

PERFORMANCE EVALUATION OF PLASTIC MODIFIED BITUMEN IN FLEXIBLE PAVEMENT

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Abstract: - Advancement of the 21st century has brought with it various merits and demerits to the world. A major demerit is the waste generated everyday and more specifically the plastic waste. Flexible pavement provides a solution to this problem, where the plastic waste if added to the bitumen not only enhances its chemical properties but also provide a greater strength to the roads. Pavement in today's scenario are subjected to various kinds of loads affecting its performance causing distresses. Some distresses are fatigue cracking, temperature cracking etc. Glancing at today's world, plastic has become a part of our everyday routine. Thus using the plastic waste as an innovative technology in pavement not only increases the road life but also gets rid of the waste. This paper includes various tests on bitumen and plastic modified bitumen with results.

Keywords: - Bitumen, Low density polyethylene, Plastic modified bitumen, Plastic pavement.

I. INTRODUCTION

Today the availability of the waste plastics is enormous, as the plastic materials have become part and parcel of daily life. They either get mixed with Municipal Solid Waste or thrown over land area. Their present disposal is either by land filling or by incineration. Both the processes are not Eco friendly. Under this circumstance, an alternate use for the waste plastics is also the need of the hour.

Rapid industrial and enormous population growth has resulted in increasing the various types of waste materials. Considerable measures have been done for the disposal of these waste products. These plastics are considerably non-biodegradable thus can be used as a modifier in bitumen to increase their strength. This study presents the proper utilization of waste in hot bitumen to enhance pavement performance, to protect environment and to provide low cost roads.

This study presents the proper utilization of waste in hot bitumen to enhance pavement performance, to protect environment and to provide low cost roads. Use of plastic along with the bitumen in construction of roads not only increases its life and smoothness but also makes it economically sound and environment friendly. Plastic waste is used as modifier of bitumen to improve some of bitumen properties. Roads that are constructed using plastic waste are known as Plastic Roads and are found to perform better compared to those constructed with conventional bitumen. Further it has been found that such roads were not subjected to stripping when come in contact with water. Use of higher percentage of plastic waste reduces the need of bitumen by 10%. It also increases the strength and performance of the road.

II. RESEARCH METHODOLOGY

The research methodology for present study has adopted various tests to investigate the results on bitumen and plastic mix. The tests conducted were Softening Point, Penetration Test and Ductility Test for bitumen. For mixing the ingredients of road mix, dry process was adopted. In this process, waste plastic is mixed with bitumen. This bitumen plastic mix is later tested in laboratory and required optimum results are obtained. The plastic was mixed in proportions of 10%, 15% and 20%.

III. RESULTS AND DISCUSSION

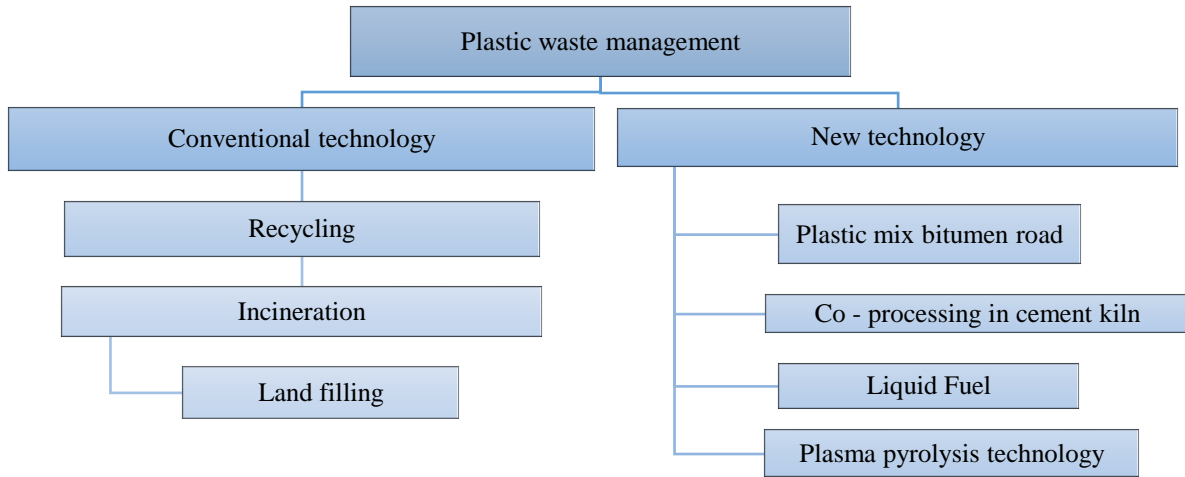


Figure 1. Plastic Waste Management

2.1 LABORATORY TESTS ON BITUMEN:

The studies on the behaviour and binding properties enhanced for the preparation of plastic waste-bitumen mix to find suitability properties of material for road construction. Polyethylene carry bags were cut into pieces using cutter in to small pieces. These plastic pieces were slowly added to the hot bitumen and the mixture was stirred well using mechanical stirrer. Polymer-bitumen of different compositions were prepared and used for carrying various tests. Following are the test conducted in laboratories:

2.1.1 SOFTENING POINT

The softening point is the temperature at which the substance attains a particular degree of softening under specified condition of tests. Higher softening point is generally preferred in warm climate, whereas lower the softening point lower will be preferred in cold climate. As per IRC recommendation the softening point of bitumen is 50 degree C. The following result is shown in TABLE 1 and Fig.1.

Table 1. Observations for Softening point test

% of bitumen	% of plastic	Softening point in degree C
100	0	64
90	10	71
85	15	78
80	20	82

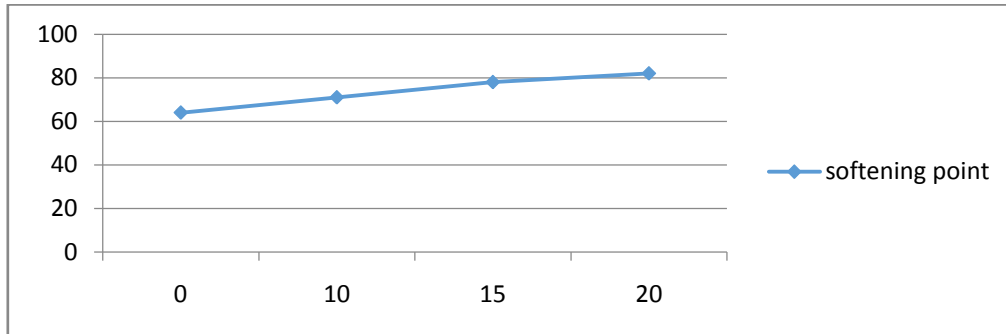


Figure 2. Variations in Softening Point of Bitumen with Increase in percentage of plastic

2.1.2 PENETRATION TEST

The penetration test is carried out to know the hardness or softness of bitumen used in road construction by measuring the distance to which the needle penetrates. Samples having different percentage of plastic waste in bitumen is prepared and their penetration values are determined as per IS code. The penetration values of the blends are decreasing depending upon the percentage of polymer added. As per IRC recommendation the penetration values of Bitumen is from 20-225 mm. The following results of penetration test are shown in TABLE 2 and Fig.3.

Table 2. Observations for the Penetration test

% of bitumen	% of plastic	Penetration value in mm
100	0	72
90	10	70
85	15	67
80	20	63

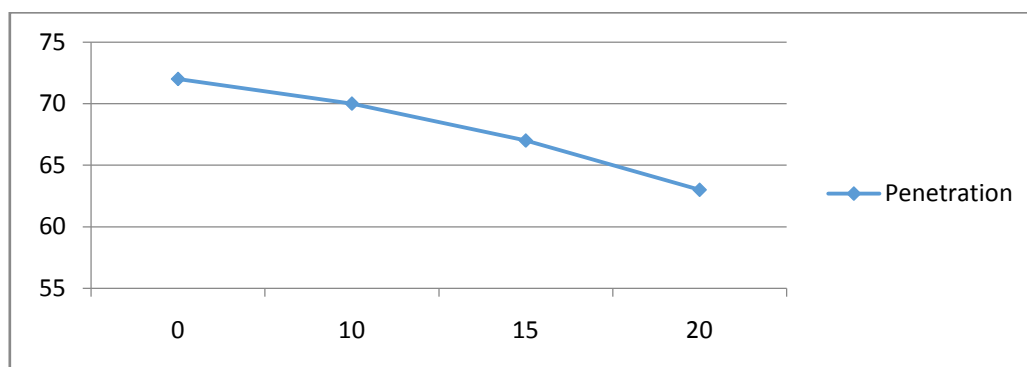


Figure 3. Variations in Penetration Value of Bitumen with Increase in percentage of plastic

2.1.3 Ductility Test

The principle of this test is that: the ductility of a bituminous material is measured by distance in cm to which it will elongate before breaking. As per IRC recommendation the Ductility of Bitumen is 75 cm. The following results of ductility test are shown in TABLE 3 and Fig.4

Table 3. Observations for ductility test

% of bitumen	% of plastic	Ductility value
100	0	72
90	10	65
85	15	60
80	20	56

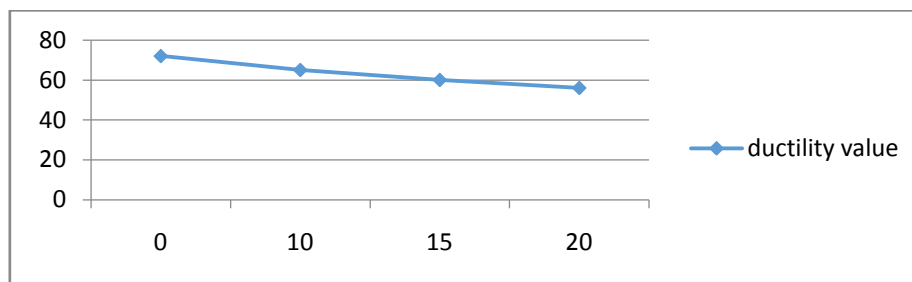


Figure 4. Variation in Ductility of Bitumen with increase in percentage of plastic

IV. CONCLUSION

- Better binding property, Higher Softening point; withstands high temp.
- Lower penetration value; withstands higher load.
- The polymer coating also reduces the voids. This has resulted in reduced rutting, revealing, there is no formation of pot hole. The road can withstand heavy traffic & show better durability.
- It shows that with the increase of waste plastic in bitumen increases the properties of bitumen.
- Use of waste plastic in flexible pavements shows good result when compared with conventional flexible pavements.
- Use of plastic waste for modifying bitumen for road construction is an idea which will save environment as well as cost of construction of road.
- The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air.

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