending for Virgin Aggregatewith 30% RAP Material

Combined Sieve analysis of Dense Graded Bituminous Macadam Grading-II													
	(26.5-16mm)	(16-6.3mm)	(6.3-3.0mm)	(3.0-0.0mm)									
	30	30	10	30									
Sieve Size in mm	(26.5-16)mm	(16-6.3)mm	(6.3-3.0)mm	(3.0-0.0)mm	(26.5-16)mm	(16-6.3)mm	(6.3-3.0)mm	(3.0-0.0)mm	JMF	Specification Limits As per Morth Table 500-10	Lower Limit	Upper Limit	Mid Limit
37.5	100	100	100	100	30.00	30.00	10.00	30.00	100.00	100	100	100	100
26.5	100	100	100	100	30.00	30.00	10.00	30.00	100.00	90-100	90	100	95
19.0	62.58	98.51	100	100	18.77	29.55	10.00	30.00	88.33	71-95	71	95	83
13.2	4.01	86.68	100	100	1.20	26.00	10.00	30.00	67.21	56-80	56	80	68
4.75	3.20	18.03	62.01	99.8	0.96	5.41	6.20	29.94	42.51	38 – 54	38	54	46
2.36	0.00	7.77	8.50	92.95	0.00	2.33	0.85	27.89	31.07	28 - 42	28	42	35
0.300	0.00	4.67	7.77	34.37	0.00	1.40	0.78	10.31	12.49	7-21	7	21	14
0.075	0.00	0.00	5.28	6.95	0.00	0.00	0.53	2.09	2.61	2-8	2	8	5

4. CONCLUSION

On the basis of study and experimental investigations following conclusions -

1. It was observed that the RAP materials can be successfully used in flexible pavements after blending to match the required grading as per MORTH specifications for sub base material.

2. It was also observed that the RAP materials in combination to natural aggregate in various proportions can be easily used after blending to match the required grading as per MORTH specifications in the base courses of flexible pavements.

3. It is clear from the above investigation results that 30% replacement of natural aggregate can be successfully done in base course of flexible pavements, resulting in a savings of around 20- 25% in construction cost.

4. It was observed that RAP has a higher content of fines as a result of degradation of material during milling and crushing operations it can be easily used for soil stabilization purpose to increase the CBR value of sub-grade and hence the crust thickness of road will be reduced resulting in reduction of cost of construction.

5. Above all the problem of disposal of RAP wastes can be easily solved and adverse effect on environment may be avoided by using the RAP materials in flexible pavement construction.

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