

Performance Evaluation Of Recycled Bitumen Before And After The Addition Of Plastic Waste

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Abstract

The main objective of our research is to characterize the bitumen which has been extracted from selected roads before and after the addition of plastic waste through the determination of Engineering properties. Laboratory tests were carried out on three samples from each of the roads in order to obtain extracted bitumen characteristics. The extracted bitumen percentage from the mix was 5-6%, which fell within the specified range of 5-8%. Plastic waste in Municipal Solid Waste is been increasing day by day due to increase in Population, Urbanization, development activities, which is leading to wide spread of land use for the disposal of waste. Thus these wastes are not disposed scientifically there will be a possibility to create ground water pollution and also leads to the loss of fertile soil. Thus our project focuses on using the plastic waste as well as used bitumen rather than to dispose them. Thus we even reduce ground water pollution and also reduce soil degradation. Thus we added plastic waste to the recycled bitumen and the mix obtained so showed better binding property, stability, density and more resistant to water.

1. Introduction

Population growth and economic development have resulted in an extensive network of asphalt paved roads. Several kilometers were constructed to meet the demands of the people.

Plastic is a versatile material. Due to industrial revolution, and its large scale production plastic seemed to be a cheaper and effective raw material. We are using the plastic waste along with recycled bitumen and obtained satisfactory results.

Salient features of the plastic-waste-bitumen mix road:

- Road strength is twice stronger than normal roads.
- Resistance towards water stagnation, plastic in bitumen provides im-permeability to the mix.
- Less bleeding during summer.
- Burning of plastics waste could be avoided.
- It doesn't increase cost of road construction.
- It helps to reduce the consumption of bituminous mix.
- It helps in protecting our environment from waste plastic.

2. Aim and Objectives of the Research

- **Aim:**
To utilize the bitumen extracted from used asphalt pavement by the addition of plastic waste for road construction.
- **Objectives:**
 - (1) To characterize extracted bitumen from UAP by the addition of plastic waste through the determination of engineering properties
 - (2) To establish the effects of age on asphalt content, penetration and viscosity of recovered bitumen

3. Materials and Methodology

Materials are composed of samples of different selected roads. The research would be conducted on those samples by adding different percentages of plastic waste to the extracted bitumen. Bitumen samples are collected at ongoing rehabilitation sites. Plastic wastes have been collected and are made fine so that they can be added to bitumen. Materials and equipments that we have used are

- Benzene
- Plastic waste
- Extracted bitumen
- Bitumen extractor
- Penetrometer
- Ductility testing machine

- Ring and ball apparatus for the determination of softening point of bitumen
- Induction
- Pensky martin's flash and fire apparatus

Methodology

We have collected road samples of different roads and extracted bitumen from it with the help of bitumen extractor and we have added plastic waste of different percentages to it and carried out test on the mix obtained to determine its engineering properties.

Waste plastic bags were collected from roads, garbage trucks, dumpsites and compost plants, rag pickers, waste-buyers at Rs5-6 per kg. Household plastic was also collected for the project work, like empty milk bags, used plastic bags etc. The collected plastic waste was sorted as per the required thickness. Generally, polyethylene of 60 micron or below is used for the further process. Less micron plastic is easily mixable in the bitumen at higher temperature (160°C-170°C). It is clean by de dusting or washing if required. Collected Plastic was cut into fine pieces as far as possible. The plastic pieces were sieved through 4.75mm sieve and retaining at 2.36mm sieve was collected. Firstly, Extracted Bitumen was heated up to the temperature about 160°C-170°C which is its melting temperature. Pieces were added slowly to the hot bitumen of temperature around 160-170°C. The mixture was stirred manually for about 20-30 minutes. In that time period temperature was kept constant about 160-170°C. Polymer-bitumen mixtures of different compositions were prepared and used for carrying out tests i.e., Penetration test, Ductility test, Flash point test & Fire point test, Ring and ball test.

4. Results and discussions

- The average extracted bitumen from UAP on Road samples ranged from 5.0 to 6.0 % which fell within the specified limits of 5.00 – 8.00 %.
- Furthermore, the penetration and viscosity before the addition of plastic waste ranged from 32.3 to 67.4 and 9,660.9 to 16,465.3 respectively.
- UAP binder may have penetration values from 10 to 80 and absolute viscosity values at 60°C (140°F) in a range from as low as 2,000 poises to as high 50,000 poises or greater.
- The increase in percentage of polymer decreased the penetration value. This shows that the addition of polymer increases the hardness of the bitumen. The penetration values of the blends are decreasing depending upon the percentage of polymers and the type of polymer added.
- The ductility decreased by the addition of plastic waste to bitumen. The decrease in the ductility value may be due to interlocking of polymer molecules with bitumen.
- Flash and fire point increased with the increase in the percentage of polymer .The polymer bitumen blend road surfaces are less affected by fire hazards.
- The softening point increased by the addition of plastic waste to the bitumen. Higher the percentage of plastic waste added, higher is the softening point.

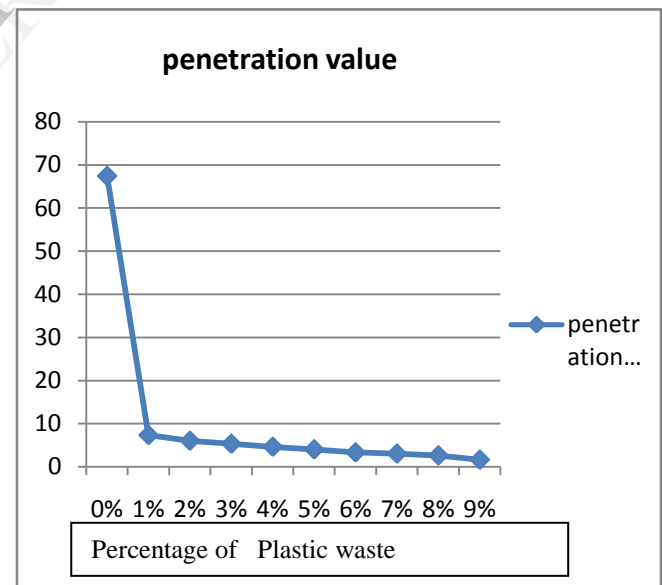
Effect of Age:

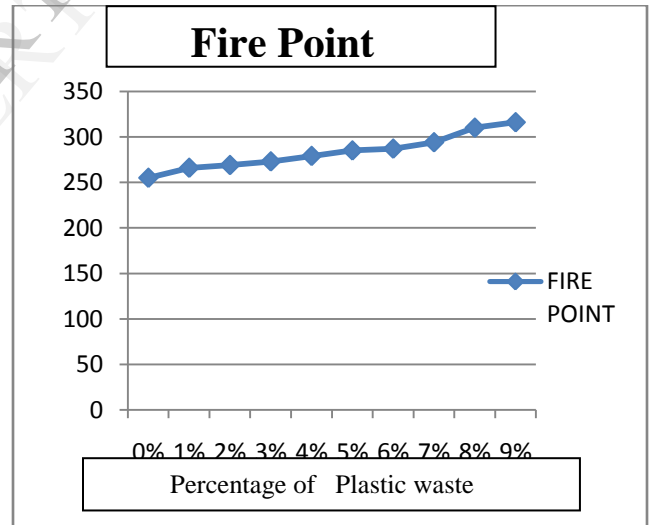
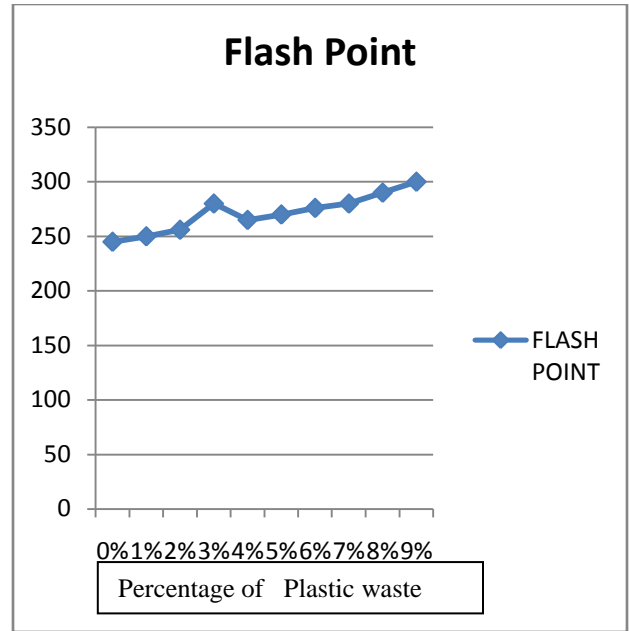
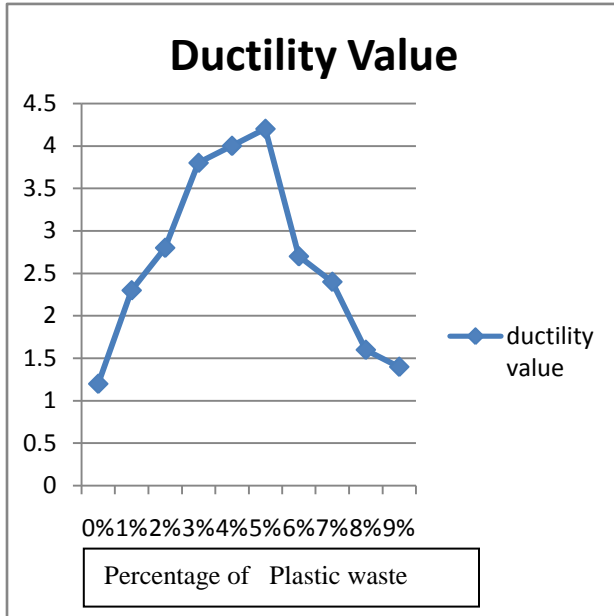
Effect of age	Relation
Effect of age of Road on Asphalt Content	Poor Relation
Effect of age of road on penetration of binder	Fair Relation
Effect of Age of Road on Viscosity of Binder	Fair Relation

Table No1: Effect of Age

(Recycled Bitumen Before and addition of plastic waste)

Percentage addition of plastic waste→	0	1	2	3	4	5	6	7	8	9
Name of the test ↓										
Penetration value	67.8	7.3	6.0	5.3	4.6	4.0	3.3	3.0	2.6	1.6
Ductility value	5.2	4.9	4.8	4.3	4.0	3.4	3.0	2.8	2.3	1.2
Softening point	81.5	83.5	85.5	87.5	90.1	92.5	94.5	96.5	98.5	99.5
Flash Point	245	250	256	260	265	270	276	280	290	300
Fire point	255	266	269	273	279	285	287	294	310	316





5. Conclusion:

- The addition of plastic waste modifies the properties of Recycled bitumen.
- The resultant mix obtained after the addition of plastic waste showed good result when compared to standard results.
- The optimum content of waste plastic to be used is in between the range of 5% to 10%.
- The problems like bleeding are reduced by the addition of plastic waste.
- Plastic has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic.
- Thus the waste plastics can be put to use and it ultimately improves the quality and performance of road.
- Total material cost of the project is reduced by 7.99%.
- As the bitumen is a non-renewable resource it is very important to store it for our future generations.
- Characteristic's of recycled bitumen is analyzed after the addition of plastic waste and from analysis we came to know that recycled bitumen is suitable for road construction after the addition of plastic waste.

6. References

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