

Partial Replacement of Bitumen by Waste Plastic in Road Construction

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Abstract- *Plastics are more friendly to human beings and now a days most of the packings, toy products is done by plastics. As all we know that plastics are user friendly but it is not a degradable product, it stays in our environment for long years. Some of the peoples burn this product and by this it produces environmental pollutions and also its affects our global conditions. Proper way of disposal of these plastics is very less and some of the disposals were more costly and dumping of plastics in a land causes different types of diseases pollutions etc.*

Plastics will not allow the penetration of water during rainy seasons and thus it affect our ground water table level. Mainly plastics is disposed in such a way that incineration of materials and land filling which are dangerous to nature. So disposal of plastics is an major problem now a days and these are not scientifically disposed. So plastics has an property of binding in molten state and by this property we can use plastics along with bitumen for road laying. Once plastic waste is separated from the municipal waste, then biodegradable wastes can be used for making organic manur In many developed and developing countries they were using these waste plastics to regenerate toys and other useful products . The materials which are used in the road making is based on economical, saving money(economical) & technical aspects. Roads are the most important factor that highlights to show the country for developed one. Better roads brings good transportation and by this economic status of country will changes. The possible uses of these waste plastics can be used for the development of construction of low volume roads This project gives a review of plastic wastes (Low Density Polyethylene) for the construction of roads.

Keywords- Bitumen, Waste Plastics.

I. INTRODUCTION

General

Plastic is usually found in today's way of life. It is regularly utilized for packaging, protecting, and even disposing every one of the sorts of purchaser waste or

merchandise. Through mechanical increment day by day, large scale manufacturing of organization items and every single people searches for benefits and plastic appeared to be a less expensive and viable crude material. Presently a days each critical part of the economy beginning from agriculture to packaging, automobile, building construction equipments and byproducts, communication has been for all intents and purposes altered by the uses of plastic.

Utilization of this plastic and after utilize it appeared to a waste and it is non-biodegradable material. plastic can remain the length of numerous years on earth. Plastic waste is developing step by step and the issue is the thing that to do with Plastic waste. Thinks about states that the despicable transfer of plastic causes a few issues, for example, bosom disease, regenerative issues in people and creatures, genital anomalies and even a decrease in human sperm tally and quality.

So if use this waste plastic in road construction is giving its importance. Here we should provide some major consideration regarding the quality aspects of role. Two main process, wet & dry process are adopted mainly for the construction of polymer roads. A brief explanation and comparison of above processes are detailed in our project

A new bituminous macadam mix modified using polymer is designed on the basis of test conducted on 12mm down size aggregate and bitumen. The strength of ordinary mix and waste plastic modified bituminous mixes were compared on the basis of test conducted.

II. OBJECTIEVES & METHODOLOGY

1. Objectives

- Disposal of waste plastic is a major problem
- It is non-bio degradable
- Burning of these waste plastic bags causes environmental pollutions

- d) In this project we were using of low density polyethylene waste plastics
- e) Laboratory experiments were conducted in waste plastic under polythene carry bags on heating soften at bituminous mixes. Laboratory studies provided that waste plastic or other low density waste plastics enhances the property of mix
- f) By using this in road construction we can reduce the amount of waste plastic under low density polyethylene in a useful way
- g) To conduct mix design as per IS:SP 23-1982
- h) To find out Optimum Plastic Content(OPC)
- i) Compare the properties of plain and plastic coated bitumen

2. Methodology

Bituminous Mix Design

First we are going to find selection of mix constituents

- Test on Binder
- Penetration Test
- Ductility test
- Softening Point Test
- Specific Gravity Test
- Test on Aggregates
- Impact Test
- Aggregate Gradation

Proportioning Of Aggregates

Use of waste plastic in roads can be done in two ways

Dry process and Wet process

Pavement Structural Design

- Determination of physical properties of the soil
- Liquid Limit Test
- Plastic Limit Test
- Determination of Strength properties
- Heavy compaction

III. TEST ON BINDER

1. Penetration Test:

Penetration of bitumen is a count of discovering its hardness of bituminous material. In this the pointer leaves from a specified height the vertical separation penetrated by

the purpose of standard needle into the bitumin material under particular states of load, time, temperature.

- **Result:**

The Penetration Value of Bitumen = 63.33 mm

As per IRC the penetration value of bitumen in mm in the range of 60-70. Thus Obtained value of Penetration for used bitumen is 63.33 mm, & this lies in the range

- **Ductility Test:**

Ductility test will be performed by determining ductility of bitumen material by elongation before breaking when 2 ends of briquette specimens are pulled apart by giving supply externally at a specified speed & temperature

- **Result:**

Ductility Value = 96 cm

IRC recommendation is greater than 75 cm

4.1.3 Softening Point Test:

Result:

Softening Point of bitumen = 45.25 deg Celsius

The softening point of bitumen is in the range 40-60 (deg Celsius) as per IRC specifications

- **Specific Gravity Test:**

- **Result :**

Specific Gravity of bitumen is = 1.02

Bitumen has the specific gravity in the range 0.09-1.02. Specific Gravity of the bitumen material

2. Test on Aggregates

- **Impact Test :**

After construction work has done in pavements there may be a chance of breaking the aggregates on high loads from vehicles, of different size of vehicles is there with selfweight and external weight, so we have to find out the toughness of aggregates as well as the resisting power and stability of aggregates before construction has done. Impact test is one of the test conducted in aggregates before road works starts. According to IRC recommendation the aggregate impact value should not increase by 35 %.

Note: Aggregates without plastic

- **Result:**

Aggregate impact value=7.295

The value is 7.295 which lies in the range and can be used for pavement surface course

- Impact Test :

Note: Plastic coated aggregates

After construction work has done in pavements there may be a chance of breaking the aggregates on high loads from vehicles, of different size of vehicles is there with selfweight and external weight, so we have to find out the toughness of aggregates as well as the resisting power and stability of aggregates before construction has done. impact test is one of the test conducted in aggregates before road works starts. According to IRC recommendation the aggregate impact value should not increase by 35 %.

- Result :

Aggregate impact value=3.45

The value is 3.45 which lies in the range and can be used for pavement surface course

- Specific Gravity of Quarry Dust

- Result :

Average Specific Gravity = 2.6

Selection of Optimum Bitumen Content

The optimum bitumen content for mix design is found by taking the average value of the

following three bitumen contents found from the graphs of test results.

- I. Bitumen content corresponding to maximum stability.
- II. Bitumen content corresponding to maximum unit weight
- III. u. Bitumen content corresponding to median of designed limits of percent air voids in total mix (4%)

The optimum bitumen content = 3.4%

Preparation of Plastic Coated Aggregate Mix

- i. Find the optimum percentage of bitumen.
- ii. To calculate the amount of plastic to be added to the plastic coated bitumen mix, replace a small percentage from optimum content by percentage of plastic.
- iii. Each trial percentage of plastic thus obtained by decreasing the bitumen percentage.



Figure 1. Plastic coated aggregates

Selection of Optimum Bitumen Content

Procedure as that of Ordinary mix.

Optimum bitumen content = 2.9 Optimum plastic content = 0.5

So the percentage of plastic that of bitumen content = 10 %

The stability of plastic coated mix is higher than that of ordinary mix.

IV. USAGE OF WASTE PLASTIC IN ROAD CONSTRUCTION

1. Introduction

Usage of waste plastic in roads can be done in two different methods- the dry process and wet process. It can also be a complete success only if the roads are satisfying its intended purpose. For that, a detailed study on the quality aspect of polymer roads was made, and the description of the two processes is given below,

2. The Wet Process

In this method, the plastic is used directly in to the bitumen to form the plastic modified bitumen (PMB). The procedure adopted is the following: waste plastic carry bags are cut into various pieces using hand manually and It is sieved and the plastic pieces passing through 4.75mm sieve and retaining at 2.36mm sieve are collected and then added slowly to the hot bitumen(using pan and induction stove we can melt bitumen) whose temperature is around 170- 180deg C and the mixture is mixed well using normal stirrer for about 20-30 min to form the proper mix bitumen.

3. Dry Process

This method involves collecting the waste plastics polyethylene & polypropylene films & carry bags putting them through a simple dry tumbling machine to shake off the dirt. They are cut into various pieces using shredding machine. It is sieved. The plastic pieces passing through 4.75mm sieve and retaining at 2.36mm sieve are collected. The pieces are then added slowly to the heated aggregate nearly 175 deg C. This gives a uniform coating of plastic waste over the aggregates. To these hot plastics-coated aggregates, the heated bitumen was added to it. A uniform mix is obtained. This was used in the construction of roads.

4. Environmental And Economic Advantages In Using Waste Plastic In Road Construction

In the case of polymer coated aggregate mix, 10% of bitumen is replaced by plastic. In most areas of our country, the plastic waste is having no scrap value. Hence it is a freely available raw material. In addition, if we are considering the durability aspect; a fair amount of money can be saved for the maintenance works of PCA roads. The major challenge in the field of polymer road is the collection and separation of plastic waste. So it is obvious that this method is providing new employment opportunities in the above mentioned fields. The table showing the requirements of plastic and the corresponding cost reduction is listed in Below table.

Table 1. Requirement of plastics and the corresponding cost reduction

Cost of bitumen per kg	Rs.50
Cost of waste plastic per kg	Rs.6
Cost of shredded plastic per kg	Rs. 15
Savings per kg	Rs.35
For 1000m x 3.75m road bitumen required	11.25 tons
Bitumen replaced by 10% of plastics	1.125tons = 1125k
Cost reduced due to the usages of plastic in road of 1000m x 3.75m	1125*35 = Rs39375
Cost saved in 1sqm road	Rs. 10.20
Plastic required in 1 sqm	0.3 kg

The total resource parameter for the material handling conveyors are of total number of seized resources are of 83 minutes and the total unutilized time is of 0.05 minutes and the bottlenecking is of 0.05 minutes.

IV. PAVEMENT STRUCTURAL DESIGN

1. Determination of Physical Properties of the Soil

Liquid Limit

Results:

Water content corresponding to 25 blows = 37%

Plastic Limit

Result:

Plastic limit of the soil = 33%

Plasticity Index = Liquid limit - Plastic limit

= 37%-33%

= 4%

VI. CONCLUSION

Comparing the results obtained for each plastic coated and un coated aggregates, we finalized that we can

reduce the amount of bitumen by 10 percentage and it will be economical. By this we can reduce the amount of waste plastic from environment in a useful way and also we can protect our nature from harmful effects

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