Experimental Investigation on Higher Proportion of Recycled Asphalt Pavement Mixture for Road Construction

Anu Thakur, Sandeep Singh

Abstract*: *The tremendous usage of virgin asphalt and aggregates is leading to their exploitation as a resource. There is a great importance to use the ruined pavement materials which causes various environment hazards and creates disposal problems. The main purpose of this study is to use the higher proportion of recycled asphalt pavement mixtures for road construction in a national highway project. The percentage of Recycled Asphalt Pavement (RAP) is taken at a range of 10% to 50% and then doing various tests related to strength and check the best one percentage of Recycled Asphalt to be used in road construction. The main scope of this study is to reduction in material cost, energy cost and also total job cost. This is done as RAP involves reuse of materials so the above all cost reduces. Through this the amount of bitumen content present in the RAP is calculated. Today the reduction on the dumping of reusable materials is increasing. So in future there is very high possibility of ban on their disposal into landfills. So that is the reusing of bituminous material show to sustainable development. An effort is done to achieve the stabilization of asphalt by performing different tests on bitumen and aggregates as per MORTH specification. Furthermore an attempt was carried out through Marshall Stability Test to examine the all Marshall values mainly the load and flow rate of asphalt specimen by using manual compaction and conditioned in a water bath at a specified temperature. This paper presents a research to study the behavior of mixture of asphalt with RAP. Finally a guideline that is selected from the reference sample to be in service of access the higher proportion of RAP and the optimum value of modified sample.

Keywords: - RAP, Asphalt, Marshall Test, Flow, Stability.

I. INTRODUCTION

RAP(Recycledasphaltpavement)isdefinedasdetached pavement material containing asphalt and aggregates. These materials are caused when asphalt pavements are removed for resurfacing, reconstruction or to obtain access to buried utilities. The use of recycled asphalt pavement has become the most common resource to produce new asphalt. It also reduces the cost of construction and environmental impacts by reusingthe Existing pavement. Now RAP is being used with various methods as the technology with RAP has increased. Hot mix asphalt without RAP materials has been shows the same qualities as hot mix asphalt with RAP material in terms of rutting, ravelling and weathering and also fatigue and cracking. These materials are also used for granular sub base andgranularbaseofflexiblepavement.ThepropertiesofRAP materials can be improved by blending of aggregates and by addition of chemicalstabilizers.

In recent years there was a gradual increase in construction and demolition wastes. It has resulted in waste disposal problem due to shortage of available landfills. Reuse of these materials after proper recycling cab be the right solution for thesame.Therewillbereductionincostabout25%to30%by reusing the recycled material generated at same site. Before using such materials the mechanical properties must be tested and suitable blending is done ifrequired.

The percentage of Recycled Asphalt is chosen at different levels by various researchers. But in this work we take a range ofRecycledAsphaltfrom10%to50%andcheckthebestone percentage of Recycled Asphalt to be used in road construction.

II. OBJECTIVES

- To check the feasibility of using up to 50% Recycled Asphalt. Used in road construction (by doing proportionofRecycledAsphaltofrange10%to50% and then preparing the sample and doingvarious test related to strengthetc.)
- To compare the test results for different proportion of Recycled Asphalt and find the Optimum Percentage Value.
    - To do costanalysis.
    - Using VG40grade.

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III. METHODOLOGY

It is one of the most important and difficult step for anyworkbecausethewholeresultsaredependupon the series of task that are followin the methodology. Nowfollowingarethestepsareadoptedinthiswork.

- To conduct the standard test for the performance of bitumen.
- To conduct the standard test onaggregates.
- To determine the Optimum binder content (OBC) by Marshall StabilityTest.
- Mixing the different range of Recycled Asphalt from 10% to 50% and check the best one percentage of Recycled Asphalt to be used in roadconstruction.
- Add the chemical admixture named as Zycosoil to further enhance the percentage of Recycled Asphalt in roadconstruction.
- FindthestabilityandflowbyperformingtheMarshall test onsample.

IV. EXPERIMENTWORK

4.1 MATERIALS

4.1.1 VG40Gradeisusedtopreparethesamples.Therelated test of this bitumen is shown in belowTable1.

S.NO	BITUMEN TEST	OBTAINED VALUE	ACCEPTANCE LIMITS
1	Penetration Test (ASTM D5)	38mm	35-50
2	Softening Point Test (ASTM D36)	50.67°C	50-58
3	Ductility Test (ASTMD113)	52.4cm	≥60
4	Specific Gravity Test(ASTM D70)	1.030	1.0 – 1.1

Table 1 Test on Bitumen VG-40

4.1.2 Aggregates: The test conducted for aggregates will be as per IS383:2016 Specifications are underas:

S.NO	AGGREGATE TEST	OBTAINED VALUE	ACCEPTANCE LIMITS
1	Aggregate Crushing Test (IS 2386 Part 4)	21.80%	30% max
2	Aggregate Impact Test (IS 2386 Part 4)	15.60%	24% max
3	Aggregate Abrasion Test (IS 2386 Part 4)	22.9%	30% max
4	Flakiness And Elongation Test (IS 2386 Part 1)	26.22%	40%
5	Specific Gravity Test	2.4	2.1 – 3.2

Table 2 Test on Aggregate

4.1.3 RecycledAsphalt:

The RAP sample is collected from NH 95, near Village –Khamano, District- Ludhiana (Punjab). Through the Milling machine a required depth ofthe pavement is removed and smooth the surface by removing the paved area and RAP is loaded intohaul trucks. Afterwards the percentage of recycled asphalt is calculated by performing Bitumen Extractor Test with the use of Benzene. In 500g of RAP the 3% (15g) Recycled Asphalt isextracted.

Figure 1: RAP loaded into truck

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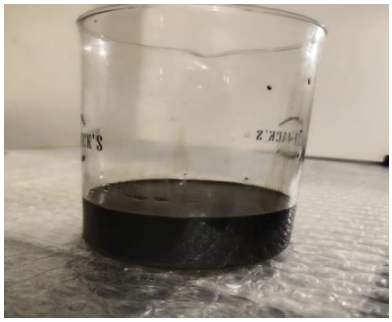

Figure 2: Recycled Asphalt

4.1.4 Benzene: It is an organic compound havinga chemical formula C6H6. As in liquid appearance benzene is colourless, clear and it is very easily evaporates at room temperature. Here, benzene isuse to separate the Recycled Asphalt fromRAP.

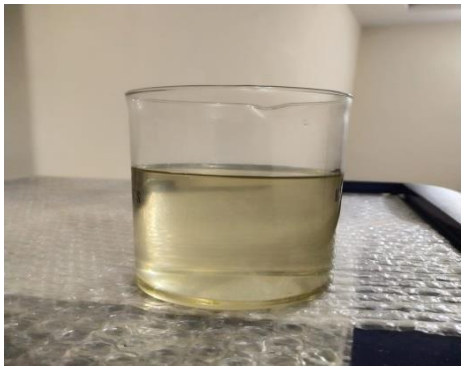

Figure 3: Benzene

4.1.5 Admixture: Zycosoil (ZYDEX Industry) is very rich in to control the Anti-stripping of the aggregates and asphalt by giving them proper stability. It helps to reduce the oxidation of the bituminous binder and also it is very much stable. Here, this admixture is used to enhance the best percentage to Recycled Asphalt with different dosage of Zycosoilchemical.

4.2 MIXPREPARATION

Theconstructionofcommonasphaltmixisdone by traditional method. The RAP mix includes the followingsteps:

- Take 500g sample of recycled asphalt pavementanddeterminethequantityof recycled asphalt.
- Replacement is performed at different proportion from 10% to 50% of recycled asphalt with virginasphalt.
- NowthesamplewithmixtureofRAPand naturalmaterialsispreparedforfurther testing.

4.2.1 MarshallTest:

- Toprepareasampleof1200gbituminous mix the required quantities of a course and fine aggregates are collect in pan and further kept in oven at a temperature of175ºC.
- Heat the bitumen to its melting point and kept it in the oven at preheating between 100 to150ºC.
- Now mix the heated Recycled Asphalt at required percentage in the virgin bitumen.
- When the whole mixture is mix completely, transfer the mix to the pre-heated mould and compacted the mixwith75numbersofblowsbyusing hammer from both thesides.
- After this, the sample is left to cool at room temperature for 24hours.
- Before the testing is to be done, the weight in air and submerged weight of the sample is calculated and then the sample is kept in water bath of temperature of 60ºC for 30minutes.
- Find the value of flow and stability in Marshall Stability TestApparatus.

4.2.2 Marshall Test Result: After finding the OptimumBitumenContentat5%,thefollowingpercentages of Recycled Asphalt is mixed with the virgin materials and find that with increase the percentage up to 30% gives better resultsbutafterthatthereisdeclinedinthestabilityvalue.So the use of 30% of Recycled Asphalt gives the best percentage from 10% to50%.

Recycled Asphalt + Natural Material	VA (%)	VMA (%)	VFB (%)	FLOW(MM)	STABILITY(Kg)
10% + 90%	4.35	15.7	72.92	2.86	2161.76
20% + 80%	3.71	15.15	76.06	3.19	2243.34
30% + 70%	**3.44**	**15.26**	**77.16**	**3.48**	**1855.85**
40% +60%	3.10	14.19	79.25	3.97	1815.66
50% + 50%	0.7	12.86	94.59	4.50	1325.61

Table 3: At Optimum itumen at Content 5%

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So,wecansaythat**30%RecycledAsphalt**isthebesttobe with the virgin or natural materials for road construction in National HighwayProject.

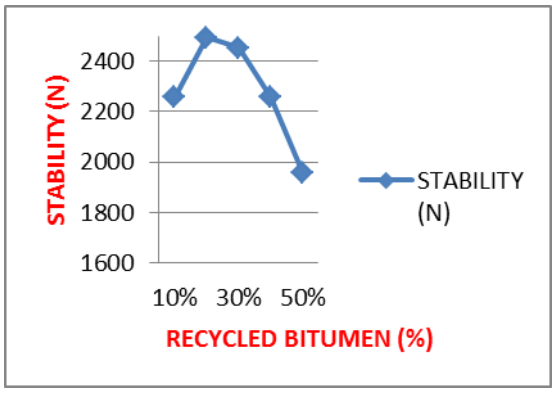

Figure 4: Marshall Stability v/s Recycled Asphalt content.

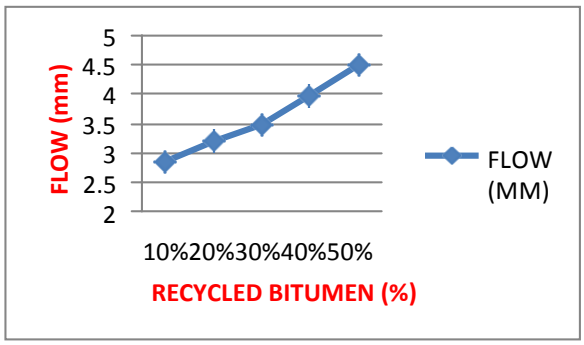

Figure 5: Flow value v/s Recycled Asphalt content

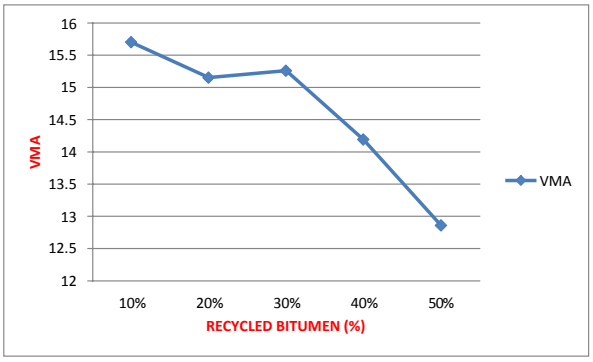

Figure 6: Volume of Mineral Aggregates (VMA) v/s Recycled Asphalt content.

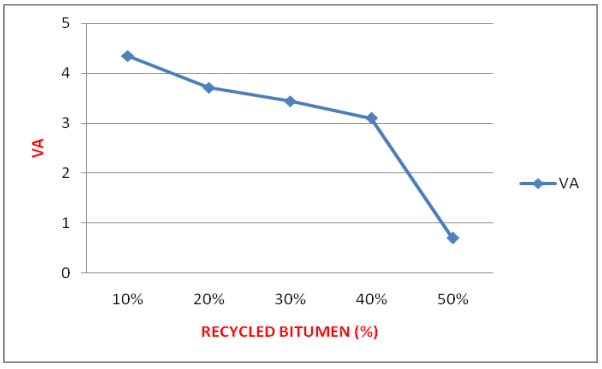

Figure 7: Air Voids (VA) v/s Recycled Asphalt Content.

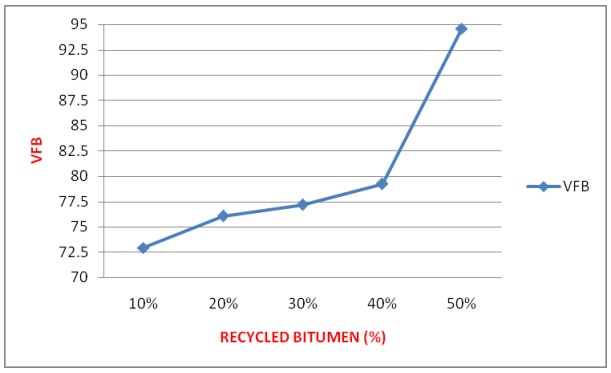

Figure 8: Void filled with Bitumen (VFB) v/s Recycled Asphalt Content.

V. CONCLUSIONS

- It was conclude that 15g Recycled Asphalt is extracted from the 500g of Recycled AsphaltPavement.
- It was noticed that the Recycled Asphalt can surely be used in any National Highway after making it compatible to the required specifications ofMORTH.
- Fromtheaboveresultsitisveryclearthatfrom 10% to 50% the 30% of Recycled Bitumen percentageisthebesttobeusedin mixtures for road construction because it gives the quite better stability and flowvalue.
- So by this the problem of dumping of RAP is totally solved as the waste material is used in thepavement.
- The effective use of waste material make it environment friendly as well as deduction in thecost.

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