



CONSTRUCTION OF BITUMINOUS ROAD USING PLASTIC WASTE

Manisha Gaikwad, Sameer Kamble, Sudheer Karpe, Aniket Kelgandre,

(Department of Civil Engineering, Viva Institute of Technology, University of Mumbai, India)

(Department of Civil Engineering, Viva Institute of Technology, University of Mumbai, India)

(Department of Civil Engineering, Viva Institute of Technology, University of Mumbai, India)

(Department of Civil Engineering, Viva Institute of Technology, University of Mumbai, India)

Abstract: Waste plastic and its disposal is a major problem to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength, durability, life. It will also be the best solution for plastic waste disposal & various defects in pavement i.e., potholes on roads, corrugation, etc. the types of waste plastic used are polyethylene, polypropylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and result plastic-bitumen mix is used for pavement construction. This will not only strengthen the pavement but also increase its durability & strength, the life of the pavement/road. This new technology will be beneficial for the Indian hot-humid climate. It's economical and eco-friendly. In this paper, we have discussed the soil properties to be considered in the design of flexible bituminous pavement, pavement design, the process of construction flexible. The plastic wastes could be used in road construction and the field tests reduce the stress and proved that the plastic wastes used after proper processing as an additive would enhance the life of the roads and find out the solution to environmental problems. After the addition of plastic, the melting point of bitumen will increase.

Keywords: Plastic waste, flexible bituminous pavement, strength, eradication of potholes, improved pavement stability.

INTRODUCTION

Plastic materials have become the cornerstone of our lives, so it leads to the generation of huge quantities of plastic waste. There is an immediate need to improve the properties of pavement in the present scenario since a steady increase is observed in areas like wheel loads, tire pressure, change in climatic conditions and daily wear and tear which affect the performance of bituminous mix pavement in a huge amount. The number of plastic waste materials is either mixed with Municipal solid waste or dumped in an open area leading to an increase in the area covered under wasteland. Plastic waste, if not recycled, is either landfilled or incinerated, where both of them prove to be a disaster to the environment. Incineration leads to air pollution whereas dumping the waste in open areas causes contamination of water bodies and soil. Thus, an alternative for the treatment of plastic waste and waste rubber tires is required as early as possible. Plastic use in road construction is not a new invention. Recent studies in this direction have shown some hope in terms of the use of waste plastic in road construction. On plastic roads, mainly use plastic carry bags, disposable cups, and PET cups that are collected from garbage dumping yards. When the plastic is mixed with hot bitumen, plastic melts to form an oily coat over the aggregate and this mixture is laid on the road surface like in a normal tar road. Plastic is a huge threat to the environment. Plastic waste can be used in road construction and research proved that the plastic wastes used after proper processing can enhance the life of the road also a solution to environmental problems. The plastic used in road construction is not new and it is already using plastic waste such as carry bags, water bottles, milk packets, glasses, cups, etc. Roads built with plastic waste, popularly known as plastic roads, perform better when

II. Research methodology

In the process of construction of roads having plastic added bitumen; several tests needed to be conducted on the various materials and the components. The materials used for carrying out the present research are 1. Aggregates 2. Bitumen 3. Plastic waste (shredded condition). The various laboratory tests were carried out on these materials and the results were computed.

I. Aggregates

Aggregates form the major portion of pavement structure and they form the prime materials used in pavement construction. Aggregates have to bear stresses occurring due to the wheel loads on the surface course. They also have to resist wear due to the abrasive action of traffic. These are used in pavement construction in cement concrete, bituminous concrete, and other bituminous construction and also as granular base courses underlying the superior pavement layers. Hence properties of the aggregates which are to be considered are abrasion, strength, durability, hardness, etc. Following tests were conducted on the aggregates:

1. Aggregate Impact Value Test
2. Combined Flakiness and Elongation Index
3. Specific gravity and Water Absorption Test
4. Los Angeles Abrasion Test.

II. Bitumen

Bituminous materials used in highway construction are broadly classified into bitumen and tar. Bitumen may further be divided into petroleum asphalt or bitumen and native asphalt. There are different forms in which native asphalts that are available. These are those which occur in a pure or nearly pure state in nature. Bitumen is available in various grades and types; to judge the suitability of the bitumen various tests are to be conducted on it which are as follows:

1. Softening point Test
2. Penetration Test.

III. Plastic Waste (Shredded Condition)

Plastic waste is one of the biggest problems in the waste treatment and management industries. Hence such plastic we can shred into less particle size and can use it as a partial replacement of the bitumen. Marshall Stability test can be performed to examine the changes in the properties of the whole mix.

During this research, we had partially replaced the bitumen content with shredded plastic content varying from 5%, 10%, 15%. After the addition of plastic, we had conducted a Marshall Stability test to determine the changes in the mix.

IV. Marshall Stability Test

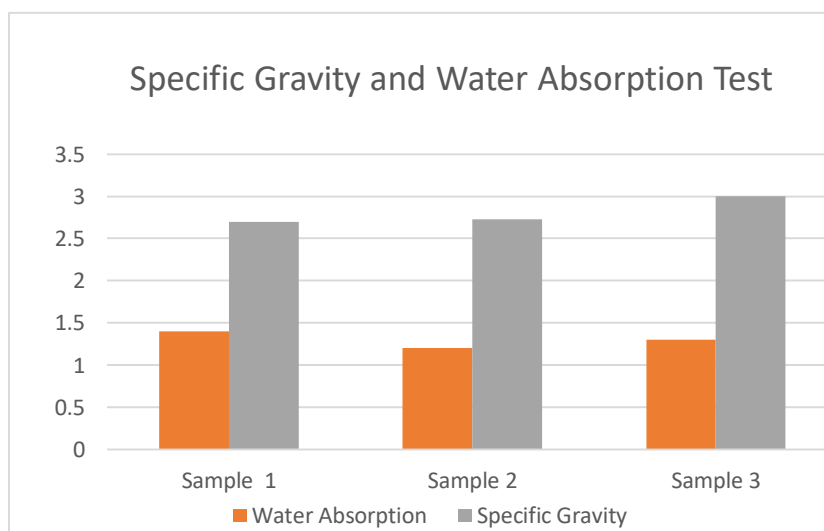
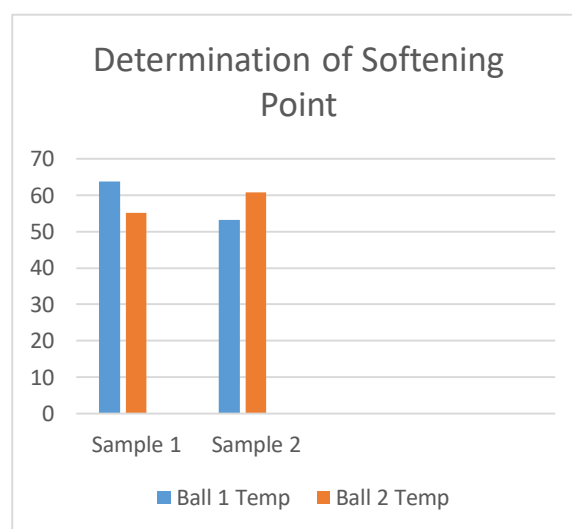
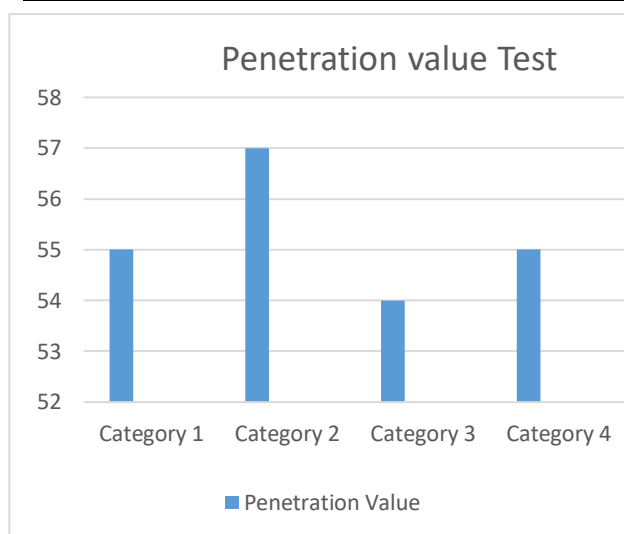
Marshall Stability Test is a common test for pavements. The stability of the mix is defined as the maximum load carried by a compacted specimen at a standard temperature. The flow is measured as the deformation in units. This deformation gives us the flow value.

Results: Tables and Charts

Aggregate Impact Value Test	
Metal Type	10 mm.
Source	Jasai Uran
Sampling	12.5mm Passing & 10mm Retain
Weight of empty cup in gms. (W2)	838 mm

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Weight of empty cup + Aggregate in gms. (W2)	1178 mm
Weight of Aggregate in gms. (W3)	340 mm
Weight of Aggregate passing through 2.36 mm sieve in gms. (W4)	25 mm
% of Impact Value = $(w4/W3*100)$	7.35 %
IS Limit	35 %



- **Crushing Value Test:** If the aggregate crushing value is less than 10%, it signifies an exceptionally Strong Aggregate. Whereas, if the crushing value is 35% or above, it would normally be considered as a weak Aggregate, we got 21.2% which is less than 35% so it indicates that it has good Strength to resist Compressive load.
- **Abrasion Test on Aggregate:** Abrasion value of Aggregate should not more than 30% for Aggregate used for surface wearing course, we got 21.8% so it shows that ability of Aggregate to resist wear and tear is good.
- **Impact Test on Aggregate:** Aggregate Impact value is the same as the Abrasion test result. Impact value of Aggregate should not exceed 30% for Aggregate used for surface wearing course, we got 7.35% it shows the ability of Aggregate to resist sudden impact is Good.

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- Elongation and Flakiness Index value test: Recommended result of aggregates should be in range of 15% to 30% according to area of use. We got combine value for sample is 27.32% for 20mm Aggregate and 23.94% for 10mm Aggregate which is between 15 to 30% so it's safe for work.
- Specific Gravity and Water Absorption test on Aggregate: The Specific gravity of Aggregate generally used in construction range from about 2.5 to 3 and Water Absorption range from about 0.1 to 2%. We got specific gravity 2.74 and Water Absorption 1.3% which is acceptable according to standard guideline.
- Softening Point of Bitumen: The softening point of various bitumen grades generally lies between 35°C to 70°C softening point of bitumen to be used for road construction at a place where the maximum temperature is 40°C should be greater than 40°C. We got 55.27°C which is acceptable.
- Marshall Stability Test: We design specimen for ratio of (6% Bitumen content and 94% Aggregate + lime), from these ratio or proportion we got 13.9KN stability value. Then we replace bitumen by plastic (5%,10%,15%) and we got stability value as 16.1,17.5 and 13.13kn it shows that after adding plastic in mix stability value increase gradually.

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