

UTILIZATION OF WASTE PLASTICS COATED AGGREGATE FOR ROAD CONSTRUCTION

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Plastic Scenario

Plastics have become common man's friend. It finds its use in every field. 7.5 million tones is the estimated consumption in 2009 and 12 Million tones/year in 2010.

Nearly 50% of the plastic consumed is used for packing. The most used plastic materials for packing are carry bags, cups, thermacole and foams. These materials are manufactured using polymers like Polyethylene, polypropylene and polystyrene. (The tubes and wires are made out of poly vinyl chloride)

These materials, once used are thrown out or littered by us more because of wrong culture. They mix with Municipal Solid Waste. As they are non-biodegradable, the disposal is a problem and they cause social problems contributing to environmental pollution.

Yet these packing materials either mono layer or laminated poly layers made out of poly ethylene, poly propylene and poly styrene can be easily used for various uses like road construction, block making, roofing, etc... without affecting the environment. (Note: Poly Vinyl Chloride is not used.)

Plastics as a Binder

These plastic materials when heated to around 120°C to 150°C, they melt and in their molten state they can be used as a binder. Only if they are heated to more than 250°C they may decompose producing gaseous products which results in air pollution. Coating molten plastic over granite stone brings out the following effects

1. It is observed that the stones coated with plastics can be made to bind with bitumen strongly resulting in better mix for road construction.
2. The coating of plastics over stone reduces the voids in the stone and helps to reduce moisture absorption to a great extent.
3. Salt deposition on the pores of stone results in degradation of stones. This is also prevented
4. The spreading of bitumen is easy

Waste Plastics for Road construction

Plastics waste (Carry bags, cups, thermacole, foams and flexible films) is shredded into small pieces (between 1.6mm - 2.5mm). The granite stone is heated to around 170°C. the shredded plastics waste is added to the stone. It get melted and coated over stone in just 30 seconds. Then the bitumen is added

and mixed. The mix is used for road construction. From rural roads to National High ways all types of roads can be laid using this technique.

Process Details - Mini Hot Mix Plant

- Step. I: Plastics waste (bags, cups, flexible films, thermocole) made out of PE, PP, and PS cut into a size between 2.36mm and 4.75mm using shredding machine, (PVC waste should be eliminated)
- Step II a: The aggregate mix is heated to 165^oc (as per the HRS specification) and transferred to mixing chamber.
- Step II b: Similarly the bitumen is to be heated up to a maximum of 160^oc (HRS Specification) to have good binding and to prevent weak bonding. (Monitoring the temperature is very important)
- Step III: At the mixing chamber, the shredded plastics waste is to be added. It get coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look.
- Step IV: The plastics waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The road laying temperature is between 110^oc to 120^oc. The roller used is 8-ton capacity

Process Details - Central Mixing Plant

The modified process can also be carried out using a *central mixing plant*. The shredded plastics are added along the aggregate or a special mechanical device is developed which will spray the plastics inside the chamber to coat the plastics effectively.

CMP helps to have better control of temperature and better mixing of this material thus helping to have a uniform coating

A comparative study for 25mm thickness SDBC-10mm²

Material	Plain bitumen process	Plastic-tar road
60/70 Bitumen	30kg	27kg
Plastic waste	-	3kg

Characteristics

a. Characteristics of the process with easy disposal of waste plastics:

1. Plastics waste like carry bags, disposal cups, thermacole, laminated films and polyethylene and polypropylene foams can be used.
2. There is no need of segregation into different types of plastic.
3. No need for much cleaning
4. Multi layer films can also be used.
5. Easy process without any new machinery
6. Simple process without any industry involvement

7. No granulation or blending is needed
8. Land filling and incineration process can be avoided
9. In situ process
10. Use of lesser percentage of bitumen and thus savings on bitumen resource
11. Use of plastics waste for a safe and eco-friendly process
12. Both Mini Hot Mix Plant and Central Mixing Plant can be used
13. Only aggregate is polymer coated and bitumen is not modified
14. Use of 60/70 and 80/90 bitumen is possible
15. No emission of any toxic gases like dioxin
16. Fly ash can also be used to give a better performance
17. **Use of each ton of plastic waste avoids the entry of 3 tons of Co₂ in to the atmosphere, which otherwise results in global warming**
18. For 1km X 3.75m road, 1 ton of plastic (10 lakh carry bags) is used and 1 ton of bitumen is saved.
19. Value addition to the waste plastics (cost per kilogram increases from Rs 15 to Rs 30).
20. Flexible pavement scrap can be reused effectively by coating with plastics waste. This helps to reduce the cost by 50%; saves the use of raw material by 70 - 80% and also the level of the road can be maintained.

b. Characteristics of the Plastic Tar Road:

- Stronger road with increased Marshall Stability Value
- Better resistance towards rain water and water stagnation
- No stripping and hence no potholes.
- Increased binding and better bonding of the mix.
- Reduction in pores in aggregate and hence less rutting and raveling.
- No leaching of plastics.
- No effect of radiation like UV.
- Can Withstand Heavy Load and Heavy traffic.

Recognition

- Patent has been obtained from the Government of India for the plastic tar road laying process - Patent No. A-CH\871; 198254. Utilization of waste plastics for flexible pavement construction is a new technology, which was patented in 2002 Patent No: A- CH/871.
- Guidelines published by IRC-2013 IRC-SP:98-2013

- Guidelines book on laying of plastic tar road was published by Central Pollution Control Board, New Delhi (Ref www.cpcb.nic.in); Probes/101/2005-2006
- A book on the Performance Studies of laid plastic tar road was published by Central Pollution Control Board, New Delhi (Ref www.cpcb.nic.in); Probes/121/2008-2009
- In the year 2010 the National Rural Road Development Agency in consultation with us, have published a Guidelines for laying plastic tar road laid
- The latest gazette notification revised plastic waste management rules mention that plastics can be used for making road by local bodies. (Ministry of Environment and forest notification ; dated 4th February 2011; P. No. 21)

Performance of roads laid

Roads using a mix of tar and bitumen have been laid since 2002 in Tamil Nadu and then in Andhra Pradesh, Kerala, Maharashtra, Goa and Pondicherry.

The test results obtained for roads laid between 2002 and 2006 in Tamil nadu and exposed to various environmental conditions, show that these roads are performing very well in spite of their age. Under similar conditions most of the bitumen roads are not performing well at all. These roads have not developed even small cracking and no potholes. They have good skid resistance values and good texture values. Bump integrator studies show that the unevenness index is nearly 3,000 mm/km which indicates a good surface evenness.
