



Usage of Waste Plastic in Bituminous Road Construction

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WASTE PLASTIC

- Approximately **9.4 million TPA plastic waste** is generated in the country.
- **26,000 T wastes plastics are generated per day.**
- Of this, about **60%** is recycled.
- Balance **9,400 tonnes** of plastic waste is a challenge for the environment.



Harmful Effects of Plastics

- Burning of plastic results into release of harmful gases causes for severe health problems.
- Plastics are not biodegradable when use it for Land fill.
- Blockage of Street Drainage system.



PLASTIC WASTE MANAGEMENT

PROCESS FLOW



Plastic Waste Management

Types of Plastics

The seven types of plastic include:

1. Polyethylene Terephthalate (PETE or PET)
2. High-Density Polyethylene (HDPE)
3. Polyvinyl Chloride (PVC)
4. Low-Density Polyethylene (LDPE)
5. Polypropylene (PP)
6. Polystyrene or Styrofoam (PS)
7. Miscellaneous plastics (includes:

Polycarbonate, Polylactide, Acrylic,
Acrylonitrile butadiene, Styrene,
Fiberglass and Nylon)



Salient features of Plastic Waste Management (PWM Rules), 2016

- **Waste Generators** has responsibility to segregate waste plastic and handover to authorized agency and to pay user fee.
- **Local Bodies** shall responsible for setting up of Plastic waste management unit and encourage use of plastic waste for road construction or energy recovery or waste to oil or co-processing in cement kilns etc.

CASE STUDY ON PLASTIC WASTE MANAGEMENT MUDI KANDANALLUR PANCHAYAT IN MAYILADUTHURAI DISTRICT

- 🚫 Plastic Shredding Unit was established in 2020 as a district-level initiative.
- 🚫 The PWMU's capital cost, including machinery and minor repairs to the existing building, was Rs. 9,79,900/-
- 🚫 The Plastic waste collected by the Thooimai Kaavalars/ Sanitary workers / SHG Members of village panchayats and other sources are being segregated based on the type and grades of plastic weighed, and segregated plastic waste is shredded.
- 🚫 Under **the 'Plastic Buy Back Policy'**, the shredded plastic is being sold for Rs.35/- per kg for laying plastic roads in the district.
- 🚫 So far, **34,969** Kg of plastic waste was shredded, and Rs. **12,87,926/-** was generated as income within a year.
- 🚫 The revenue generated was reimbursed against the loan.



PLASTIC WASTE MANAGEMENT

Costing of Plastic Waste Management Unit

1. Plastic shredder @ Rs.5.40 Lakh approx. (100 – 125 kg/hr)
2. Dust remover @ Rs.3.75 Lakh approx. (100 – 150 kg/hr)
3. Bailing machine @ Rs.4.80 Lakh approx. (60kg/bale)
4. Weighing machine @ Rs.8,000 approx. (500 kg)

Total = Rs. 14 lakhs
(only for machinery)

Eligible funding under
SBM(G) = Rs. 16 lakhs



SHREDDER



DUST REMOVER



BAILING MACHINE



WEIGHING MACHINE

Scale Up

Plastic Waste Management Units in Tamil Nadu were proposed on a cluster basis where a cluster of panchayats will send their collected plastics.

PLASTIC WASTE MANAGEMENT

- ❌ 296 Plastic Waste Management Units (PWMU) are available in the State
- ❌ **'Plastic Buy Back Policy'** initiated with the involvement of Local Bodies in all the Districts
- ❌ Awareness created in the Village Panchayats through distribution of pamphlets, audio announcements, IPC by Swachhagrahis, etc.
- ❌ Plastic is purchased **at the rate of Rs. 10 per kg** in the Collection Centres/ Plastic Waste Management Units managed by SHGs. After purchase, the plastic waste is shredded and sold to DRDAs at the cost of Rs.35/- per kg.



Quantity of Plastic Waste Purchased/Received since January,2022	410 MT
Amount Paid for Purchase of Plastic Waste through Buyback policy	Rs. 23.26 Lakh
Total Quantity of Shredded Plastic sold	146 MT
Revenue Generated from the sale of Shredded Plastic	Rs.51.38 Lakh
Total Kms of Rural Road Laid by using Shredded Plastic	186 km



WASTE PLASTICS TO ROAD CONSTRUCTION

- Road construction using plastic waste in TamilNadu was initiated by Prof. Dr. R. Vasudevan, Department of Chemistry, Thiyagarajar College of Engineering, Madurai.
- The first waste plastic road was laid during 2002 using 10% weight of bitumen.
- Plastic conforming to Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE) shall only be used in pavement construction.
- Poly-Vinyl Chloride (PVC) sheets or Flux sheets should not be used.
- After successful performance gradually increased.

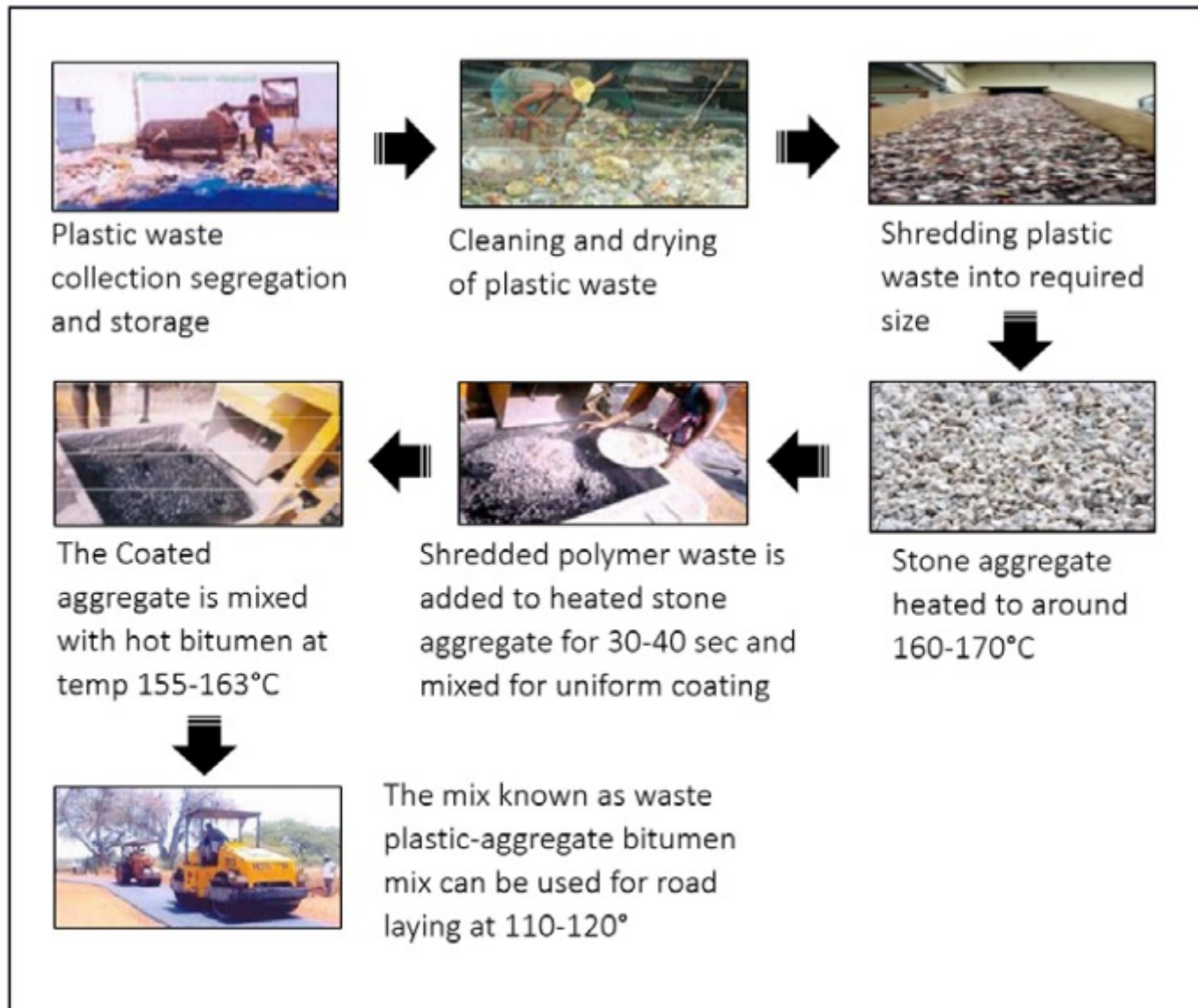
WASTE PLASTICS TO ROAD CONSTRUCTION-IRC GUIDELINES (IRC:SP:98-2013)

- Indian Roads Congress has prepared guidelines in 2013 for the Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Courses
- Waste plastic should conform to size passing 2.36 mm sieve and retained on 600 micron sieve.
- Dust and other impurities shall not be more than 1%.
- Plastic is coated over stones improving surface property of aggregates.
- Waste plastic should be 6% to 8% of the weight of bitumen in the mix depending on the climatic condition of high or low rainfall areas.

Types of Process

- **Dry process** - the processed waste plastic is added after shredding into the hot aggregates and is recommended for isolated works.-Cheaper
- **Wet process** - processed waste plastic in the form of semi-solid is added in the hot bitumen and then mixed with the heated aggregates.-Expensive

• Flowchart of Plastic Bitumen Road process



WASTE PLASTICS TO ROAD CONSTRUCTION- PREPARATION



Cleaning Process



Shredding

WASTE PLASTICS COATED AGGREGATE- BITUMEN MIX

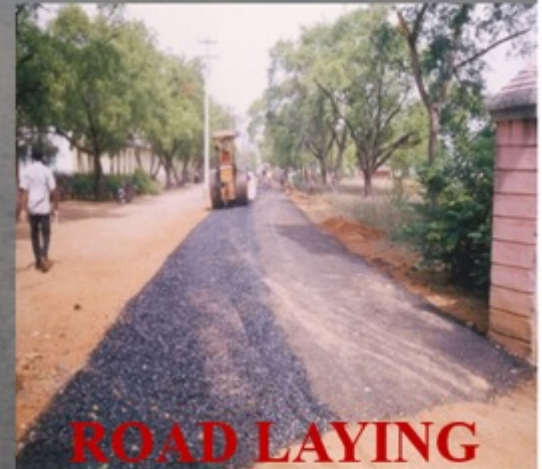
AGGREGATES $\xrightarrow{170\text{ }^\circ\text{C}}$ **HOT AGGREGATES**



**Waste
plastics**

**POLY.COATED
AGGREGATES**

**HOT
BITUMEN
160 °C**



ROAD LAYING

POLYMER – BITUMEN – AGGREGATES - MIXTURE

MINI HOT MIX PLANT





Mini Hot Mix Plant

Aggregate heated To 170°C



**Aggregate Transferred to
puddling chamber**



MINI HOT MIX PLANT -PROCESS

- The stone aggregate mix is transferred to the mix cylinder where it is heated to 160 °C 170 °C and then it is transferred to the mixing puddler.
- In the puddler, calculated quantity of shredded plastics is sprayed over the hot aggregate within 30 seconds.
- The sprayed plastic films melts and gets coated over the aggregate thus forming an oily coating.

Waste Plastics mixed With the hot aggregate



COATED AGGREGATE



IMPROVED CHARACTERISTICS OF PLASTIC COATED AGGREGATE



- NIL SOUNDNESS
- NIL MOISTURE ABSORPTION
- IMPROVED AGGREGATE
IMPACT VALUE
- IMPROVED ABRASION VALUE
- IMPROVED CRUSHING VALUE
- ZERO VOIDS

MINI HOT MIX PLANT - PROCESS

- Bitumen is heated to a maximum of 155 °C -163 °C in a separate chamber and kept ready.
- Heated bitumen is added over the plastic coated aggregate in the puddler and the resulted mix is used for road construction.
- The road laying temperature is between 110°C to 120°C.
- The roller used is a one with 8-ton capacity.

Bitumen added





Aggregate-plastics-bitumen mix

WASTE PLASTIC MIXED BT ROAD



CENTRAL MIXING PLANT (CMP)

- The aggregate materials are transferred to the cylinder through the conveyer belt.
- The shredded plastic is sprayed manually over the aggregate while it is moving in the conveyer belt to the heating cylinder.
- The polymer coated aggregate and bitumen is mixed in the cylinder and then transferred to the Tipper.
- The plastic bitumen mix will be laid by using Paver finisher and compacted by Vibratory roller.

CENTRAL MIXING PLANT (CMP)



CENTRAL MIXING PLANT (CMP)



CENTRAL MIXING PLANT (CMP)



DISTRICT : DINDIGUL SCHEME : TNRRIS 2016 - 17 BLOCK : PALANI
NAME OF WORK : CHITRAIKULAM TO THATHANAICKENPATTI ROAD KM 0/0 - 1/4
EST AMOUNT : Rs. 21.00 LAKHS



COMPARISON BETWEEN ORDINARY BITUMINOUS ROADS AND WASTE PLASTIC BITUMINOUS ROADS:-

S.No.	Properties	Plastic Road	Ordinary Road
1.	MARSHALL STABILITY VALUE	MORE	LESS
2.	BINDING PROPERTY	BETTER	GOOD
3.	SOFTENING POINT	LESS	MORE
4.	PENETRATION VALUE	MORE	LESS
5.	TENSILE STRENGTH	HIGH	LESS
6.	RUTTING	LESS	MORE
7.	STRIPPING(POT HOLES)	NO	MORE
8.	SEEPAGE OF WATER	NO	YES
9.	DURABILITY OF THE ROADS	BETTER	GOOD

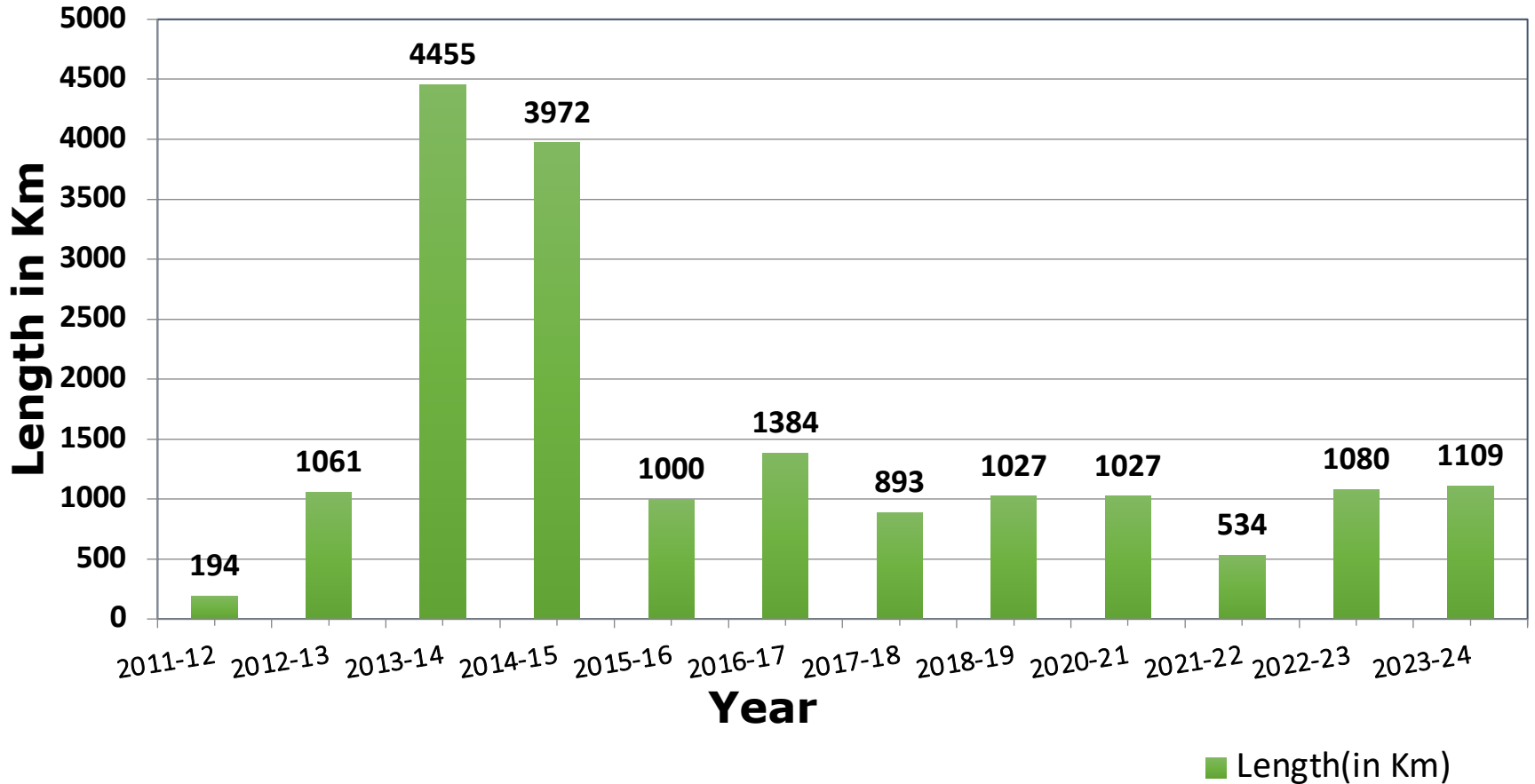
WASTE PLASTICS IN BITUMEN ROAD CONSTRUCTION- PERFORMANCE

- Waste Plastics in Bitumen road construction has improved longevity and pavement performance.
- In Tamil Nadu, around 17,735 km length were constructed using waste plastic under the various scheme from 2011-12. The performance of all these roads stretches are satisfactory.
- MoRTH sponsored research scheme on the use of waste plastics in SDBC mix made on test track on NH-207 reported excellent performance of waste plastic in bituminous mixes.
- As per IRC SP 98-2019 Waste Plastic @ 6 % to 8 % of the weight of the bitumen can be used for BT road construction depending on low rainfall or high rainfall areas
- IRC SP 98-2019 indicated that it may also be used for National Highways as well as State Highways with use of waste plastic thus contributes to construction of green roads.
- MoRTH has directed that for all periodic renewal of highways falling within the 50 km periphery of an urban area having population of more than 500 thousands shall be with plastic waste bitumen road.

WASTE PLASTICS IN BITUMEN ROAD CONSTRUCTION-

Site Name	Surface Condition Survey	Photo
<p>Jumbulingam road, Chennai (2002) Photo Date: 21-02-2008</p>	<ol style="list-style-type: none"> 1. No Pot hole 2. No Cracking 3. No Deformation 4. No Edge Flaw 	
<p>Veerbadhra Street, Erode(2003) Photo Date: 04-01-2008</p>	<ol style="list-style-type: none"> 1. No Pot hole 2. No Cracking 3. No Deformation 4. No Edge Flaw 	
<p>Vandiyur Main road (2004) Photo Date: 10-02-2008</p>	<ol style="list-style-type: none"> 1. No Pot hole 2. No Cracking 3. No Deformation 4. No Edge Flaw 	
<p>Vilachery Main road (2005) Photo Date: 11-02-2008</p>	<ol style="list-style-type: none"> 1. No Pot hole 2. No Cracking 3. No Deformation 4. No Edge Flaw 	
<p>Canteen road (2006) Photo Date: 01-03-2008</p>	<ol style="list-style-type: none"> 1. No Pot hole 2. No Cracking 3. No Deformation 4. No Edge Flaw 	

TAMIL NADU - YEAR WISE PLASTIC ROADS LAID DETAILS



WASTE PLASTICS IN BITUMEN ROAD CONSTRUCTION-STATE SCHEME

- Announcement made by Hon'ble Minister of Rural Development and Panchayat Raj department in 2023-24

"1,500 Km length of roads will be constructed using waste plastic technology under "Mudalvarin Grama Salaigal Membattu Thittam". Through this 500 MT of waste plastic will be disposed."

- 441 Kg of shredded plastic is required for laying 1 Km length of Premeix Carpet layer.
- Cost saving of Rs 2400 per Km on replacing of plastic with bitumen.



WASTE PLASTICS IN BITUMEN ROAD CONSTRUCTION UNDER STATE SCHEME (MGSMT)



Name of District : Coimbatore
Name of Block : Masukkarai
Name of Scheme : MGSMT (2022-23)
Name of Work : BT road from Mampalli to Elur kattu Road (via) Elur (Km 0/0-1/760)
Estimate Amouny : 38.85 Lakhs

Waste Plastics in Bitumen road construction Under PMGSY

- Ministry of Rural Development, Government of India mandate in the New Technology vision – 2022 that,

"Compulsory use of Waste Plastic atleast 70% of length of eligible proposed length involving Hot mix (Dry)Process".

- Till March 2022 under PMGSY **25,904 Km of road has been constructed** using Waste plastic and approximately **10362 MT of waste plastic has been utilized all over the country.**
- In Tamil Nadu 2153 Km length plastic road has been proposed under PMGSY-III 2023-24.

Waste Plastics in Bitumen road construction Under PMGSY (3-4 years old road)





“Let us understand the importance of waste plastic and good garbage culture- Let us make the environment clean”

Don't litter plastic on road but use it for road construction.

Thank You