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Behavior of Bituminous Concrete Pavement with addition of polythene waste

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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. In developing country like India, 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. This paper studies the behavior of bituminous concrete pavement by addition of polythene waste. In this study various percentage of polythene was used for preparation of mixes with a selected aggregate grading as according to IR Code. By preparing Marshall Sample for BC mixtures the role of polythene is studied. Marshall Properties such as Marshall Stability value and Marshall Flow value are used to determine optimum polythene content for grade 60/70.

Key words: Bituminous concrete (BC), Marshall Stability, optimum polythene content, voids filled bitumen.

1. 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 behavior of bitumen concrete mixes. It is proved in field tests that polythene wastes used after proper processing as an additive would enhance the life of pavements. 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. Polythene waste causes many health related problems. In developing country it is not easy to ban the use of polythene completely but we can utilize it effectively for constructive work.

2. Background

In Bangalore a 25 km road was constructed using plastic modified bitumen concrete. This plastic road showed superior smoothness, uniform behavior and less rutting as compared to a plastic free road. The process has also been approved by the CRRI (Central Road Research Institute Delhi) in 2003.Science Tech Entrepreneur in 2008 proposed that the durability of the roads laid with shredded plastic waste is much more compared with those which asphalted with the ordinary mix. While a normal highway road lasts 4 to 5 years it is claimed in this paper that plastic-bitumen roads can last up to 10 years. According to this paper rainwater will not seep through because of the plastic in the tar. So, this technology will result in lesser road repairs.

3. Importance of the study

Using modified polymer could be a boon to construction technology. In India where temperature rises up to 50°C, this adversely affects the life of pavement. The modified polymer bitumen shows improved property of pavement. In the modification process plastic waste is coated over aggregate which increase the surface area of contact and ensure better bonding between aggregate and bitumen. Hence taking into account all these consideration we can conclude that we can obtain a more stable and durable mix for the pavement by polymer modification. It will add the value of plastic as well as develop a technology which is eco friendly.

4. Methodology

This consist the mixture of aggregates, typically size less than 25 mm, through the fine filler that is smaller than 0.075mm. Required bitumen is added to the mix to make the compacted mix impervious and to have acceptable dissipative and elastic properties. Bituminous mix design aims to determine the proportion of bitumen, filler, fine aggregates, and coarse aggregates to produce a workable, strong, durable and economical mix. Aggregates, fly ash, slag, bituminous binders and polythene are the basic material used in bituminous concrete mix. In this study the GYAN MILK Polythene is used as stabilizing additive. GYAN MILK is a local brand of Gorakhpur city and hence the polythene used for milk packaging is locally available. The GYAN MILK Polythene packets were collected, washed and cleaned by putting them in hot water for about 4-5 hours. After that they were dried. After drying the packets were cut into the

smaller uniform pieces. This ensures the uniform size of the polythene in the bitumen mix. Mixing should be proper while adding the polythene to bitumen and aggregates. The specific gravity of polythene was found 0.90

Figure-1: Marshall Test in progress

4.1 Marshall testing

The test was conducted as per ASTM D-06 procedure.

Marshall Stability value:

It is defined as the maximum load at which the specimen fails under the application of the vertical load. It is the maximum load supported by the test specimen at loading 51 mm/ minute. Generally, the load was increased until it reached the maximum value and then when the load just began to reduce, the loading was stopped and the maximum load was recorded by the ring.

Marshall flow value:

It is defined as the deformation undergone by the specimen at the maximum load when the failure occurs. During the loading an attached dial gauge measures the plastic flow as a result of loading of specimen. The flow value was recorded in 0.25mm increments at the same time when the maximum load was recorded. Two readings were taken from the dial gauge i.e. initial reading (I) and final reading (F). The Marshall value (f) is given by **F=F-I.**

In India a rational method of grading paving bitumen, known as "viscosity grading" (VG) has been adopted by the BIS. In this study VG 30 bitumen (grade 60/70) was used to prepare the mix with specific gravity 1.02. Various tests are performed to determine the physical properties of binders. The physical properties obtained are given in following table 1

Table 1: Physical properties of binder

Property	Test Method	Value
Penetration at 25 °C (mm)	IS:1203-1978	65
Absolute viscosity at 60 °C ,poise (min.)	IS:1203-1978	2200
Specific gravity	IS:1203-1978	1.02
Softening point (°C)	IS:1203-1978	50.00

In this study each % of polythene, three samples have been tested. Hence the average values of three were taken. The average values are shown in following table 2.

Table 2. Marshall stability and Marshall flow value

Mean s (kN)	Mean f (mm)
14.35	4.06
14.26	3.8
14.55	3.13
15.54	2.96
17.72	2.86

Based on the above results the following graphs are plotted.

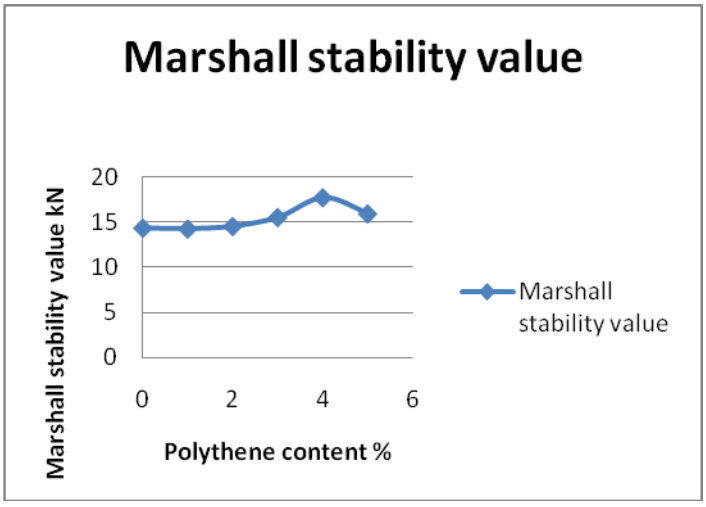

Figure-2: Marshall Stability value vs. Polythene content

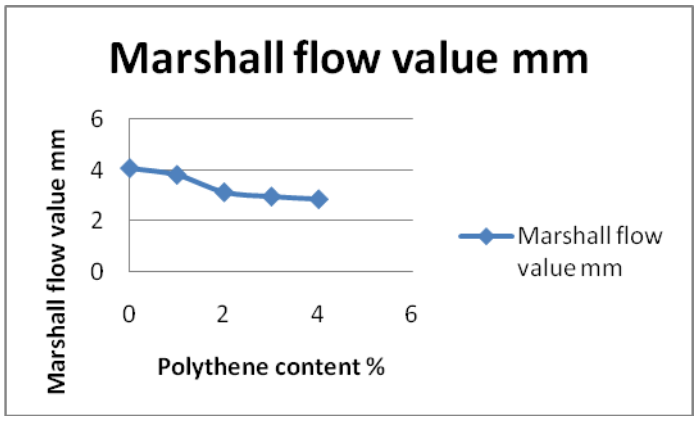

Figure-3: Marshall flow value vs. Polythene content

5. Results and conclusion

The properties of bitumen binders were improved by introducing polythene. This process of modification of bitumen has enhanced resistance to cracking, potholes and rutting by increasing softening point and hardness. Hence addition of polythene improved the general performance of pavement. The value of polythene content at which the sample has maximum Marshall stability value and minimum Marshall flow value is called optimum polythene content and is found to be 4%. The study shows that the addition of polythene decreases the voids present in mix. From the figure 3 we observe that Marshall Flow value decreases upon addition of polythene which shows that resistance to deformations under heavy wheel loads increases.

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