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# USE OF WASTE PLASTIC IN CONSTRUCTION OF BITUMINOUS ROAD

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***Abstract:*** The plastic wastes could be used in road construction and 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 use in road construction is not new. It is already in use as PVC or HDPE pipe mat crossings built by cabling together PVC (polyvinyl chloride) or HDPE (high-density poly-ethylene) pipes to form plastic mats. Waste plastic is ground and made into powder; 3 to 4 % plastic is mixed with the bitumen. The durability of the roads laid out with shredded plastic waste is much more compared with roads with asphalt with the ordinary mix. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income.

## I. INTRODUCTION

Now-a-days disposal of different wastes produced from different Industries is a great problem. These materials pose environmental pollution in the nearby locality because many of them are non-biodegradable. Traditionally soil, stone aggregates, sand, bitumen, cement etc. are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Also, cost of extracting good quality of natural material is increasing. Concerned about this, the scientists are looking for alternative materials for highway construction, and industrial wastes product is one such category. If these materials can be suitably utilized in highway construction, the pollution and disposal problems may be partly reduced. In the absence of other outlets, these solid wastes have occupied several acres of land around plants throughout the country.

Plastics are user friendly but not eco-friendly as they are non-biodegradable generally, it is disposed by way of land filling or incineration of materials which are hazardous. Plastic is versatile material and a friend to common man becomes a problem to the environment after its use. The better binding property of plastics in its molten state has helped in finding out a method of safe disposal of waste plastics. Road surface with neat bitumen can cause bleeding in hot climate, may develop cracks in cold climate, possess fewer loads bearing capacity and can cause serious damages because of higher axle load in present conditions due to rapid infrastructure development. Useful life of bituminous overlays has reportedly declined 7- 8 from average life of 5-6 years in the past to about 3-4 years at present as compared to average pavement life (5-6 years) in abroad. Polymer and plastic modified bitumen, often abbreviated as modified bitumen is obtained with the incorporation of selected thermoplastics and shredded plastic from discarded waste, natural plastic or any other suitable elastomers in bitumen.

## II. CONSTRUCTION

Since plastic roads are a relatively new idea, construction processes vary. In Jamshedpur, India, roads are created from a mix of plastic and bitumen. In Indonesia roads are also being built using a plastic-asphalt mix in many areas including Bali, Surabaya, Bekasi, Makassar, Solo, and Tangerang.

These roads are made from recycled plastics, and the first step in constructing them is to collect and manage the plastic material. The plastics involved in building these roads consists mainly of common post-consumer products such as product packaging. Some of the most common plastics used in packaging are polyethylene terephthalate (PET or PETE), polyvinyl chloride (PVC), polypropylene (PP), and high- and low-density polyethylene (HDPE and LDPE). These materials are first sorted from plastic waste. After sorting, the material is cleaned, dried, and shredded. The shredded plastic is mixed and melted at around 170°C. Hot bitumen is then added and mixed with the melted plastic. After mixing the mixture is laid as one would with regular asphalt concrete.

## III. METHODOLOGY


**Fig 1. Flow Chart**

### 3.1 Cleaning of plastic waste

The first step involves a collection and cleaning of items categorized as plastic waste. It includes carry bags and cups with 60 microns of thickness, hard and soft foams, laminated plastics like biscuits and chocolate wrappers.


**Fig 1.1 Cleaning**

**Fig 1.2 Cleaning**

Various waste plastics like carry bags, plastic cups, plastic packaging are taken as raw material.

- Plastic waste collected from various sources must be separated from other waste.
- Maximum thickness of 60 microns.

### 3.2 Shredding of plastics

In the second step, the collected plastic is cut into a size of 2.36 mm to 4.75 mm by using a shredding machine.
In the process, large plastic items are fed into the shredder. Moving at a slower speed than a granulator, blades break the plastic down into smaller chunks. These pieces are then collected and washed and treated in washing and recycling plants before being granulated and sent to manufacturers.

**Fig 1.3 Shredding**

**Fig 1.4 Shredding**

- Plastic waste will be shredded or cut into small piece.
- The different types of plastic wastes are mixed together

### 3.3 Mini hot mix plant

The aggregate mix from previous step is then heated to 165 to 170 Degree Celsius and transferred to a mixing chamber whereas the bitumen is heated up to 160 Degree Celsius to prevent weak bonding.

**Fig 1.5 Mixing**


**Fig 1.6 Mixing**

### 3.4 Transfer of aggregate to puddler

The stone aggregate mix (as per specification) is transferred to the mix cylinder where it is heated to 1650c (as per the IRC specification) and then it is transferred to the mixing puddler (Temperature can be monitored using IR thermometer), while transferring the hot aggregate into the puddler, calculated quantity of shredded plastics is sprayed over the hot aggregate within 30seconds. The sprayed plastic films melt and gets coated over the aggregate, thus forming an oily coating.

**Fig 1.7 Transfer of aggregate**

**Fig 1.8 Transfer of aggregate**

### 3.5 Addition of plastics

At the mixing chamber, the shredded plastic gets coated uniformly over the aggregate within 30-60 seconds and shows an oily look.

**Fig 1.9 Addition of plastics**

### 3.6 Addition of bitumen

At the mixing puddler, the hot bitumen is added over the plastic coated aggregate and the resulted mix is used for road construction.

**Fig 1.10 Addition of bitumen**

**3.7 Aggregate plastic bitumen mix**

- The plastic waste mixture is combined with the bitumen mixture
- The resulting aggregate is used for constructing the road between 110 to 120-degree Celsius.

**Fig 1.11 Aggregate plastic bitumen mix**

**3.8 Road laying**

- The road laying temperature is between 1100c to 1200c.
- The roller used is normal 8-ton capacity.

**Fig 1.12 Road laying**

## IV. RESULT

The increase in percentage of polymer decreased the penetration value. This shows that the addition of plastic increases the hardness of the bitumen. The penetration values of the blends are decreasing depending upon the percentage of plastics and the type of plastic added. The ductility decreased by the addition of plastic waste to bitumen. The decrease in the ductility value may be due to interlocking of plastic molecules with bitumen. Flash and fire point increased with the increase in the percentage of plastic. The plastic bitumen blend road surfaces are less affected by fire hazards. The softening point increased by the addition of plastic waste to the bitumen. Higher the percentage of plastic waste added, higher is the softening point. The influence over the softening point may be due to the chemical nature of plastics added. The increase in the softening point shows that there will be less bleeding during summer. Bleeding accounts, on one side, increased friction for the moving vehicles and on the other side, if it rains the bleedings accounts for the slippery condition. Both these adverse conditions are much reduced by plastic-bitumen blend.

## V. CONCLUSION

**I.** The addition of waste plastic modifies the properties of bitumen.
**II.** The modified bitumen shows good result when compared to standard results.
**III.** The optimum content of waste plastic to be used is between the range of 5% to 10%.
**IV.** The problems like bleeding are reduce in hot temperature region.
**V.** Plastic has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic.
**VI.** The waste plastics thus can be put to use and it ultimately improves the quality and performance of road.
**VII.** Total material cost of the project is reduced by 7.99%

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