Effect of Plastic Waste on Properties of Road Aggregate

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Abstract

The present study investigates the use of waste plastic for the modification of properties of road aggregates. The shredded plastic waste was thoroughly mixed with heated aggregates forming a layer on the surface of the aggregates. These plastic waste coated aggregates are tested for impact value, crushing value, specific gravity and water absorption. It has been found that there is significantly improvement in the properties of plastic coated aggregates.

Keywords: Aggregate, Bitumen, plastic waste

I. INTRODUCTION

Aggregates form the major portion of pavement structure and these are prime material used in the construction of various layers of pavement. The aggregates have to bear stresses due to the wheel loads on the pavement and they also have to resist, the abrasive action of the traffic. The aggregates to be used in the road construction should be sufficiently strong, hard, tough to withstand the stresses abrasive action and due to wheel load. They should also be durable to resist disintegration due to the action of the weather. Number of tests are recommended in the specifications to judge the properties of the aggregates, e.g. strength, hardness, toughness, durability, angularity, shape factors, clay content, adhesion to binder etc. The aggregates are bound together either by bituminous material or by cement. Flexible pavements are widely used in India due to various advantages and economical construction over rigid pavement. The bitumen mixes are generally considered as surface and wearing courses in flexible pavement. The utilization of waste plastic in the construction of flexible pavement is a new concept. The quantity of waste plastic in the municipal solid waste is increasing day by day due to increase in the pollution, development activities and urbanization. The disposal of this waste plastic has become a serious problem because of the non-biodegradability. This waste plastic can be used in the construction of bituminous roads as a modifier of road aggregates properties and Marshall Parameters.

This paper envisages the use of plastic waste for the improvement of the desirable properties of road aggregates like impact value, crushing value, specific gravity, water absorption. For this laboratory test are conducted on the plain aggregates and aggregates coated with different percentages of plastic waste.

II. LITERATURE REVIEW

The Use of plastic waste in flexible pavements would open up a solution for the disposal issues regarding plastic wastes. Many research works have been done in the area of use of plastic waste in bituminous road construction.

Bhageerathy et al. (2014) investigated the use of biomedical plastic waste in bituminous road construction. They concluded that the Marshall stability value of plastic modified mix was found to be 51 percent more than that for the normal mix which indicates an increase in load carrying capacity.

Dr. R. Vasudevan (2007) investigated that the coating of plastics reduces the porosity, absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy disposal of waste plastics. Use of plastic bags in road help in many ways like Easy disposal of waste, better road and prevention of pollution.

Dr. R. Vasudevan and S. Rajasekaran, (2007) stated that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased Softening point and decreased Penetration value with a suitable ductility.

Gawande et al. (2012), Summarized an overview on waste plastic utilization in asphalting of roads. They reviewed techniques to use plastic waste for construction purpose of roads and flexible pavements.

Raji et al. (2007) investigated the “utilization of marginal materials as an ingredient in bituminous mixes. They concluded that when plastic wastes can be used as additives on bituminous pavements. Hence in their study, the properties of bituminous mix when modified with shredded syringe plastic waste were investigated. The work was carried out by mixing shredded autoclaved plastic syringes with heated aggregates by dry process.

Sultana et al. (2012) investigated the utilization of waste plastic as a strength modifier in surface course of flexible and rigid pavements. They concluded that the potential use of waste plastic as a modifier for asphalt concrete and cement concrete pavement.
Swami et al. (2012) investigated the Use of waste plastic in the construction of bituminous Road. They concluded that plastic waste consisting of carry bags, cups and other utilized plastic could be used as a coating over aggregates and this coated stone could be used for Road construction.

III. METHODOLOGY

The following tests were conducted on the plain aggregates coated with different amount of plastic waste.

- Aggregate impact value
- Aggregate crushing value
- Specific gravity
- Water absorption

The four type of aggregates are taken as shown. Aggregates without plastic and aggregates coated with of waste plastic equal to 0.5%, 0.55%, 0.6% of weight of dry aggregates. The results obtained are summarized in table 1-

**A. Result on Aggregate**

<table>
<thead>
<tr>
<th>Plastic content % by weight of aggregates</th>
<th>Aggregate impact value</th>
<th>Aggregate crushing value</th>
<th>Specific gravity</th>
<th>Water absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 %</td>
<td>16.57</td>
<td>23.7</td>
<td>2.81</td>
<td>0.6</td>
</tr>
<tr>
<td>0.5 %</td>
<td>15.42</td>
<td>22.0</td>
<td>2.78</td>
<td>0.5</td>
</tr>
<tr>
<td>0.55 %</td>
<td>14.85</td>
<td>21.0</td>
<td>2.75</td>
<td>0.4</td>
</tr>
<tr>
<td>0.6 %</td>
<td>15.14</td>
<td>21.6</td>
<td>2.74</td>
<td>0.35</td>
</tr>
</tbody>
</table>

The variation of the above properties are shown in fig. 1 to fig. 4

Fig. 1: Variation of Aggregate impact value with plastic %

Fig. 2: Variation of Aggregate crushing value with plastic %
IV. CONCLUSION

The use of plastic waste in the construction of flexible pavement is one of the best methods for the safe disposal and better performance of the bituminous mix, if plastic coated aggregates are used. From the test conducted on aggregates coated with different amount of plastic, the following conclusions are drawn:-

1) The coating of aggregates with waste plastic reduces the absorption of moisture.
2) There is significantly a decrease in the aggregates impact value and aggregates crushing value if compared with the values of conventional aggregates without plastic.
3) There is small decrease in the specific gravity values with the increase of plastic content in the aggregates.

From the above test results it can be concluded that the performance of the aggregates is improved with the addition of waste plastic into them.

REFERENCES


