

# MODIFICATION OF BITUMEN WITH POLYTHENE, AN ENVIRONMENTAL MENACE

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**Abstract:** With the increase in population, urbanization and changes in life style the use of polythene is increasing day by day and the disposal of waste plastic has become a serious problem. Polythene is non-biodegradable and environmentally unacceptable. So, to dispose these plastics we have to make alternate use of it and, there is the need to adopt effective methods to utilize these plastics waste. The study evaluates the addition of shredded waste plastic in the bituminous concrete which results in significant increase in the stability value. Bitumen modification has been commonly performed by addition of thermoplastic or elastomeric polymers. However, there are just a few studies on bitumen blends using multiple materials seeking for specific advantages provided by addition of these modifiers. The addition of polymers to bitumen allows the modification of certain physical properties such as softening point, brittleness and ductility, of the bitumen. In the presence study the use of waste plastic in bitumen is safe and sustainable for road construction.

**Keywords:** Waste Plastic, bitumen, polythene, Marshall Mix

## Introduction

It is possible to improve the performance of bituminous concrete pavements by adding Polythene content to bitumen. Studies reported that the use of polythene with bitumen binders enhances the physical and structural behaviour of bitumen. Due to the development and industrial revolution, large scale polythene is being produced. Plastic is a non-biodegradable material and can remain on earth for 5000 years without disintegration. The rate of production of waste has increased tremendously in almost all parts of the world in the past few decades. The quantities of these waste that are accumulating, are causing serious disposal problems. Bitumen is a by-product of the fractional distillation of crude petroleum oil, but is also found in natural deposits. Various types of crude source and refining process lead to extreme complexity in bitumen chemistry and rheology. The plastic usage in roads can replace some percentage of natural bitumen that is extracted from petroleum. The main objectives of the present study to provide an eco-friendly road by mixing polythene and bitumen in different ratios, doing surface modification of the modified bitumen by heating and suitability analysis of the modified bitumen by performing various tests on sample.

## Materials and Methods

### Materials

The two primary materials used in the present study are Bitumen and Polythene.

Bitumen is a very viscous material which is black in colour it is a mixture of hydrocarbons which is extracted from petroleum distillation. The prime use of bitumen is use as a binding material in road.

Polythene is material which is soft in touch and a very ductile in nature. Polythene is manufactured from polymerizing ethylene. Today there are many use of polythene such as plastic bag, packing of items, Water bottles and plastic sheets.

### Methods

The methodology in the present study starts from sampling and ends with the conclusion. Sampling for bitumen was done at SantKabir Nagar. About 15 liters of bitumen was collected while sampling. Sampling for Polythene was done at Ghaila village near Lucknow, Uttar Pradesh, India. About 20 kg of polythene was collected while sampling. Then both the materials were heated parallel and then melted polythene is mixed in bitumen in the ration of 23%, 25% & 27% afterwards the mixture of all three sample are mixed vigorously and left for cooling. The analysis of the prepared sample was done according to the IS 154622004, in Transportation laboratory. Analysis of all three samples were did by performing Ductility test, Penetration test, Specific gravity and Softening point test. Afterwards stability test was also conducted by performing Marshall Mix design on the modified bitumen in order to check the stability of bitumen. Afterwards the results of the above mentioned test were obtained and graphs were plotted on the values of stability test performed on Marshall Mix design and on the basis of the plotted graphs conclusion of the present study were made.

## Results

### Softening Point (R & B) Test-

Softening point (ring and ball) test is a method for the determination of the softening point of bitumen and bituminous binders, in the range 30 °C to 150 °C.

Softening point of sample 1 is 73°C

Softening point of sample 2 is 77.45°C

Softening point of sample 3 is 69.45°C

**Penetration Test-**

Penetration value is the measure of hardness or consistency of bitumen sample. This test is used for evaluating consistency of bitumen.

Penetration value of sample 1 is obtained as 58.5 mm

Penetration value of sample 2 is obtained as 88.33 mm

Penetration value of sample 3 is obtained as 101 mm

**Specific Gravity-**

Specific gravity of bituminous material is defined as ratio of mass of given volume of Substance to the equal volume of water, temperature of both being 27°C.

Specific gravity of sample 1 is obtained as 1.094

Specific gravity of sample 2 is obtained as 1.089

Specific gravity of sample 3 is obtained as 1.100

**Ductility Test-**

The ductility of a bituminous material is measured by the distance in centimetres to which It will elongate before breaking when a briquette specimen of the material are pulled apart at a specified speed and at a specified temperature.

Ductility value of sample 1 is obtained as 65.00 cm.

Ductility value of sample 2 is obtained as 55.75 cm.

Ductility value of sample 3 is obtained as 47.10 cm.

**Marshall Mix Test-**

The various properties of bituminous mix has been obtained and calculated using Marshall Test. Marshall stability value is defined as the maximum load at which the Specimen fails under the application of the vertical load.

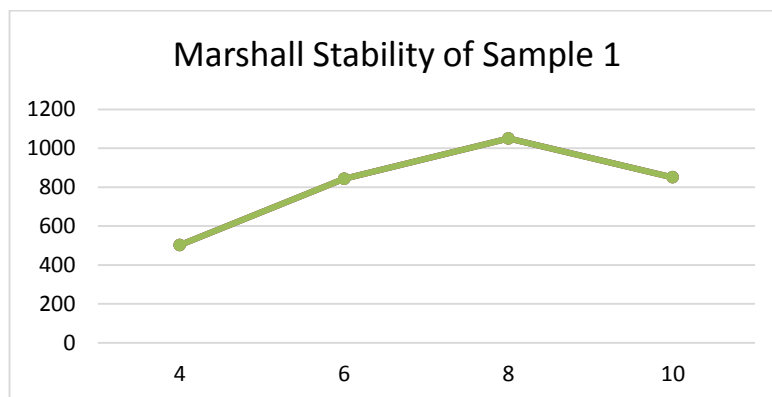


Fig: Marshall Stability for Sample 1

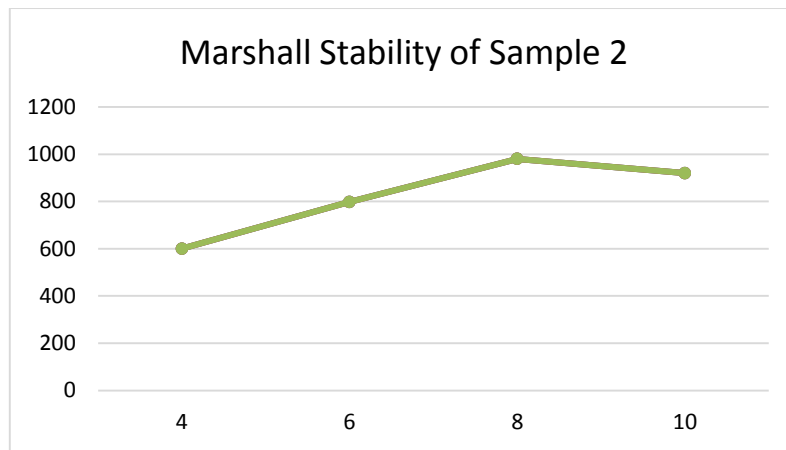


Fig: Marshall Stability for Sample 2

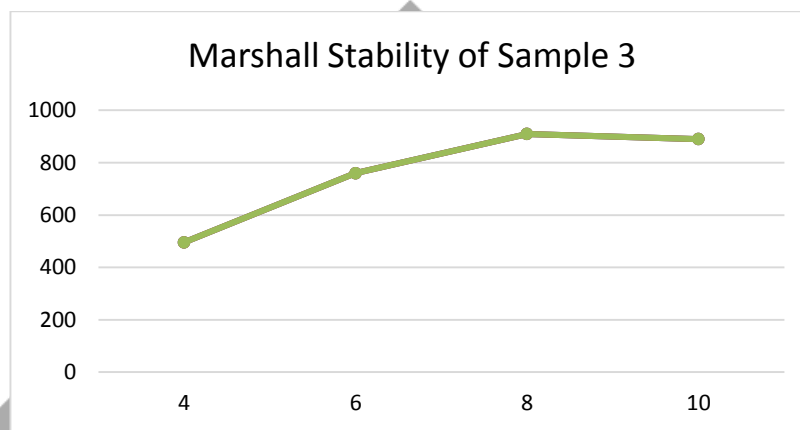


Fig: Marshall Stability for Sample 3

### Conclusion-

Addition of polythene to bitumen improves the stability value of the mix which results increase in the toughness of the mix. Due to addition of plastic waste the flow value increases resulting the improvement in the workability. For softening point test Sample 2 is proving better results and after that sample 1 is providing good result. For Penetration test sample 1 is performing very well as compare to other two sample and then sample 2 performance is good. For specific gravity sample 1 and sample 2 lie in the same range i.e. 1.094 & 1.089 but the specific gravity of the sample 3 is increasing a little bit and the value is 1.10. For ductility test Sample 1 is proving better results and after that sample 2 is providing good result. For Marshall Mix Test the test were performed in the laboratory at four different percentage of bitumen and then the graphs are plotted for all three sample now the according to the marshal stability graph sample 1 bears a maximum load of 1050 kg at 8% bitumen whereas sample 2 bears a maximum load of 980 kg at 8% bitumen and sample 3 bears a maximum load of 910 at 8%. So the stability of sample 1 is very good as compare to other two sample.

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