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STUDY OF DESIGN OF RECLAIMED ASPHALT MATERIAL BYCOLD IN-PLANT METHOD

[1]Ms. Kiran Sharma, [2]Mr. Mr. Ravindra Kumar, [3] Dr. Ravi Kant Pareek
[1]M. Tech scholar, [2]Assistant Professor, [3]Associate Professor,
[1]Department of Civil engineering,
[1]Vivekananda Global University, Jaipur, India.

Abstract: *This paper presents an in-depth exploration of the mix design process for asphalt pavement using the cold in- plant method. The cold in-plant method is an innovative approach that involves mixing asphalt aggregates and binders at ambient temperatures, offering several advantages such as reduced energy consumption, increased production flexibility, and improved workability. This report aims to provide a comprehensive understanding of the key components, considerations, and procedures involved in cold in-plant mix design. The study encompasses a detailed analysis of aggregate selection, binder characterization, gradation optimization, and performance criteria to ensure the production of high-quality asphalt mixtures. Moreover, it highlights the importance of laboratory testing, quality control measures, and sustainability aspects associated with cold in-plant mix design.*

Keywords*: Asphalt, Payment, Cold in-plant, Mix design, Workability.*

I INTRODUCTION

Reclaimed asphalt pavement in short means (RAP). Reclaimed asphalt pavement is defined, these materials are generated, when the asphalt pavement are removed for the reconstruction, resurfacing and to obtain buried utilities. The natural aggregates have been carried out from a variety of rock sources and have been used as a road material. They serve the purpose of reducing the amount of construction, land disposal, reducing environmental disturbanceand rate of natural resource depletion.

Reclaimed means -recycling of material, involves milling out of thick layers of bituminous courses forming the road crust over number of years, asphalt/ bituminous pavement consist of layers of bituminous material courses laid according to the requirement of pavement design.

The summation of recycling +asphalt pavement =RAP.

The Reclaimed asphalt pavement (RAP) technique involves the reuse of old aggregates with the same stiffness, durability, and strength. The percentage of the reclaimed asphalt pavement material to be used depends upon the thickness requirement of the new area where it is to be used. The quality property of that source decides the characteristics of the RAP. Normally 30% of the RAP material is used in National highway and State highways.

But after research it is found that more than 50 percent of the material of RAP can be used for low volume roads. Rest of the material if available is dumped at a convenient place over is used in paved shoulder, which is treated as the contaminated material. The ministry of rural development, GOVERNMENT OF INDIA has advised making optimum use of RAP material, as per IRC guidelines and ASSHTO methods. Countries like Japan, Canada, the USA are having the proper guidelines, are very well advanced in following this procedure. But in India, the use of RAP is recently introduced. The engineer is not equipped with the proper data. But with the coming time, our engineer will be more expert than in other countries.

1.1 Objective of paper

The objective of this study is to provide a comprehensive understanding of the mix design process for asphalt pavement using the cold in-plant method. The report will cover the key components, considerations, and procedures involved in this method, including aggregate selection, binder characterization, gradation optimization, performance criteria, laboratory testing, quality control measures, and sustainability aspects.

- To study the use the recycled material as filling material without doing any test in low volumeroad.
- To investigate the characteristics of the recycled material to be used in road construction.

II MATERIALS AND METHODS

2.1 ABOUT THE PROJECT-

SOURCE-Aggregate is brought from the Pathankot and bitumen from IOCL Panipat.LOCATION-Khadar to Samrala chowk, Ludhiana.

2.2 MATERIAL USED

Table-1 Material and specifications

Bitumen	Bitumen of VG-40 is used for the preparation of sample.
Virgin Aggregates	As per IRC 90:2010 & MORTH specification the selection of aggregates is made.
RAP Aggregates	RAP aggregates are the aggregates obtained after the screeningof milled pavement.

2.3 STEPS USED -

- STEP -1 CONDITION OF ROAD

Different road has different criteria of improving. This is done by the survey of engineer after investigating the site. The condition may me good, better or worst it's all depend upon the surface, base and sub base. The condition of the road may be raveled, polished surface and many other

distressconditions. These conditions will decide the depth of reclamation. The core cutter method is also used forknowing the depth of road.

- STEP-2 RECLAMATION

Reclamation has three method, first one is demolition, milling and breaking. We have chosen milling method for reclamation. Milling is the machine which is used to extract the pavement surface Layer from thebituminous and bituminous asphalt mixes. We have reclaimed about 75 mm of layer.

- STEP-3 RECYCLING-

There is various method of recycling such as cold in place recycling, Hot in place recycling, cold inplant recycling, Hot in plant recycling. The best suitable method of recycling in INDIA is cold in plant recyclingmethod. All other method has different process and our country is new in this field.

Table-2 Types of conditions of the road

S.No.	Type of road	Problem
1	Raveled Road	• The raveled road surface is the progressive disintegration of a pavementsurface through the loss of both bitumenbinder and aggregate. • HIR is the best method to recycle.
2	Worst Serviceability	• It is layered by the fatty surface given worst serviceability for the motor vehicles and skid resistance. • HIR is the suitable option.
3	Corrugated road	• Corrugated surface giving serviceability. • Corrugation in the base layer checked by digging a hole across the surface road. The digging of the test pit will indicate the failure
		of the base and subgrade. After investigation of the pavements, thedepth of the recycling is determined.
4	Diagonal cracking, transverse cracking, longitudinal cracking, Cornerbreaks.	• Longitudinal cracks occur due to faulty construction, while the diagonalcracks occur due to shear failure of the mix. • HIR and CIR are a suitable option.
5	Alligator cracks	• HIR is not the suitable recycling option. • HIP or CIP could be the better option provided on cracks for deeper progress

Table-3 Different methods of recycling and details

S.NO.	NAME OF THE METHOD	USE & DEPTH OF RECYCLING
1	Reclamation	Cold and hot recycling method
2	Hot in Place recycling (HIR)	It entails the manufacture and placement of hot mix material without the use of virgin aggregate or binders. (50mm)
3	Hot in plant recycling (HIP)	Infrared heating is used to recycle in this process (100 mm)
4	Cold in Place recycling (CIR)	In cold in place recycling method milling and mixing are the simultaneous process accomplished bythe single equipment and conveying the milled material in to the pugmill. (75mm)
5	Cold in Plant recycling (CIP)	Cold in plant recycling the reclaimed material is stock piled in large quantity. (100mm)

Fig-1: Picture gives prediction of the cold in plant recycling of reclaimed asphalt pavement (RAP).

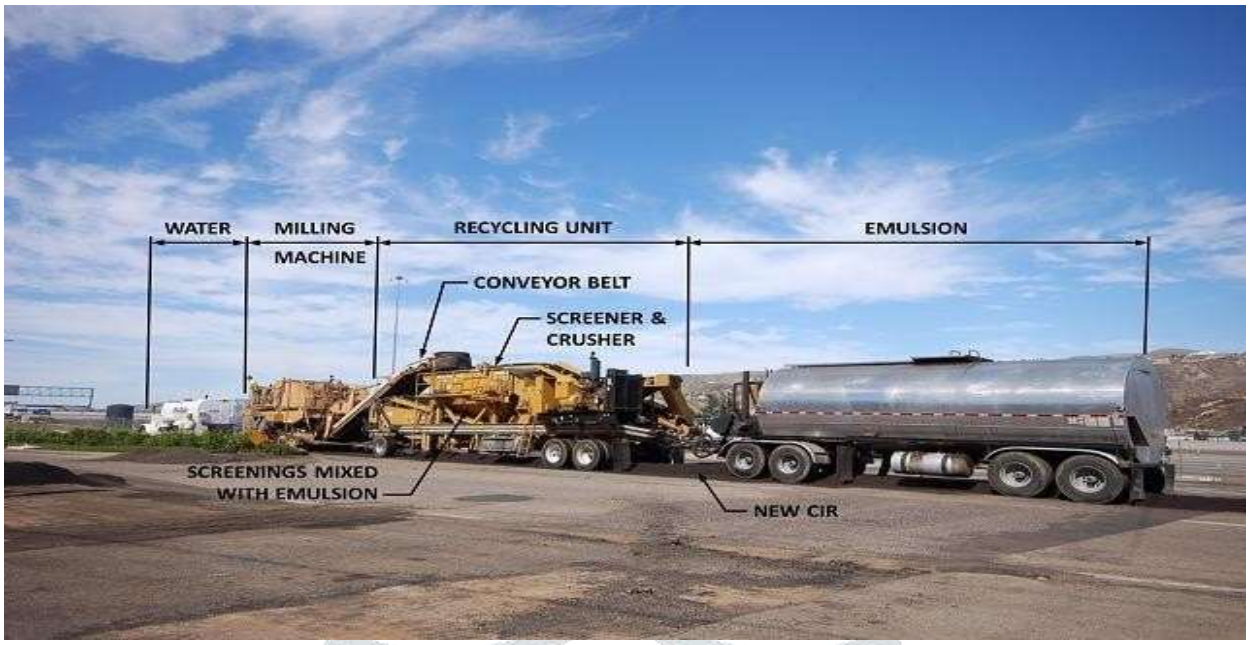

Fig-2: Pictorial representation of cold in place recycling

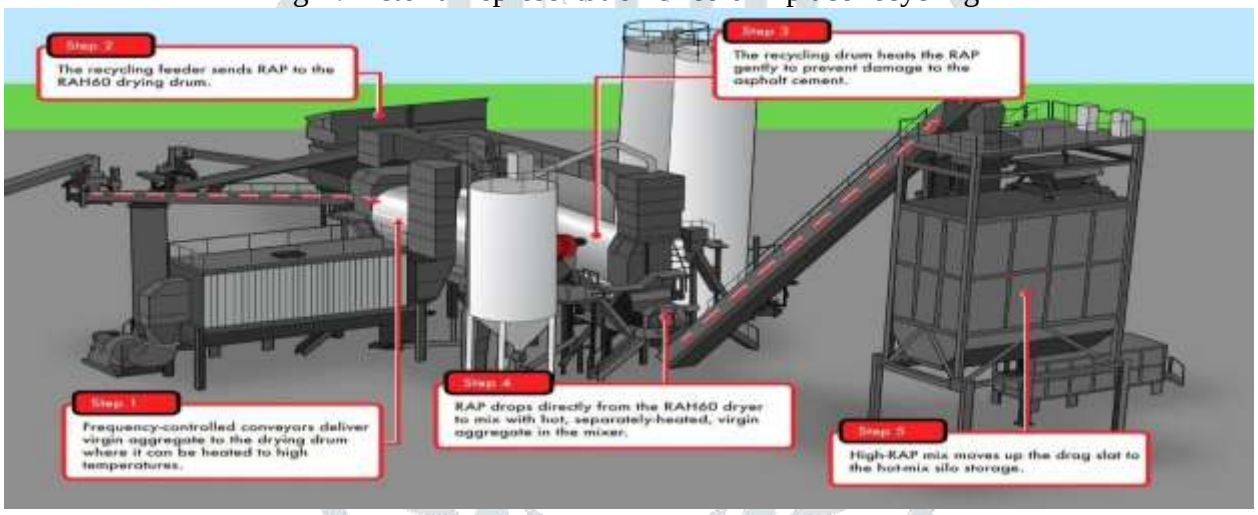

Fig-3: Pictorial representation of Hot in Plant recycling method

Table-4 Laboratory Tests done after recycling

S.No.	Material	Tests
1	Bitumen	• Viscosity test • Softening Point test • Penetrometer test • Ductility test • Fire and Flash Point test
2	Aggregate	• Sieve Gradation test • Specific Gravity test • Aggregate Impact Value test • Flakiness and Elongation test
3	Bituminous Asphalt	• Observation of bitumen content • Bulk and apparent Specific Gravity (DBM) • Marshal Stability test

III RESULTS AND DISCUSSION

3.1 Results with related to viscosity:

Table-5 Characteristics of the paving grade

S. NO	CHARACTERISTICS	PAVING GRADES				MTD. OF TEST REF. TO IS NO.
		VG 10	VG 20	VG 30	VG 40	
1	ABSOLUTE VISCOSITY AT 60 DEGREE CELSIUS, POISE, MIN	800	1600	2400	3200	IS 1206(PART-2)
2	KINEMATIC VISCOSITY AT 135 DEGREE CELSIUS, MIN	250	300	350	400	IS1206 (PART-3)
3	FLASH POINT AT CELSIUS, MIN	220	220	220	220	IS 1209
4	VISCOSITY RATIO AT 60 DEGREE MAXIMUM	4	4	4	4	IS 1206 (PART-2)
5	DUCTILITY AT 25 DEGREE CELCIUS	75	50	40	25	IS1208

3.2 Penetration test:

The penetration value of the bitumen came about 47mm.

3.3 Result of sieve gradation test:

Table-6 Average value of all sieve gradation tests

IS SEIVE SIZE (mm)	K-1(40.0-24.0mm)	K-2 (24-14mm)	K-3 (14-6mm)	K-4 (6-0mm)
37.50	100	100	100	100
26.50	100	100	100	100
19.00	67.24	91.09	100	100
13.20	7.53	39.17	97.91	100
4.75	0.22	1.12	18.34	93.56
2.36		0.42	9.10	73.59
0.300			3.04	39.66
0.075			1.39	8.20

3.4 Flakiness and elongation index test results:

Table-7 Flakiness index/ Elongation index (As per IS 2386 -PART-1-1963)

IS SEIVE RANGE (MM)	TOTAL WT. AGGREGATE (GM)	TOTAL WT.OF FLAKY PARTICALS	FLAKINESS INDEX	TOTAL WEIGHT OF NON-FLAKY PARTICLES	TOTAL WIEGHT OF ELONGATED PARTICLES	ELONGATION INDEX%
40-25	1360	125		1235	90	
25-20	2088	152		1936	115	
20-15	1755	202		1553	102	9.33
16-12.5	1169	185	11.69	984	124	
12.5-10	685	152		533	138	
10-6.3	248	38		210	33	
TOTAL	7305	854		6451	602	

Table-8 Aggregate Impact value (As per IS 2386 PART-4)

SAMPLE NO-	WT. OF CONTAINER +AGGREGATE (GM)		WT. OF AGGREGATE BEFORE CRUSHING (GM)	WT. OF AGGREGATE PASSING ON 2.36 MM SEIVE	AGGREGATE IMPACT VALUE%	AGGREGATE IMPACT VALUE%
	1	2	3=2-1	4	5=3-4	6=(5/3)*100
1	590.0	940.0	350.0	303.3	46.7	13.33
2	590.0	940.0	350.0	303.8	46.2	13.20
3	590.0	940.0	350.0	304.3	45.7	13.05
4	590.0	940.0	350.0	304.5	45.5	13.00
5	590.0	940.0	350.0	303.6	46.4	13.25
6	590.0	940.0	350.0	303.3	46.7	13.35

Table-9 Specific gravity test

SL. NO	% OF BITUMEN	% OF AGG	MOULD NO	WT. IN AIR	WT. IN WATER.	SSD WT	BULK VOLUME	BULK SP. GR. OF SPECIMEN	AVG .SP. GR. OF SPECIMEN
	PB	PS=(100-PB)		Wa	Ww	Wssd	Bv=Wssd- Ww	Gmb=Wa/Bv	Gmb
1	5.52	94.48	1	1194.3	687.8	1197	509.1	2.346	2.348
			2	1193.6	686.3	1197	510.5	2.338	
			3	1201.5	694.6	1204	509.3	2.359	
2	5.51	94.49	4	1198.7	691	1202	510.7	2.347	2.352
			5	1196.3	690.9	1200	509.3	2.349	
			6	1198.8	694	1204	508.6	2.359	

3.5 Bituminous and Asphalt test results (BC/DBM/BM) (RAP MATERIAL)

3.5.1 Theoretical maximum specific gravity and density GMM TEST-

1) The max. specific gravity is: 2.467

2) Average max. specific gravity is 2.469.

3.5.2 Bitumen extraction test:

The percentage of bitumen is 1.50, the result obtained shall be reported as the percentage of the bindercontent in the mix to the nearest second decimal.

3.5.3 Marshal stability test for bitumen:

Table-10 Calculation of marshal stability test

STABILITY				FLOW	
MEASURED (DIVISION) (A)	CORRECTION FACTOR FOR VOLUME (B)	ADJUSTED(KG) (A*B*PF)	AVERAGE	MEASURED (DIVISION)	AVERAGE
215	1	1357.51	1378.56	3	3.1
230	1	1452.22		2.8	
210	1	1325.44		3.5	
240	1	1515.36	1438.33	2.6	3
225	1	1420.65		2.7	
210	1.04	1378.98		3.7	

Result-The average value we observed is 3.1 and 3.0.

IV CONCLUSION

- The RAP material is dumped and rolled in to the shoulder for increasing its thickness andstability.
- saving the Bitumen which is highly costly natural source.
- The recycled material is used for making urban road.
- RAP material has limited the use of virgin aggregate.
- By performing laboratory test and other trial error method. we came to conclusion that, theRAP material can draw the same result of strength, stability and durability as virgin aggregate.
- With the 30% use of RAP material, we are benefited by same strength and low cost.

(a) Raveled road

(b) Worst Serviceability

(c) Corrugated Road

(d) Diagonal cracking, transverse cracking,longitudinal cracking, Cornerbreaks.

Fig-4: Types of Road

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