

USE OF WASTE PLASTIC IN ROAD CONSTRUCTION

*O P Shrivastava,
Chief Engineer, MoRTH*

February ,17,2024

Initiative by MoRTH

- Based on outcome of laboratory investigations conducted by different research groups in different countries including India-Ministry decided to utilise plastic waste in road construction
- MoRTH through Indian Roads Congress got published Guidelines for the Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses" in the year 2013

IRC:SP:98-2013

GUIDELINES FOR THE USE OF WASTE PLASTIC IN HOT BITUMINOUS MIXES (DRY PROCESS) IN WEARING COURSES



INDIAN ROADS CONGRESS
2013

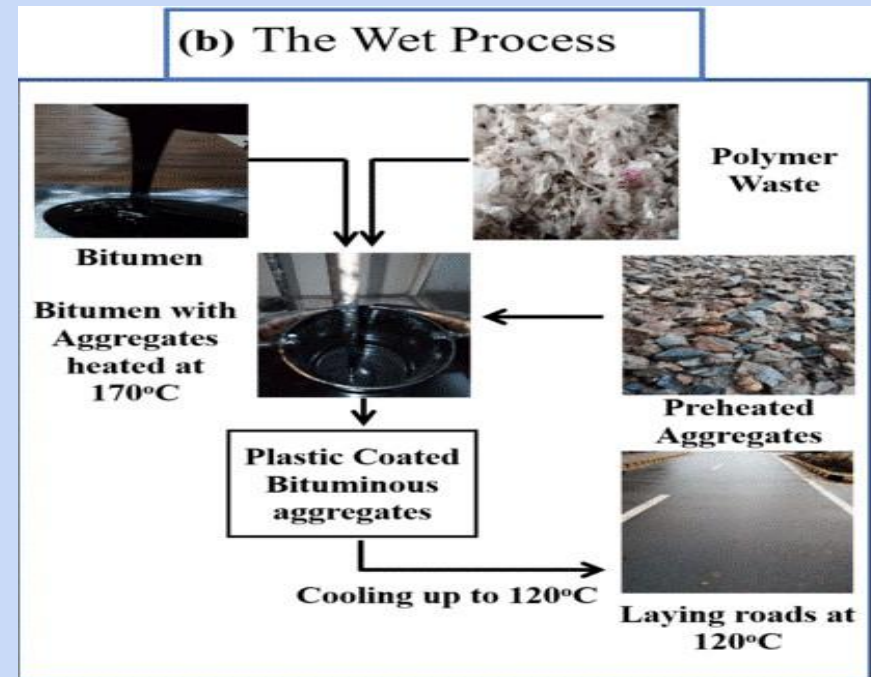
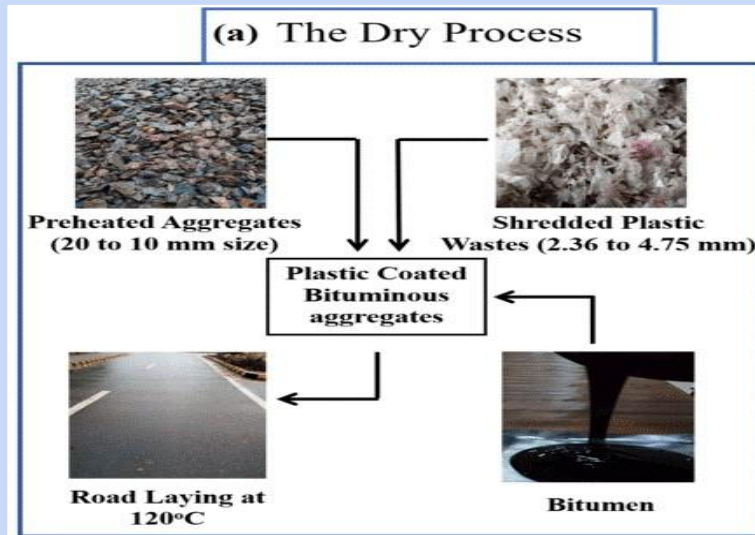
What are advantages of using Waste Plastic as modifier in binder?

- Higher resistance to deformation
- Higher resistance to water induced damages
- Increased durability and improved fatigue life
- Improved stability and strength
- Environment friendly solution for disposal of waste plastic

Methods of use of waste plastic in road construction -

As per IRC:SP:98 ,there is two processes for addition of waste plastic to bituminous mixes in road construction

- **Dry process** -Processed waste plastic is added in appropriate physical form (shredded) to hot aggregates.This process is being used in NH projects
- **Wet process**- waste plastic, in powder or other suitable form, is blended with bitumen to produce modified bitumen-Not being used due to quality issue.



Different types of Waste Plastic type and their type

Thermosetting plastic materials[80% of waste plastic]-Once shaped, cannot be softened or remolded by the application of heat. Hence, thermosetting waste plastic materials shall **not** be used for **dry process** addition in bituminous mixes.

Thermoplastic materials[20% of waste plastic]-Can be repeatedly softened by heating and hardened by cooling. Some thermoplastic waste materials are recommended in these guidelines for addition in bituminous mixes in **dry process**.

Thermoplastic Type	Origin	Recommended in Dry Process
LDPE (Low Density Polyethylene)	Carry bags, Milk pouches, bin lining, cosmetic , Sacks,and detergent	YES
HDPE(High Density Polyethylene)	Carry bags, bottle caps, house hold articles etc.,	YES
PET(Polyethylene Terephthalate)	Drinking Water Bottles etc.,	NO
PP (Polypropylene)	Bottle Caps, Wrappers of detergent, biscuit wrappers etc.,	NO
PS (Poly Styrene)	Egg packs, bottle caps, foamed polystyrene,, disposable cups, protective packaging, etc.,	NO
PVC (Poly Vinyl Chloride)	Mineral water bottles,toys ,electrical fittings, folders , medical disposable, etc.,	NO

Consideration for use of waste plastic in road construction

- The waste plastic shall be shredded to have plastic shred sizes ranging between 2.36 mm and 600 microns with a maximum length of 2.36 mm and a maximum width of 2.00 mm.
- Dust and other impurities, measured in terms of ash content shall not be more than 1.0 percent (by weight of plastic) as per IS :14535-1998.
- For satisfactory coating of the aggregates and mixing with hot bitumen, the melting point temperature of the plastic material, measured as per ASTM D 7138-16 [32], shall be less than 170°C.
- Thermoplastic materials are likely to emit gases and may undergo thermal degradation at temperatures higher than 180°C. It is essential to ensure that the waste plastic is not heated to more than 180°C temperature under any circumstance.

Design & Quality testing for bitumen mix with waste plastic for dry process

DESIGN CONSIDERATION

- **Design of mix /Bitumen content** -As per IRC SP-98 ,14,SP:78 & MORTH Orange Book
- **No reduction shall be made in the bitumen content** arrived as per mix design on account of use of waste plastic.
- **Waste Plastic content** -Permissible quantity of waste plastic is **8% by weight** of bitumen

QUALITY TESTING

- **Frequency of testing and acceptance criteria**-As per IRC SP-98 ,14,SP:78 ,111 & MORTH Orange Book
- **Suitability and melting point temperature** -As per clause 3.4.3 and 3.4.4 of IRC SP-98

Additional precautions during road constructed with bitumen mix with waste plastic

- Safety mask to all workers in HMP and at laying site
- Waste plastic bituminous mix with oversized plastic should be rejected.
- Care should be taken to ensure HDPE & LDPE only in the waste plastic.
- Waste plastic when heated to high temperature causes air pollution and micro plastic pollution through run off water contaminating soil and water bodies and the environment effects. Therefore care should be taken to handle the material in judicious manner to ensure strict temperature control of mixing and heating.

Initiatives of MoRTH to promote use of Waste Plastic

Date	Circular
Nov 2013	IRC-SP 98.2013- Code for plastic waste in Pavement construction
09.11.2015	Use of plastic waste in hot mix bituminous wearing coat in periodic renewal work[surfacing course] within 50km periphery of Urban area having population of more than 5 lakh
27.12.2016	In at least 10 km stretch ,use of plastic waste in bituminous surface course coat will be done as pilot project in each State/UT.
27.08.2016	Swachata Hi Seva Campaign - Use of plastic waste in road construction
26.03.2021	<u>Mandatory</u> for use of plastic waste in wearing course of service road in NHs within 50km periphery of Urban area having population of more than 5 lakh
02.06.2022	NHAI has issued policy guidelines (Policy Circular No. 13.24/2022 dated 2 nd June 2022) which mandates use of waste plastic for making 5% of the length of the road in a project.

Mandatory use of plastic waste on NHs within 50km periphery of Urban area having population of more than 5 lakh

MoRTH issued
guidelines vide
circular dated
06.02.2023 on
mandatory use of
waste plastic in NH
projects

New construction:

- Service road
- Slip road

Surfacing of main carriageway[4 lane/2 lane completed]:

Relaying of surface course of main carriageway

GUIDELINES FOR THE USE OF WASTE PLASTIC IN HOT BITUMINOUS MIXES (DRY PROCESS) IN WEARING COURSES

(First Revision)



**INDIAN ROADS CONGRESS
2020**

**IRC-SP 98-2020- Code for
plastic waste in Pavement
construction -Revised in
December 2020**

Based on performance report of the road constructed with waste plastic as per IRC -SP-98-2013, the revision of this code has been done in December 2020.

Accreditation of waste plastic material by HRB of IRC

- CMR Bitplast-M/s Aathreya Technologies Ltd.
- Waste Plastic Road Methodology-M/s Bharat Petroleum Corporation Ltd.
- Polymer Modified Bitumen Cubes - For constructing Flexible Pavements using waste plastics under wet process technology-M/s. Polymer Bitumen Ltd.
- ReRoute- Shredded Multi Layered Plastics-M/s. Reliance Industries Ltd.

Environmental effect of Waste Plastic on road construction

Environmental effect

- **Air emissions pollution**-Heating plastics may sometimes release moderate to highly toxic emissions which may cause health and safety concerns.
 - **Microplastic pollution**-Microplastics flushed down into rivers, lakes and seas could pose a major threat to marine life

WASTE PLASTIC USE IN NHAI PROJECT:

- PROJECT OF 4/2 LANING OF RAEBARELI -JAGDISHPUR SECTION OF NH330A INCLUDING JAGDISHPUR BYPASS
- NHAI has taken up work of measurement of all emissions and microplastic generation on a trail section in Raebareli on NH through CRRI & IIT ,BHU

Road projects constructed with Waste Plastic Applications

This technology has been successfully implemented in India in a number of road projects in low volume commercial traffic village and urban roads.

- More than 2000 km length of road was constructed using waste plastic in dry process in Bangalore
- In Tamil Nadu, waste plastic was utilized in surface mixes of different stretches of roads whose total length is more than 1000 km.
- In Delhi, in a number of test sections, whose total length is about 50 km, waste plastic was used and most of them are performing well.
- National Rural Infrastructure Development Agency (NRIDA) has constructed over 13,139 km of roads using waste plastics. The performance of these roads has been rated as excellent by the quality monitors.
- Using the technology of use of waste plastic in bituminous mixes, the Pune Municipal Corporation constructed a 150-metre stretch of Bhagwat lane at Navi Peth near Vaikunth Crematorium in 2016.
- Jamshedpur Utility and Services Company (JUSCO), which is a subsidiary company of Tata Steel, constructed a 12-15 km road in the steel city using plastic road.
- Madhya Pradesh Rural Road Development Authority (MPRRDA) constructed about 35 km of roads in 17 districts with waste plastic
- The R-85 research project sponsored by the Ministry of Road Transport and Highways on the use of waste plastics in SDBC mixes laid on the test track on NH-207, has reported satisfactory performance of waste plastic in bituminous mixes.

Use of waste Plastic in NH works

- Approximately **1.0 tonne** of waste plastic is consumed in **1.0 lane-km** of road construction.
- About **2900-km** of **NH length** has been constructed using waste plastic.
- Further, innovations are in progress for conversion of **Waste Hard Non-Recyclable Plastic** to **polymer aggregates**.
- **Paver block** from waste plastic screened from municipal landfill has been developed in laboratory.

NH constructed with Plastic waste - Morena Ambah Porsa road NH-552

Porsa Ater Bhind on NH 552 in MP



R&D Scheme by MoRTH on waste plastic use in Highway sector

R&D scheme related to Plastic waste in road construction	Agency entrusted with R&D scheme
Use of Waste Plastic and Computer Electronic Waste in Pavement Construction - Bituminous pavement	IIT,BHU,Varanasi
Exploring of Eco-Friendly Civil Engineering Techniques for disposal of plastic waste- Concrete and bituminous pavement	NIT ,Warangal

Requirement for waste plastic for use in road construction	Issue
Type of waste plastic -HDPE/LDPE without other type of plastic mentioned in IRC-SP-89	Other plastic was not allowed
Size of shred - 2.36 mm and 600 microns and of maximum size 2.36 mm length and 2.00 mm width	Over size
Dust and other impurities- Maximum 1.0 percent (by weight of plastic).	More impurity

Suggestion-

Municipal Authorities /Suppliers of Plastic waste may be requested to make available processed Plastic waste as per provisions of IRC -SP-98-2020

Thank You

email : omprakash.svv@nic.in