JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

EXPERIMENTAL STUDY ON UTILISATION OF WASTE ENGINE OIL AS PARTIAL REPLACEMENT OF BITUMEN AND PINE RESIN

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ABSTRACT

In today's world conservation of environment from the different waste generated and the excessive use of the non-renewable resources has led to the way to find the new material either a waste or a renewable resource, which also don't harm the environment and which can also be utilize to partially replace the bitumen used in the road construction work. Therefore, use of waste engine oil obtained from vehicle and pine resin generated by trees could answer that demand. They can be used in order to meet the demand of the bitumen required in road paving without compromising there properties which is essential for construction or paving work. The pine resins can be used as an admixture .Bitumen mixtures were tested by means of different tests like softening point, penetration value, specific gravity and ductility. It was concluded that the waste motor oil when added it increases the value of penetration and improves ductility.

Key words: Bitumen,waste Engine oil, Modified Bitumen, pine resins, waste material, waste motor oil.

1.INTRODUCTION

Right now, there is a developing worry to reuse waste materials and to monitor or limit the utilization of natural assets in road paving. In this manner, numerous investigations have as of late risen in which these issues, or some portion of them, are talked about.
For prevention and construction of road infrastructures the road paving industries utilize a high amount of natural and finite resources, such as bitumen and aggregates.
Bitumen plants are considered as significant sources of pollution as it has very excess amount of greenhouse gas emissions. Bitumen is a non-renewable resource so we have to use it suitably as it is generated after many years and the extraction of bitumen is not very eco-friendly and environment friendly. In India the production of bitumen have been limited and only some time period of year it can be extracted and only in limited amount.

2.OBJECTIVE

This study is conducted to accomplish some predefined objectives. These objectives are:

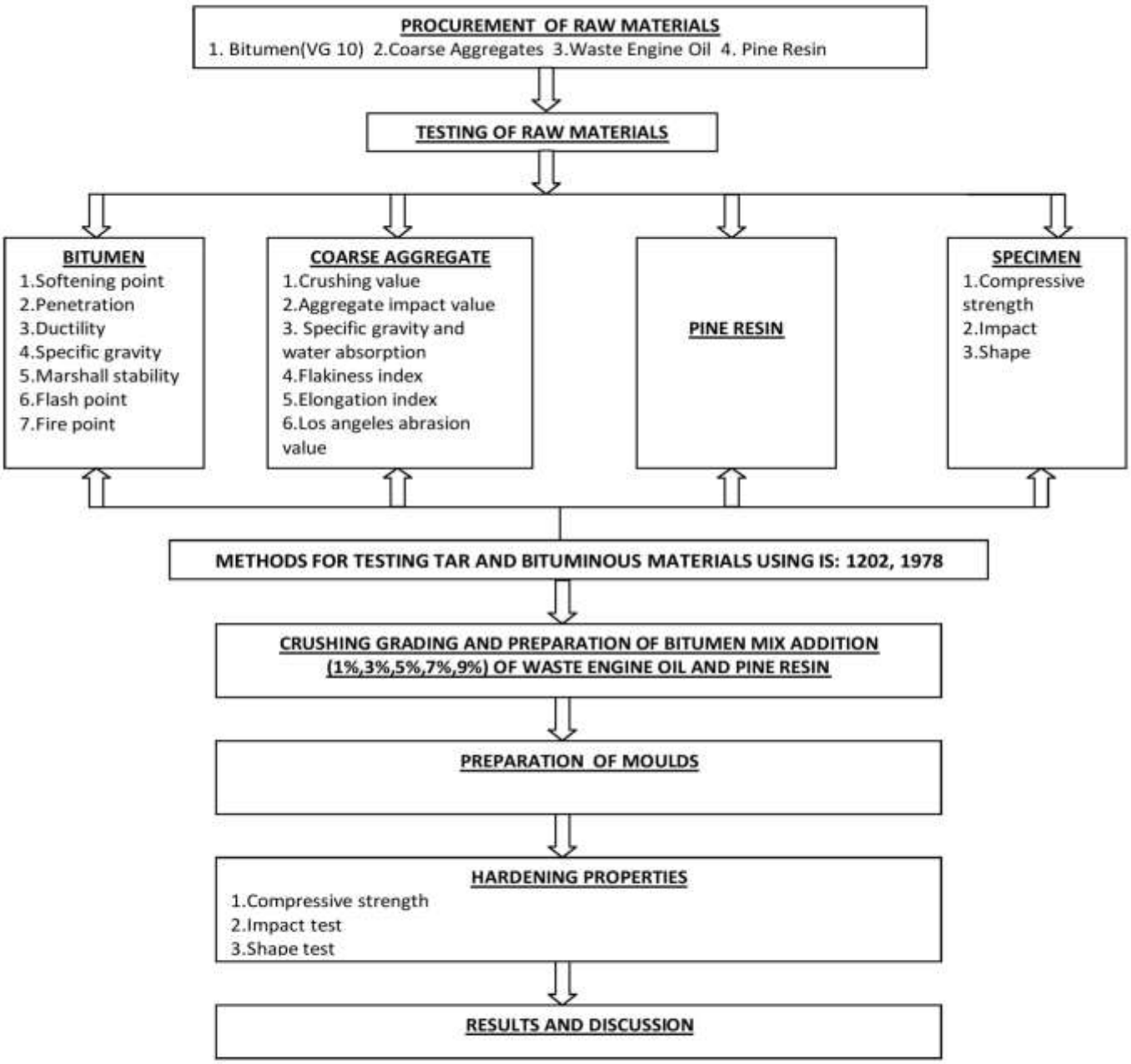
I. To study experimentally the partial replacement of conventional bitumen by waste engine oil and pine resin(admixture).

II. The partial replacement of conventional bitumen with different proportions/percentages like 1%, 3%, 5%, 7% and so on up to 9% of waste engine oil and pine resin respectively by

weight.

III. This solution is also environmentally friendly, because waste motor oil is not totally recyclable.

3.METHDOLOGY



.RESULTS

4.1 TEST RESULTS FOR COARSE AGGREGATES		
Sl.NO	**TESTS**	**RESULTS**
1.	GRADING	10 MM NOMINAL SIZE
2.	SPECIFIC GRAVITY	2.630
3.	WATER ABSORPTION	0.55%

4.2TEST RESULTS ON CONVENTIONAL BITUMEN			
Sl. NO	**Characteristic**	**Value**	**Remark(IS:73:2013)**
1	Penetration(0.1mm)	86	80-100
2	Softening point(°C)	48	40(Min.)
3	Ductility(cm)	84	75(Min.)
4	Specific gravity	1.02	0.98(Min.)
5	Marshall stability(KN)	5.5	≥3.4

SL. No.	Sample	W1(gm)	W2(gm)	W3(gm)	W4(gm)	Specific Gravity
1.	VG-10 (conventional bitumen)	26	70	45	71	1.01
2.	1% of replacement with waste engine oil	20	64	41	65	1.05
3.	3% of replacement with waste engine oil	26	81	50	81	1
4.	5% of replacement with waste engine oil	20	64	40	64	1

5	7% of replacement with waste engine oil	27	71	46	72	1.01
6	9% of replacement with waste engine oil	27	64	44	72	1.03
7	11% of replacement with waste engine oil	20	64	40	64	1
8	13% of replacement with waste engine oil	20	64	41	64	1.04

Specific gravity= ((W3-W1)/ (W2-W1)-(W4-W3))

As from the above table 4.2 it is clear that the specific gravity of the conventionalbitumen as well as modified bitumen with waste engine oil lies within the permissible limit as specified by the Indian standard code IS: 1202 1978. Hence this is suitable for testing.

PROPERTIES OF BITUMEN ON ADDITION OF PINE RESIN

Penetration test:

Table 4.4 Penetration test results

Sr. No.	**Sample**	**Penetration value**			**Mean Value of penetration (mm)**
		1(mm)	**2(mm)**	**3(mm)**	
1.	VG-10 (conventional bitumen)	86	84	90	86
2.	Bitumen with 1% replacement of pine resin	13	13	10	12
3.	Bitumen with 3% replacement of pine resin	9	9	12	10

4.	Bitumen with 5%replacement of pine resin	8	8	9	8.33

As from the above table 4.4, that as the percentage of pine resin increases the penetration value decreases significantly. It is clear that the addition of pine resin has a strong effect on bitumen mix as its makes the bitumen very hard in nature.

Softening point test:

On the basis of the results it was observed that the percentage of pine resin in bitumen increases the value of softening point also increases as shown in Table 4.3. Therefore, it was concluded that bitumen modified with pine resin has a good potential at hot climates regions where temperature rises to more than 50°C.

Table 4.5 Softening point test results

SL. No.	**Sample**	**Temperature (° C)**		**Mean value of softening point(°C)**
		Ball(1)	**Ball(2)**	
1.	VG-10 (conventional bitumen)	48	48	48
2.	Bitumen with 1% replacement of pine resin	63	63	63
3.	Bitumen with 3% replacement of pine resin	67	67	67
4.	Bitumen with 5% replacementof pine resin	69	71	70

We also observe that as the percentage of pine resin increases, value of Softening Point keep on increasing due to the fact that penetration also decreases and it becomes brittle.Ductility test

Table 4.6 Ductility test results

SL. No.	**Sample**	**Ductility in cm**
1.	VG-10 (conventional bitumen)	86
2.	Bitumen with 1% replacement of pine resin	4

3.	Bitumen with 3% replacement of pine resin	0(sample failed)
4.	Bitumen with 5% replacement of pine resin	0(sample failed)

From above table 4.6 we observed that as the percentage of pine resin increases the value of ductility has drop down significantly. This can also be inferred that as the softening point value increases and penetration value decreases with increase in the percentage of pine resin as a result of which it is becoming brittle and hence we see the failure.

Marshall stability test

Bituminous concrete mixing is routinely employed by Marshall Law. This test is widely used in regular testing programs for the construction of paving jobs. The dependence of the mixture is characterized as the most extreme burden expressed by a narrow exampleat a standard test temperature of 60 degree Celsius. This test set attempts to obtain optimal bonding material for mixture type and traffic intensity. Marshall Stability and Flow Testing provide the predictive measurement of performance for the Marshal Mix design method. To check stability of the test which determines the maximum load supported by the test load when a loading rate of 50.8 mm per minute. The load is appliedto the sample until it fails, and the maximum load is named as the stability. During loading, due to dial gauge which is attached provides loading, the plastic flows of the sample (distortion) measure. The value of the flow is recorded at 0.25 mm (0.01 in) increase at the same time when the maximum load is recorded.

Specification for Marshall stability test

- Replacement of Bitumen with waste engine oil and pine resin
- Grading according to IRC:37-2002 for VG 10 type bitumen

Gradation of DBM Mixes

Sieve Size mm	Cumulative % passing	Specified Grading
37.5	100	100
26.5	95	90-100
19	83	71-95
13.2	68	56-80
4.75	46	38-54
2.36	35	25-42
0.3	14	21-42
0.075	5	2-8

Table 4.7 IRC-Grading

Fig 4.1 Grading for VG 10

Sl. No.	Bitumen Content(In %)	Conventional Bitumen(KN)	Stability of mix having 3%waste Engine oil (KN)	Stability of mix Having 4%waste engine oil + 1% pine resin(KN)	Stability ofmix having 5% waste engine oil + 2 % pine resin(KN)
1	3	5.1	-	5.8	5.5
2	4	6.6	-	7.6	7.2
3	5	5.9	-	6.9	6.2

Table 4.8 Marshall Stability Value

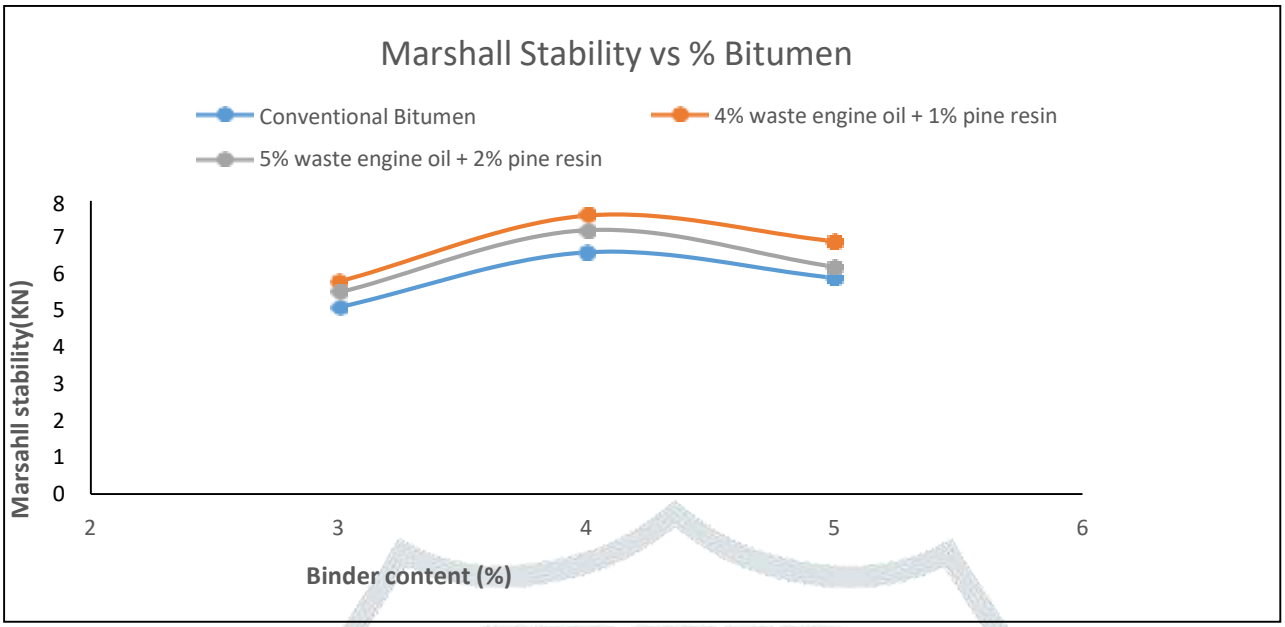


Fig 4.2 Bitumen content vs Marshall Stability

Form the above fig 4.8 it is clear that stability value for bitumen modified with waste engine oil and pine resin is added as an admixture is more than that of normal bituminousmix throughout the varying percentage of bitumen content. The maximum stability is achieved at 4% bitumen content in the case of modified bitumen with waste engine oil and pine resin as an admixture.

SL. No.	Bitumen Content (in %)	Flow value conventional Bitumen (mm)	Flow value of mix having 3%waste engine oil (mm)	Flow value of mix having 5% waste engine oil + 1 % pine resin (mm)	Flow value of mix having 7% waste engine oil+ 3% Pine resin(mm)
1	3	2.03	-	2.33	2.6
2	4	2.67	-	3.23	3.53
3	5	3.56	-	4.25	4.54

Table 4.9 Marshall Flow value

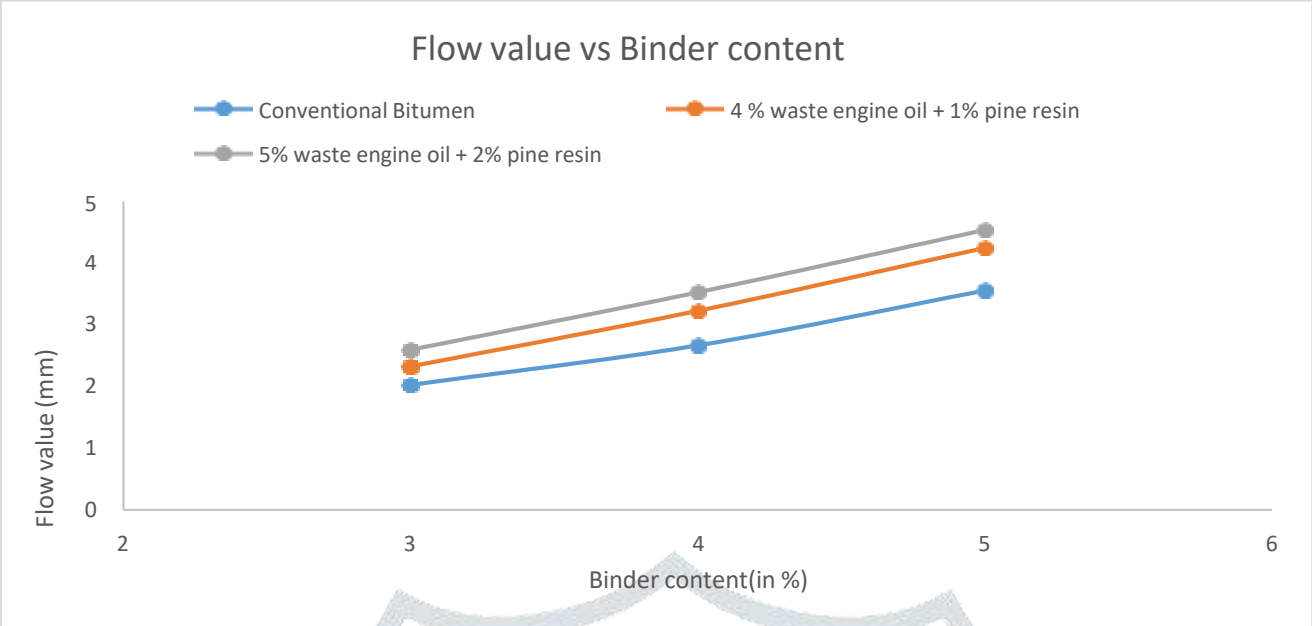


Fig 4.3 Flow value vs Binder content

Penetration Test Results

Percentage of waste engine oil	Penetration value in mm
0	86
1	90
3	120
5	150
7	170
9	200

Softening Point results

Percentage of waste engine oil	Softening point in °C
0	48
1	46
3	46
5	44
7	44
9	40

Table 4.10 Softening Point results

Ductility Test Results

Table 4.11 Ductility test results

Percentage of waste engine oil	**Ductility value in cm**
0	82
1	79
3	78
5	75
7	No breakdown. (Distance from lowest Surface less than 1cm)
9	No breakdown. (Distance from lowest Surface less than 1cm)
11	No breakdown. (Distance from lowest Surface less than 1cm)
13	No breakdown. (Distance from lowest Surface less than 1cm)

Specific Gravity test results

Table 4.12 Specific Gravity test results

Percentage waste engine oil	Specific Gravity
0	1.01
1	1.05
3	1
5	1
7	1.01
9	1.03
11	1
13	1.04

5.0CONCLUSION AND DISCUSSION

As the study conducted in this report has shown us that is it possible to partially replace the conventional bitumen with bio binders. As per the experimental work we havesuccessful replaced the conventional bitumen with different proportions/percentages of waste engine oil and pine resin respectively. The experiments has shown us that replacingonly waste engine oil with the conventional bitumen did not gave the expected results, after mixing the conventional bitumen with waste engine oil formed a soft mixture which has passed most of the tests like penetration test, ductility etc. But showing the uncertain results in softening point and Marshall Stability test. The over soft mixture can beexplained as the waste engine oil is also a petroleum product which is more fluidic in nature and heating the mix between 120°C to 140°C, most of the hydrogen bonding ofthe waste engine getting vaporized.

The results differ when pine resin is replaced in different percentages in conventional bitumen. The addition of pine resin increased the rigidity of the mixture which has failed in all the tests conducted in the highway laboratory. The main reason behind the failure can be that most of the volatile may have vaporized resulting lesser water in the voids which is crucial/vital for making the bitumen soft thus mix has become more rigid than normal bituminous mix. From the above results obtained we concluded that pine resin has only 1 % optimum percentage as most of the test at this percentage was successfuland in case of waste engine we found that it cannot be added alone as our Marshall Test specimen has failed when 3% replacement was made. Thus after that we started the Marshall Stability test with Waste engine oil along withpine resin and they have given us favorable result after performing the test at different