Plastic Roads

A Long lasting road from waste plastic for a better and green world....
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Introduction:

- Disposal of waste plastic is a major problem. It is non-biodegradable & it mainly consists of low-density polyethylene.
- Burning of these waste plastic bags causes environmental pollution.
- To find its utility in bituminous mixes for road construction, laboratory performance studies were conducted on bituminous mixes.
- Laboratory studies proved that waste plastic enhances the property of the mix.
- Improvement in properties of bituminous mix provides the solution for disposal in an useful way.
Plastic roads mainly use plastic carry bags, disposable cups and bottles that are collected from garbage dumps as an important ingredient of the construction material.

When mixed with hot bitumen, plastics melt to form an oily coat over the aggregate and the mixture is laid on the road surface like a normal tar road.
What are waste plastic roads?

The roads constructed using waste plastic, popularly known as **Plastic Roads**, are found to perform better compared to those constructed with conventional bitumen.

1) The [Indian Centre for Plastics in the Environment](#) (ICPE) has been promoting the use of plastic waste to construct asphalt roads.

2) A few trial roads have been paved successfully by combining waste plastic with bitumen.
1) Disposal of waste plastic is a major problem.

2) It is non-biodegradable.

3) It mainly consists of low-density polyethylene.
4) To find its utility in bituminous mixes for road construction.

5) Burning of these waste plastic bags causes environmental pollution.

6) Laboratory performance studies were conducted on bituminous mixes.

7) Studies proved that waste plastic enhances the property of the mix.

8) Improvement in properties of bituminous mix provides the solution for disposal in an useful way.
CONCEPT OF UTILISATION OF WASTE PLASTIC IN BITUMINOUS MIXES FOR ROAD CONSTRUCTION:

- This Concept of Utilization of Waste Plastic in Bituminous Mixes for Road Construction has been done since 2000 in India.

- At the initiative of M/s K.K. Poly Flex Pvt. Ltd., a study on the possible use of the processed plastic waste bags with the bituminous mixes was carried out at the R.V. College of Engineering Bangalore.

BANGALORE’S KK PROCESS:

- A group of students of B.E. degree course in Chemical Engineering of this college under the guidance of the concerned teaching staff carried out their final year project.

- For studying the possibility of using of the processed plastic bags with bitumen and bituminous mixes.

- As some encouraging results were reported in this study, M/s K.K. Poly Flex Pvt. Ltd. later approached the Centre for Transportation Engineering of Bangalore University with the request to carry out further research studies on the effects of using the processed plastic bags with bituminous mixes for Road construction works.
MATERIALS USED:

- **AGGREGATE:**
  - Aggregate of 20mm, 10 mm.
  - Stone Dust and Lime as Filler

- **BITUMEN:**
  - 60/70, 80/100 grade bitumen.

- **WASTE PLASTIC:**
  - Waste plastic in the shredded form. (PVC is not Used)
Step 1–: Plastics waste (bags, cups, bottles) made out of PE, PP and PS cut into a size between 2.36mm and 4.75mm using a shredding machine.

Step 2–: The aggregate mix is heated to 165°C (as per the HRS specification) and transferred to the mixing chamber. Amount of plastic to be added is 8% of bitumen.
**Step 3-:**

- Similarly the bitumen is to be heated up to a maximum of 160°C (HRS Specification) to have good binding and to prevent weak bonding. (Monitoring the temperature is very important).

- **Step 4-:** At the mixing chamber, the shredded plastics waste is to be added. It gets coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look.
Step 5:
• The plastics waste coated aggregate is mixed with got bitumen and the resulted mix is used for road construction. The roller used is 8-ton capacity.

Step 6: The road laying temperature is between 110°C to 120 °C. And the rollers are used have capacity 8-ton generally.
Overall process:

WASTE PLASTICS COATED AGGREGATE - BITUMEN MIX

AGGREGATES → HOT AGGREGATES

170 °C

Waste plastics

POLY.COATED AGGREGATES

HOT BITUMEN 160 °C

POLYMER –BITUMEN – AGGREGATES MIXTURE

ROAD LAYING
Field trials

There are two types of field trials:
1. DRY PROCESS
2. WET PROCESS

1. DRY PROCESS:
   - The aggregate is heated to 170°C in the Mini hot Mix Plant.
   - Heated aggregates
   - The shredded plastic waste is added in equal proportion.
   - Adding shredded plastic.

2. WET PROCESS:
   - Waste plastics by direct mixing with hot bitumen at 160°C.
   - Mechanical stirrer is needed.
   - Addition of stabilizers and proper cooling.
   - Since the wet process requires a lot of investment and bigger plants.
   - Not commonly used.
## COMPARISON BETWEEN ORDINARY BITUMINOUS ROADS AND WASTE PLASTIC BITUMINOUS ROADS:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Properties</th>
<th>Plastic Road</th>
<th>Ordinary Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MARSHALL STABILITY VALUE</td>
<td>MORE</td>
<td>LESS</td>
</tr>
<tr>
<td>2.</td>
<td>BINDING PROPERTY</td>
<td>BETTER</td>
<td>GOOD</td>
</tr>
<tr>
<td>3.</td>
<td>SOFTENING POINT</td>
<td>LESS</td>
<td>MORE</td>
</tr>
<tr>
<td>4.</td>
<td>PENETRATION VALUE</td>
<td>MORE</td>
<td>LESS</td>
</tr>
<tr>
<td>5.</td>
<td>TENSILE STRENGTH</td>
<td>HIGH</td>
<td>LESS</td>
</tr>
<tr>
<td>6.</td>
<td>RUTTING</td>
<td>LESS</td>
<td>MORE</td>
</tr>
<tr>
<td>7.</td>
<td>STRIPPING (POT HOLES)</td>
<td>NO</td>
<td>MORE</td>
</tr>
<tr>
<td>8.</td>
<td>SEEPAGE OF WATER</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>9.</td>
<td>DURABILITY OF THE ROADS</td>
<td>BETTER</td>
<td>GOOD</td>
</tr>
<tr>
<td>10.</td>
<td>COST OF PAVEMENT</td>
<td>LESS</td>
<td>NORMAL</td>
</tr>
<tr>
<td>11.</td>
<td>MAINTENANCE COST</td>
<td>ALMOST NIL</td>
<td>MORE</td>
</tr>
<tr>
<td>12.</td>
<td>ENVIRONMENT FRIENDLY</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
ADVANTAGE OF WASTE PLASTIC BITUMINOUS MIX-:

1) Stronger road with increased Marshall Stability Value (measures the maximum load sustained by the bituminous material).

2) Better resistance towards rain water and water stagnation.

3) No stripping and no potholes.

4) Increase binding and better bonding of the mix.

5) Reduction in pores in aggregate and hence less rutting and raveling.

6) No leaching of plastics.

7) No effect of radiation like UV.
8) The strength of the road is increased by 100%.

9) The load withstanding property increases. It helps to satisfy today’s need of increased road transport.

10) For 1km X 3.75m road, 1 ton of plastic (10 lakh carry bags) is used and 1 ton of bitumen is saved.

11) Value addition to the waste plastics (cost per kilogram increases from Rs 4 to Rs12).

12) The cost of road construction is also decreased.

13) The maintenance cost of road is almost nil.

14) Disposal of waste plastic will no longer be a problem.

15) The use of waste plastics on the road has helped to provide better place for burying the plastic waste without causing disposal problem.
BENEFITS OF WASTE PLASTIC ROADS:

- Environmental benefits
- MSWM (Municipal Solid Waste Management)
- Employment Generation
- Farming Community
- National Economy
DISADVANTAGES OF PLASTIC ROAD

1. Cleaning process –:
Toxics present in the co-mingled plastic waste would start leaching.

2. During the road laying process –:
In the presence of chlorine will definitely release noxious HCL gas.

3. After the road laying –:
It is opined that the first rain will trigger leaching. As the plastics will merely form a sticky layer, (mechanical abrasion).
The components of the road, once it has been laid, are not inert.
• WASTE PLASTIC ROADS CONSTRUCTED:-

- The Bruhat Bengaluru Mahanagara Palike (BBMP) has used plastic on about 600 km of roads, including many thoroughfares and arterial roads.
- It uses the plastic blend in at least 25% of the road-laying works, including the present project to upgrade about 45 roads in the city.
- The plastic model was successful on major roads in Bangalore, including -:
  - Shankar Mutt Road,
  - K H Road,
  - M G Road (towards Trinity Circle),
  - J C Nagar Road,
  - Miller's Road and Cunningham Road,
  - inner ring road,
  - Rajarajeshwari Junction,
  - Mysore Bangalore state highway.

Puttanna Chetty Town Hall
Manipal Road

Dollars colony

Banglore-mysore state Highway
The experimentation at several institutes indicated that the waste plastic, when added to hot aggregate will form a fine coat of plastic over the aggregate and such aggregate, when mixed with the binder is found to give higher strength, higher resistance to water and better performance over a period of time. Therefore, it is proposed that we may use waste plastic in the construction of Roads.
Evidence of Better Performance of the Plastic Tar Roads:

The performance studies carried out on the roads constructed in Tamil Nadu indicated satisfactory performance with good skid resistance, good texture value, stronger and less amount of progressive unevenness over a period of time.

The experimentation carried out by CRRI also indicated better stability value, indicating higher strength, less flow and more air voids.
- 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.

- Plastic roads would be a boon for India’s hot and extremely humid climate, leaving most of the roads with big potholes.

- It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

Hence the use of waste plastics for pavement is one of the best methods for easy disposal of waste plastics.
Plastic roads, a simple way to make eco-friendly constructions......