Analysis Of Asphalt Binder Modified with Waste Engine Oil

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***Abstract*—The increasing environmental concern about waste materials and the necessity of improving the performance of asphalt mixtures prompted the study of incorporating different waste materials in conventional bitumen. According to studies it is estimated that 200 million gallons of oil are improperly disposed each year. This can be extremely harmful on the environment and on human health. Because of these harmful effects of used motor oil, it is important to utilize it by recycling. Waste engine oil is waste c which is produced after combustion process in engines. It is not totally recyclable hence it becomes hazardous to environment and it contaminate soil if it is buried in soil.**

After studying research papers, we came to know that in past the research has been done on use of waste engine oil with bitumen, but specific percentage has never been calculated. So, the aim was to use different percentage of waste engine oil as an additive to bitumen. It is observed in the past that whenever the waste engine oil is added to the bitumen the softening point decreases which helps us to use it in cold After studying research papers, we came to know that in past the research has been done on use of waste engine oil with bitumen, but specific percentage has never been calculated.

I. INTRODUCTION

GENERAL:

The increasing environmental concern about waste materials and the necessity of improving the performance of asphalt mixtures prompted the study of incorporating different waste materials in conventional bitumen. Each year, two hundred million gallons of used motor oil (UMO) are improperly disposed off

In India, there are a total of 252,354000 registered vehicles upto march 2017 which can contribute to the waste engine oil (WEO), that can lead to environmental pollution if not disposed of properly or recycled. little waste engine oil is enough to ruin millions of gallons of fresh water. Engine oil is a by-product of petroleum refining which provides lubrication to rotating bearings and pistons in automobile engines. Currently, there is a growing concern to reuse waste materials and to conserve or minimize the use of natural resources in road paving. Thus, many studies have recently emerged in which these issues, or part of them, are discussed. Under this assumption, the study of new asphalt binders that partially incorporate wastes is essential to reduce the use of bitumen directly obtained from oil sources, which is important for the sustainable development of road paving construction. Some studies related to this matter refer to non-petroleum binders Waste oil which discarded into the landfill without any treatments prominently produced the adverse impact to the environment. The effect can be seen by eutrophication process. The thin layer of oil appears on the surface of river or lake can block the sunlight, the photosynthesis and also disrupting the oxygen supply to the aquatic life.

II. PROBLEM STATEMENT

The increasing environmental concern about waste materials and the necessity of improving the performance of asphalt mixtures prompted the study of incorporating different waste materials in conventional bitumen. According to studies it is estimated that 200 million gallons of oil are improperly disposed each year. This can be extremely harmful on the environment and on human health. Because of these harmful effects of used motor oil, it is important to utilize it by recycling.

OBJECTIVES:

➢ To study the various properties of bitumen.

➢ To enlist the limitations of bitumen

➢ To explore the reuse of waste engine oil by partially replacing bitumen.

➢ To evaluate the effect of waste oil modification on basic properties of bitumen. ➢ To study the tests for performance of bitumen.

➢ To analyze the behavior of modified bitumen due to use of waste engine oil.

To compare the results obtained from modification of waste engine oil with the standard performance.

SCOPE OF THE PROJECT:

Using Waste Engine Oil as an additive in bitumen, performing various tests such as softening point test, penetration test, ductility test, flash and fire point test and comparing them with unmodified bitumen and analyze the results.

MATERIALS: BITUMEN:

Bitumen is also known as asphalt. . It is also called as mineral tar and is present in asphalt also. It contains 87% carbon, 11% hydrogen and 2% oxygen. It is a substance that forms through the distillation of crude oil. It has waterproofing and adhesive properties. Bitumen production through distillation removes lighter crude oil components, such as gasoline and diesel, leaving the "heavier" bitumen behind. The producer often refines it several times to improve its grade. Bitumen can also occur in nature: Deposits of naturally occurring bitumen form at the bottom of ancient lakes, where prehistoric organisms have since decayed and have been subjected to heat and pressure.

WASTE ENGINE OIL:

Waste oil is defined as any petroleum-based or synthetic oil that, through contamination, has become unsuitable for its original purpose due to the presence of impurities or loss of original properties Waste engine oil is a pollutant material that requires responsible management. Waste engine oil may cause damage to the environment when dumped into the ground or into water.

Streams including sewers.

WHY ENGINE OIL?

There are varied opinions on the feasibility of lubricating oil as an additive in asphalt cement as most of the research has focused on trying to improve the low temperature properties of asphalt. Although it is proven that the addition of engine oil can improve the low temperature properties of asphalt, little research has been done on waste engine oil as a recycling agent for lessening the stiffening effect of RAP in asphalt paving mixtures (Hayner1999; J. H. Collins and Jones 2000).The properties of WEO is dependent on the combustion process, operation temperature, contaminant sources such as moisture, soot, diluents, rust, detergents and engine wear metal particles.

III. METHODOLOGY

PROPERTIES OF ENGINE OIL: -

Specific Gravity 0.93 (Pycnometer Test) Viscosity 0.12 pas (Redwood viscometer Test) Flash Point 1200 (Closed cup flash point Test)

Common tests on the modified bitumen

Following are the various tests performed on both the plain bitumen and Engine oil and the results are analysed for further study.

1) Penetration test
2) Softening point test
3) Ductility test
4) Flash and fire test, etc.

Needle – A straight, highly polished, cylindrical, stainless steel (SS 316) rod, with conical and parallel portion coaxial, having the shape, dimensions and

tolerances given in Fig. The needle is provided with Shank approximately 3 mm in diameter into which it is immovably fixed. The taper shall be symmetrical and the point shall be blunted by grinding to a truncated cone.

Water Bath - A water bath preferably with a thermostat maintained at 25.0 +0.1°C containing not less than 10 litre of water. the sample being immersed to a depth of not less than 100 mm from the top and supported on a perforated shelf not less than 50 mm from the bottom of the bath. Transfer Dish- A small dish or tray, provided with some means which ensure a firm bearing and prevent the rocking of the container and of such capacity as will ensure complete immersion of the container during the test.

Penetration Apparatus - Any apparatus which will allow the needle to penetrate without appreciable friction, and which is accurately calibrated to yield results in tenths of millimeter shall be adopted.

Thermometer - It shall conform to the following requirements:

Characteristic Range Graduations Immersion Overall Length Stem Diameter Bulb Length Bulb diameter Length of graduated portion Longer lines at each Figured at each Scale

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Characteristic	Requirement
Range	0 to 44°C
Graduations	0.2°C
Immersion	65 mm
Overall length	340 mm
Stem diameter	5.5 to 8.0 mm
Bulb length	10 to 16 mm
Bulb diameter	Not larger than stem diameter
Length of graduated portion	150 to 190 mm
Longer lines at each	1°C and 5°C
Figured at each	5°C
Scale	+0.2°C

IV. PROCEDURE

Preparation of Test Sample

Soften the to a pouring consistency at a temperature not more than 60°C for tars and pitches and not more than 90°C for bitumen above the respective approximate softening point and stir it thoroughly until it is homogeneous and is free from air bubbles and water. Pour the melt into the container to a depth at least 10 mm in excess of the expected penetration. Protect the sample from dust and allow it to cool in an atmosphere at a temperature between 15 to 30°C for 1.5 to 2 h for 45 mm deep container and 1 to 1.5 h when the container of 35 mm depth is used. Then place it along with the transfer dish in the water bath at 25.0 + 0.1°C and allow it to remain for 1.5h to 2h and 1 to 1.5 h for 45 mm and 35 mm deep container respectively.

In the case of cutback bitumen and Digboi type cutback bitumen, residue left after distillation shall be used for the test. The procedure for handling the residue shall be in accordance with the method described under 3.2.4 of the distillation test (see IS: 1213-1978 *).

Testing

Unless otherwise specified, testing shall be carried out at 25.0 +0.1°C

Fill the transfer dish with water from the water bath to a depth sufficient to cover the container completely; place the sample in it and put it upon the stand of the penetration apparatus. Adjust the needle (previously washed clean with benzene, carefully dried, and loaded with the specified weight) to make contact with the surface of the sample.

This may be accomplished by placing the needle point in contact with its image reflected by the surface of the material from a suitably placed source of light.

Unless otherwise specified, load the needle holder with the weight required to make a total moving weight (that is, the sum of the weights of the needle, carrier and superimposed weights) of 100 +0.25 g.

Note the reading of the dial or bring the pointer to zero. Release the needle and adjust the points, if necessary to measure the distance penetrated. Make at least three determinations at points on the surface of the sample not less than 10 mm apart and not less than 10 mm from the side of the dish. After each test, return the sample and transfer dish to the water bath, and wash the needle clean with benzene and dry.In the case of material of penetration greater than 225, three 29 determinations on each of two identical test specimens using a separate needle for each determination shall be made. leaving the needle in the sample on completion of each determination to avoid disturbance of the specimen 4.2.4 For determining the penetration ratio, testing shall also be carried out a 4.0° + 0.1°C. **NOTE** - For test at 4°C, the total weight on the penetration needle shall be 200 + 0.25 g and the time of penetration shall be 60 s.

V. REPORT

Express the depth of penetration of the needle in tenths of millimeter.

The value of penetration reported shall be the mean of not less than three determinations whose values do not differ by more than the amount given below:

Penetration	Maximum Difference
0 to 49	2
50 to 149	4
150 to 249	6
250 and above	8

Determine the penetration ratio as under Penetration ratio = Pen. at 4°C.200 g.60 s/ Pen. at 25°C.100 g.5 s x100

Mixing of engine oil with plain bitumen: -

The use of residual oil in the pavement can be used directly in liquid form and capsules.

Table shows the mixing temperature range between residual oil and asphalt mixture as suggested by previous researchers. The oil is mixed with a binder to modify the binding characteristics. Usually, waste oil is mixed with the binder prior mixing it with asphalt mixture.

Table no.1. Mixing process of waste oil in asphalt

Author	Type of Oil	Mixing Temperature, (°C)	Time of Mixing, hour	Mixing speed, rpm
Dedene et al. (2011)	WEO	150	NA	NA
Borhan et al. (2009)	WEO	NA	NA	NA
A Zamhari et al. (2009)	WEO	NA	1 hour / cycle	NA
Villanueva et al. (2008)	WEO	160	1	500
Asli et al. (2012)	WCO	130	0.5	200
Zargar et al. (2012)	WCO	160	0.5	200

▪ The lower penetration value, need the higher amount of waste oil to achieve the target binder.

▪ The results by Bailey and Phillips (2010) has proven this statement as shown in Table given below. The increasing of oil content and temperature has decreased the viscosity of the samples.

Table no.3. Value of viscosity from different temperature

Oil Content (%)	Viscosity (Pa.s)		
	120°C	150°C	180°C
0	1.074	0.231	0.074
2	0.844	0.200	0.064
4	0.723	0.172	0.060
6	0.607	0.151	0.053
8	0.504	0.131	0.046
10	0.429	0.117	0.044

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