Study of waste polythene used in flexible pavement

Mayank Mohan Mishra
mayankmohan123@gmail.com
Babu Banarasi Das University, Lucknow, Uttar Pradesh

ABSTRACT
Waste polythene which is increased week to week becomes messed of the waste polythene it turns pollutes the environment, especially where there is no garbage collection system existed. A large amount of plastic comes into the tourist trekking regions and housing area are discarded or burned which is released harmful gases into the environment and air. The waste polythene collected from domestic and industrial sectors can be used in the production of plastics coated aggregate. Waste polythene, mainly used for packing and carrying any food. It’s made up of Polyethylene, Polypropylene, and polystyrene. There softening point varies between 110 degree Celsius – 140 degree Celsius and if the wastes polythene is heated thesis temperature range then they do not produce any toxic gases but the softened waste polythene have tendency to form a film like structure over the aggregate, when it is sprayed over the hot aggregate at 160 degree Celsius – 170 degree Celsius. The Plastics Coated Aggregates (PCA) is a better raw material for the construction of flexible pavement. PCA was mixed with hot bitumen of different types and the mixes were used for road construction.

Keywords— Waste plastics, Plastic coated aggregate, Bitumen, Polyethylene, Polypropylene, Polystyrene

1. INTRODUCTION
The continuous growth rate of the population of India has resulted in an overall count of around 1.35352 Billion people which represents almost 18% of the world’s total population according to google. Plastics is a material which easily changes his shape and a friend to common man. This time Plastic is everywhere in today’s lifestyle. In recent years, applications of plastic wastes have been considered in road construction with great interest in many developing countries. The use of these materials in road making is based on technical, economic, and ecological criteria. Several million metric tons of plastic wastes are produced every year in India. Plastics waste constitutes a significant portion of the total municipal solid waste (MSW) generated in India. However, the end-of-life plastics can be recycled into a second life application but after every thermal treatment, degradation of plastics takes place to a certain extent. To evaluate the performance of the built roads using plastics waste coated aggregate (PCA) bitumen mix and also to generate a database for evolving Standards by Indian Road. Disposal of a variety of plastic wastes in an eco-friendly way is the thrust area of today’s research. The waste plastics used for the construction of flexible pavement material which would give better stability, durability, resistance and strength to the road as compared to the conventional material made road. Plastic wastes consisting of mainly Polyethylene, Polypropylene and Polystyrene from items such as carry bags, cups, and thermocouples and packaging films is a major problem for their disposal. In this study, the plastic wastes were shredded into a small size, i.e. 2 mm to 4 mm, molten and thereafter coat over hot aggregate at 160°C. Several roads have been built in this manner using Waste polythene-coated aggregate – bitumen. Bitumen is a useful binder for flexible pavement. Different grades of bitumen like 60/70, 80/100 are available on the basis of their penetration values.

2. LITERATURE REVIEW
R. Manju (MAY 2017) the waste plastic and its disposal is a major threat 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. In addition, it will also be a solution to plastic disposal & various defects in pavement viz., potholes, corrugation, ruts, etc. the waste plastic used are poly-ethylene, polystyrene, polypropylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and the resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases its durability. The titanium-dioxide is used as a smoke absorbent material, which will absorb the smoke from the vehicles. This innovative technology will be boon for 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 pavement, pavement design, process of construction flexible and plastic-smoke absorbent pavement.

R. Vasudevan (MAY 2015) Infers that the addition of natural or synthetic polymers to bitumen is known to impart enhanced service properties. By adding small amounts of polymers to bitumen, the life span of the road pavement is considerably increased and the purpose is to achieve desired engineering properties such as increased shear modulus and reduced plastic flow at high temperatures and/or increased resistance to thermal fracture at low temperatures.

Saiyed Farhana (MAY 2015) they conclude that the specific gravity of these aggregates ranges from 1.5 to 2.7 and the marble chips are extremely durable. They also reported that replacement
of marble chips to aggregates had a beneficial effect on the mechanical properties such as crushing strength and stripping value.

A. J. Chavan (May 2013) Disposal of waste materials including waste plastic bags has become a serious problem and waste plastics are burnt for apparent disposal which causes environmental pollution. Utilization of waste plastic bags in bituminous mixes has proved that these enhance the properties of the mix in addition to solving disposal problems. Plastic waste which is cleaned is cut into a size such that it passes through 2-3mm sieve using shredding machine. The aggregate mix is heated, and the plastic is effectively coated over the aggregate. This plastic waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The use of innovative technology will not only strengthen the road construction but also increase road life as well as will help to improve the environment. Plastic roads would be a boon for India’s hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. In my research work, I have done a thorough study on the methodology of using plastic waste in bituminous mixes and presented the various tests performed on aggregates and bitumen.

Minakshi Singhal (May 06) Flexible pavements with bituminous surfaces are widely used. Due to increased traffic intensity of roads, overloading of commercial vehicles and temperature variation of pavements due to climatic changes leads to the formation of various distresses like rutting, shoving, bleeding, cracking and potholing of bituminous surface. Due to high temperature, bitumen becomes very soft in summer and brittle in winter. Also, in a developing country like India, roadway construction is taking place at a very high pace which requires large demand for construction material that too eco-friendly and economical. Several Studies have revealed that properties of bitumen and bituminous mixes can be improved/modified with the addition of certain additives and the bitumen premixed with these additives/modifiers is known as “modified bitumen”. The present study aims for the use of modified bitumen by using plastic waste for road construction. The paper includes details of literature and methodology of using modifiers in bitumen and aims to provide highway construction in an eco-friendly and economical way. The modified bitumen mix shows better binding property, stability, density and more resistant to water.

3. MATERIALS USED

3.1 Waste plastic

The waste polythene used like bottles, bags, wrappers etc., collected from the residential area and domestic area. The consumption of plastics has increased from 4000 tons/annum (2001) to 4 million tons/annum (2009) and it is expected to rise 8 million tons/annum during the year 2017. Nearly 50 to 60% of the total plastics are consumed for packing. Once used plastic materials are thrown out. They do not undergo biodecomposition.

Table 1: Different types and sources of waste plastic

<table>
<thead>
<tr>
<th>Types</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene (PE)</td>
<td>Water Bottle, Carry Bag, Milk Pouches etc.</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>Bottle Cap, Detergent Wrappers etc.</td>
</tr>
<tr>
<td>Polystyrene (PS)</td>
<td>Clear egg pack, Disposable cups, Protective Packaging etc.</td>
</tr>
</tbody>
</table>

3.2 Aggregates

The aggregate grading is used for all testing is taking form IRC: 94-1986.
5. PERFORM TESTS
Tests will be performed on the materials:

5.1 Following the tests have been performed on bitumen:
(a) **Penetration value test:** In the performing of the bitumen penetration test, the value will become 69mm.
(b) **Ductility test:** In the performing of the bitumen ductility test, the value will become 82mm.
(c) **Flash and Fire point test:** In the performing of the bitumen flash and fire point test, the value of flashpoint will become 230°C and the value of fire point will become 250°C.
(d) **Softening point test:** In the performing of the bitumen softening point test, the value will become 52°C in around 5 to 6 min.

5.2 Following the tests will be performed on aggregate
(a) Aggregate impact value test
(b) Water absorption test
(c) Specific gravity test

5.3 Marshall Test
(a) Six Marshall Stability samples will be prepared out of which three will be with the plastic of varying percentage
(b) And three samples without plastic waste.
(c) Marshall Stability test will be performed on all of the samples prepared.

6. CONCLUSION
By using waste-polythene coated aggregate in road construction, helps to:
- Use a higher percentage of waste polythene.
- Reduce the need for bitumen.
- Increase the strength and performance of the road.
- Avoid the use of anti-stripping agents.
- Avoid the disposal of waste polythene by burning and landfilling.
- Generate jobs for rag pickers. The ability of the aggregate to resist weather conditions is improved.
- As plastics are added to the aggregates, moisture absorption ability of aggregates decreases, resulting in better resistance to rain.
- Higher resistance to rain and waterlogging.
- Reduced the need for bitumen by around 10% to 15%.
- Increase the strength and performance of the road.
- Contribute to eco-friendly technology.

7. REFERENCES