

USE OF WASTE POLYETHYLENE IN BITUMINOUS CONCRETE MIXES

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Abstract –*The quantum of plastic waste in is increasing due to increase in population, urbanization, development activities and changes in life style which leading widespread littering on the landscape. Thus disposal of waste plastic is a menace and become a serious problem globally due to their non biodegradability and unaesthetic view. Since these are not disposed scientifically & possibility to create ground and water pollution. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics for particular road mix. In the present paper developed techniques to use plastic waste for construction purpose of roads and flexible pavements has reviewed. In conventional road making process bitumen is used as binder. Such bitumen can be modified with waste plastic pieces and bitumen mix is made which can be used as a top layer coat of flexible pavement. This waste plastic modified bitumen mix show better binding property, stability, density and more resistant to water.*

1. INTRODUCTION

The threat of disposal of plastic will not solve until the practical steps are not initiated at the ground level. It is possible to improve the performance of bituminous mixed used in the surfacing course of roads. Studied reported in the used of re-cycled plastic, mainly polyethylene, in the manufacture of blended indicated reduced permanent deformation in the form of rutting and reduced low – temperature cracking of the pavement surfacing. The field tests withstood the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. Plastic is a very versatile material. Due to the industrial revolution ,and its large scale production plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, electronics, electrical, building construction, communication sectors has been virtually revolutionized by the applications of plastics. Plastic is a non-biodegradable material and researchers are found that the material can remain on earth for 4500 years without degradation. Several studies have proven the health hazard caused by improper disposal of plastic waste. The health hazard includes reproductive problems in human and animal, genital abnormalities etc., Looking forward the scenario of present life style a complete ban on the use of plastic cannot be put, although the waste plastic taking the face of devil for the present and future generation. We cannot ban use of plastic but we can reuse the plastic waste.

2. Problem statement

One of the major problems of Indian Roads is formation of Potholes which usually occurs when vehicular loads induce shear stresses that exceed the shear strength of the materials contained in the pavement structure. This depends on vehicular loads and the visco-elastic properties of the bitumen binder .Bitumen binders are required to have high stiffness at high temperatures to resist rutting. While talking to Environmental Pollution in recent years, numerous waste materials result from manufacturing operations ,service industries and households in which several millions of plastics are produced and plastics are not being readily biodegradable will persist in the environment in a more or less unchanged state of a considerable time. The need of the hour is to use the waste plastic in some beneficial purpose. In this study an attempt was made to find solution to overcome above discussed problems.

3. importance of the study

Utilization of waste recycled packaging plastics is of great importance, particularly for bitumen conservation and for bitumen modification to find its utility in bituminous mixes for laying flexible pavements. Utilization of waste recycled packaging plastics is of great importance, particularly for bitumen conservation and for bitumen modification to find its utility in bituminous mixes for laying flexible pavements. Besides, the polymer additive in bitumen is to avoid environmental problems resulting from waste plastic disposal .By using waste polymers to modify the bitumen proved to be an ideal way, not only for solving the pollution problem in our country but also for improving the performance of bitumen

4. material selection

4.1 –selected waste plastic

Now a days in India it is most common to see these polyethylene (here in after referred as “Polythene”) materials used for packaging of drinking water in small pouches. These water pouches are very low in cost and are highly available near bus stations, railway stations, eating places and many other busy locations. After the use of water in these pouches people use to throw these unwanted polythene pouches in the surroundings which in result causes environmental pollution to the cities and other road side area. Also the disposal of these non-decaying and non-biodegradable waste polythene’s is a menace for the present society. So, Plastics used in the experiments were polythene material (LDPE) of these

water pouches and other packing goods collected from the mixed plastics wastes along the road side, figure. 1.



Figure 1- Waste Polythene

4.2 Selected Bitumen Grade

The selected bitumen penetration grade for this study was 60/70 usually used as a Paving Grade Bitumen suitable for construction of flexible pavements with superior properties.

4.3 Aggregates and Mineral Filler

Aggregate constitutes the granular part in bituminous concrete mixtures which contributes up to 90–95% of the mixture weight and contributes to most of the load bearing & strength characteristics of the mixture. Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement. The aggregates of different grades were sieved through different IS Sieves and they were kept in different containers with proper marking. Aggregates used for mix were of two types: Coarse Aggregate and Fine Aggregate. The mineral fillers may be cement or fly ash.

5 Sample Preparation

5.1 Waste Polythene – Bitumen Blend

The collected polythene wastes were washed, cleaned and dried. The polythenes were then shredded into very tiny pieces. The required quantities of polythene to be added with specified amount of bitumen for preparation of different percentage of polythene-bitumen blend were weighted and added in required percentage by weight of bitumen to the hot bitumen and the mixture was stirred well for about 30 minutes under temperature around 170-180°C.

5.2 Marshall Mould

The aggregates of different grades were sieved through different IS Sieves and they were kept in different containers with proper marking. The mixing of materials required for mould preparation was done as : Required quantities of coarse aggregate, fine aggregate & mineral fillers were taken in an iron pan. This was kept in an oven at temperature 160 °C for 2 hours. This is because the aggregate and prepared blends are to be mixed in heated

state so preheating is required. The prepared blend was also heated up to its melting point prior to the mixing. The Aggregates in the pan kept in oven were taken and heated on a controlled gas stove for a few minutes maintaining the temperature. Now blend (60 gm.), i.e. 5% was added to this mix and the whole mix was mixed uniformly and homogeneously. This was continued for 15-20 minutes till they were properly mixed. Then the mix was transferred to the Marshall sampling mould. The mix in the mould was then compacted by the Marshall Hammer. 75 numbers of blows were given on each side of the sample so a subtotal of 150 no. of blows was given per sample. Then these samples with moulds were kept separately and marked accordingly to the percentage of polythene added by weight of bitumen.

6 Physical Values of Polythene Modified Bitumen

The values for physical properties of Polythene Modified Bitumen tested through experiment are given in table 1. Below:

Table 1 Physical Properties of Modified Blend

| properties | P0 0% plast ic | P1 1% plast ic | P2 2% plast ic | P3 3% plast ic | P4 4% plast ic | P5 5% plast ic |
|------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Softening Point (°C) | 47.5 | 50.0 | 51.4 | 53.0 | 55.0 | 55.9 |
| Penetration Value (mm) | 65.0 | 55.0 | 50.0 | 48.5 | 46.0 | 44.0 |
| Ductility(cm) | 100 | 100 | 90 | 85 | 78 | 56 |
| Flash & FirePoint (°C) | >280 | >350 | >350 | >350 | >350 | >350 |

7. Marshall Stability and Marshall Flow Value

The effect of polyethylene admixture on the volumetric properties of both modified and conventional bituminous mixes are shown in table 2 & figure 2 below:

TABLE-2 MSV & FLOW VALUE

| Sample | Msv (kn) | Flow(mm) |
|--------|----------|----------|
| P0 | 14.3 | 2.31 |
| P1 | 14.2 | 2.30 |
| P2 | 14.5 | 2.28 |
| P3 | 15.5 | 2.25 |
| P4 | 17.7 | 2.21 |
| P5 | 15.9 | 2.18 |

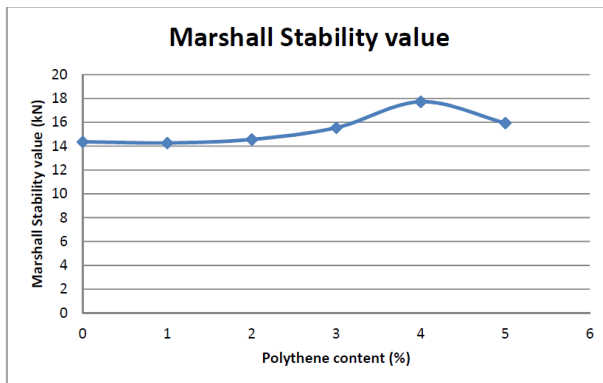


FIG-2 Msv vs polyethylene content

8. Result Analysis

The desired properties of bitumen binders were improved by introducing polythene as an additive. This process of modification of bitumen with waste polythene has enhanced resistance to cracking, pothole formation and rutting by increasing softening point, hardness and reducing stripping due to water, thereby improving the general performance of loads over a long period of time. It observed that Marshall Stability value increases with polyethylene content upto 4% and thereafter decreases. We observe that the Marshall Flow value decreases upon addition of polythene i.e the resistance to deformations under heavy wheel loads increases.

9. CONCLUSIONS

The results indicated that the utilization of waste polythene in bituminous concrete mixtures shows improved property of the mixtures thus formed. The waste polythene utilized in the mix will get coated over Aggregate of the mixture and reduces porosity, absorption of moisture and improves binding property. The bitumen modified with 4% Polythene Waste is showing better Performance as compared to other mixes. The Marshall Stability which is a strength parameter has shown increasing trend with a maximum increase percent of 34.26% as compared to Conventional mix when modified with 4% Polythene Waste. It is observed that Marshall Stability value increases with polythene content upto 4% and thereafter decreases. Thus the use of higher percentage of waste polythene is not preferable. While talking to environmental pollution due to these non-biodegradable plastics waste where disposal of such materials has become a serious problem, its use in construction of flexible pavement will give a better place for their burying and thus solving the problem of their disposal on one hand and providing a better flexible pavement with improved performance on other hand.

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