

**GOVERNMENT OF TRIPURA
PUBLIC WORKS DEPARTMENT**

No. F.6(129)-PWD(E)/2022/5306-456

Dated, Agartala, the 8thJuly, 2022.

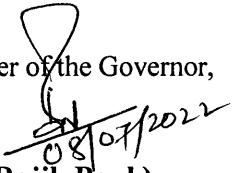
NOTIFICATION

The Governor of Tripura is pleased to notify “Policy for use of Waste Plastic in construction & periodical renewal of bituminous road” with detailed procedure for implementation within 50 km periphery of Agartala City.

The Policy for use of waste plastic in construction & Periodical renewal of bituminous road with details standard procedure will remain in operation until further order of the State Government. The State Government shall have full power to amend / modify this policy.

The policy is available in the home page of PWD website with the link <https://pwd.tripura.gov.in/images/circular/5306-456.pdf>.

By order of the Governor,



(Rajib Paul)

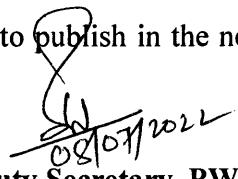
Deputy Secretary, PWD

Copy to forward to:

1. PPS to the Chief Secretary, Government of Tripura.
2. PS to Principal Secretaries/Secretaries of all Department, Government of Tripura.
3. All Chief Engineers, PWD(R&B)/DWS/WR/Buildings/PMGSY/NH, Agartala.
4. Chief Engineer, Tripura Jal Board/ U.D Department.
5. All Head of the Departments.
6. All Superintending Engineers, PWD(R&B)/ DWS /WR /Buildings/ PMGSY/NH.
7. All Executive Engineers, PWD(R&B)/ DWS /WR /Buildings/ PMGSY/NH.
8. ITCC, PWD.

Copy also to:

The Superintendent, Tripura Government Press, Agartala with request to publish in the next issue of Tripura Gazette.



Deputy Secretary, PWD



POLICY FOR USE OF
WASTE PLASTIC
IN
CONSTRUCTION &
PERIODICAL RENEWAL OF
BITUMINOS ROAD

PUBLIC WORKS DEPARTMENT (R&B)
GOVT. OF TRIPURA, AGARTALA

pwd.tripura.gov.in

1. INTRODUCTION

Tripura generates 3,00,000 kilograms or 300 tons garbage every year. Plastic Waste in different forms is found to be almost 9% to 12% in municipal solid waste, which is toxic in nature. Non-biodegradability of plastic in the environment has created numerous challenges for both urban and rural India. Common problems are choking of drains, stagnation of water, release of toxic gases upon open incineration.

One of the solutions proposed and demonstrated was by Professor Vasudevan in utilising waste environmental plastic in road construction. The technical objectives include understanding the scientific background and process, assessing relevant guidelines and rules of the Indian Road Congress, use of alternative materials, assessing the integration of technological and engineering decision of use, road construction into the policy framework and execution.

Bitumen plays an important role in binding the aggregate together by coating over the aggregate thereby imparting strength to the road. However, due to poor resistance towards water and high costs involved, there is a demand for high quality bitumen at low costs. This can be accomplished by modifying the rheological properties of bitumen by using additives such as plastic or rubber.

2. NEW APPROACH

In December, 2013, Indian Road Congress (IRC) released the code, IRC: SP: 98: 2013, for application of the 'plastic road technology'. The code provides the standard for the use of waste plastics in construction of roads. A separate cost head needs to be created to allow engineers to get shredded waste plastics and get it mixed with bitumen through the schedule of rates.

As per a general estimation, to lay one km of plastic road 3.75 m wide, 9 tonnes of bitumen and 1 tonne of waste plastic are required for coating whereas a normal road requires, 10 tonnes bitumen for each kilometre so a plastic road saves 1 tonne bitumen for every kilometre laid. There will be an approximate saving of ₹50,000 to ₹60,000 per kilometre. In addition, the environment will remain free from toxic side effect of plastic waste. One tonne of plastic waste is

equivalent to 10 lakhs carry bags.

Urban local bodies collect waste plastics from everywhere, dump yard, waste land and segregate during the waste collection. Vendors need to be identified by the local bodies for shredding waste plastics of the size less than 2.36 mm and the waste plastic with size more than this size should be used for recycling.

The road contractor workers add the segregated plastics into the heated aggregate and then the molten plastic gets coated around the metal. Then, it gets transferred to Bitumen mixer unit; there bitumen is coated over the plastic pre-coated metal. There is mechanism to monitor addition of plastic is done by Road Contractor, this is done by a lower level staff for each and every road during construction of the road.

3. SALIENT FEATURES OF PLASTIC WASTE MANAGEMENT

RULES, 2016:

(1) The plastic waste management by the urban local bodies in their respective jurisdiction shall be as under:

(a) plastic waste, which can be recycled, shall be channelized to registered plastic waste recycler and recycling of plastic shall conform to the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time.

(b) local bodies shall encourage the use of plastic waste (preferably the plastic waste which cannot be further recycled) for road construction as per Indian Road Congress guidelines or energy recovery or waste to oil etc. The standards and pollution control norms specified by the prescribed authority for these technologies shall be complied with.

(c) Thermo set plastic waste shall be processed and disposed off as per the guidelines issued from time to time by the Central Pollution Control Board.

The inert from recycling or processing facilities of plastic waste shall be disposed of in compliance with the Solid Waste Management Rules, 2000 or as amended from time to time.

3.1 RESPONSIBILITY OF LOCAL BODY

(1) Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers.

(2) The local body shall be responsible for setting up, operationalisation and co-ordination of the waste management system and for performing the associated functions, namely:

(a) Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste.

(b) ensuring that no damage is caused to the environment during this process.

(c) ensuring channelization of recyclable plastic waste fraction to recyclers.

(d) ensuring processing and disposal on non-recyclable fraction of plastic waste in accordance with the guidelines issued by the Central Pollution Control Board.

(e) creating awareness among all stakeholders about their responsibilities.

(f) engaging civil societies or groups working with waste pickers; and

(g) ensuring that open burning of plastic waste does not take place.

(3) The local body for setting up of system for plastic waste management shall seek assistance of producers and such system shall be set up within one year from the date of final publication of these rules in the Official Gazette of India.

The local body to frame bye-laws incorporating the provisions of these rules.

3.1.1 COLLECTION, SEGREGATION, STORAGE AND SALE OF PLASTIC WASTE

Collection of solid waste in all ULBs from the door steps of households/shops/ marketplaces/restaurants/commercial establishments/ organisations/institutions etc. is being done by engaging trained Women SHGs. These SHGs will collect plastic waste from the above places from their doorstep twice a week. Accordingly, all the above places will be sensitized beforehand to store plastic waste separately. In case the plastic waste is not stored separately by household women SHG members will segregate the same at the point of collection at doorsteps to demonstrate the segregation process to the owners. SHGs will inform households and other places mentioned above that separate collection of plastic waste will be done twice a week and collection charge as fixed by ULBS for household and other places will be collected at month end. Separate collection charges shall apply for household and other categories eg. shops/ marketplaces/ restaurants/ commercial establishments/ organisations/ institutions etc.

The collected plastic waste will be stored separately in their tricycles and after completion of their door to door collection activity they will carry it to the secondary centres for further segregation.

After bringing the plastic waste to the secondary centre women SHG members will further segregate the same into various categories for example (High Density Polythene (HPDE), Low Density Polythene (LPDE), Single Use Plastic(SUP) carry bag. other SUP, pet bottles, jars, containers etc.

The segregated plastic waste will be washed and cleaned to ensure removal of dirt and stored separately as per category. This will be done at secondary centre by SHG members. Upon 80-90% filling up of storage capacity of any segregated category of plastic waste or filling up of secondary segregation centres storage space the SHGs informs the supervisor/ULB representatives to inform recyclers for sale. Upon arrival of the recyclers each category of segregated plastic waste shall be weighed separately and the agreed upon price for the same will be paid by the recyclers. A record of item wise sale of recyclables along with quantity is recorded. The amount which will be earned

from the sale of the plastic waste will in turn be distributed to the women SHG as per their collection record for additional income and welfare of women SHGS. The recyclers who collects the segregated plastic waste of various categories from the secondary centres will in turn further process the plastic waste as per category to produce plastic chips, plastic granules or bail plastic waste etc. They may further send the same as raw materials to other industries or recycle as per market demand.

3.2 RESPONSIBILITY OF GRAM PANCHAYAT:

(1) Every gram panchayat either on its own or by engaging an agency shall set up, operationalise and co-ordinate for waste management in the rural area under their control and for performing the associated functions, namely.

(a) ensuring segregation, collection, storage, transportation, plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration; ensuring that no damage is caused to the environment during this process.

(b) creating awareness among all stakeholders about their responsibilities; and ensuring that open burning of plastic waste does not take place.

3.2.1 WASTE COLLECTION MANAGEMENT IN RURAL AREAS

The Government of India, in February, 2020 approved the phase-II of Swachh Bharat Mission (Grameen) to focus on the sustainability of ODF status and Solid & Liquid Waste Management (SLWM) in rural areas. The phase-II of SBM(G) will continue upto 2024-25 to generate employment and provide impetus to the rural economy through construction of household toilets and community sanitary complex as well as infrastructure for Solid & Liquid Waste Management (SLWM) such as compost pits, soak pits, waste stabilization ponds, Plastic Management Units material recovery facilities etc.

- As per guidelines of SBM(G) Phase-II, elements of Plastic Waste Management Plan in Rural Area is as follows:
- Door to door collection of all plastic from households, commercial areas, markets etc.

- Transportation to the village level shed, where segregation takes place.
- After segregation, plastics that have value like plastic bottles, broken plastics buckets etc. can be sold to recyclers.
- Balance segregated plastic from village shed shall be sent to Material Recovery Facility or Plastic Management Unit at Block/District Level
- Shredded plastic can be used for road construction or fuel for Cement Industries..

4. MORTH GUIDELINES TO ENCOURAGE THE USE OF PLASTIC WASTE IN THE HOT MIX BITUMINOUS WEARING COAT

Ministry of Road Transport & Highways vide circular no. RW-NH-33044/24/2015-S&R (R) dt,09.11.2015 (copy enclosed) had issued guidelines to encourage the use of plastic waste in the hot mix bituminous wearing coat as under:

- a) Bituminous mix with waste plastic shall be the default mode for periodic renewal with hot mixes within 50 kms periphery of urban area having population more than 5 lakhs. Any relaxation on ground of non-availability of waste plastic, cost etc. shall involve approval of the Ministry.
- b) All the agencies responsible for preparation of project reports / estimates for the National Highways and Centrally sponsored works are expected to analyse and clearly bring out reasons of inclusion or otherwise of provision of use of waste plastic in wearing coats in the proposal.

5. INDIAN ROAD CONGRESS GUIDELINES (IRSC SP 98:2013)

Safe disposal of waste plastic is a serious environmental problem. Being a non-biodegradable material it does not decay over time and even if dumped in landfills, finds its way back in the environment through air and water erosion, can choke the drains and drainage channels, can be eaten by unsuspecting grazing animals causing them illness and death, can contaminate the construction fill, etc. The best way of disposal of waste plastic is its recycling to the maximum extent and many developed countries have recycled waste plastics to manufacture various products, including some used in heavy construction, e.g. railway sleepers.

Studies have revealed that waste plastics have great potential for use in bituminous construction as its addition in small doses, about 5-10%, by weight of bitumen helps in substantially improving the Marshall stability, strength, fatigue life and other desirable properties of bituminous mix, leading to improved longevity and pavement performance. The use of waste plastic thus contributes to construction of green roads.

Depending on their physical properties, they may be classified as thermoplastic and thermosetting materials. Thermoplastic materials can be formed into desired shapes under heat and pressure and become solids on cooling. On subjected to the same conditions of heat and pressure, they can be remolded. Thermosetting materials which once shaped cannot be softened/remolded by the application of heat. The examples of some typical Thermoplastic and Thermosetting materials are tabulated in Table 1. Thermosetting materials are not used in pavement construction.

Table 1 Typical Thermoplastic and Thermosetting Resins

Thermoplastic	Thermosetting
Polyethylene Terephthalate (PET)	Bakelite
Polypropylene (PP)	Epoxy
Poly Vinyl Acetate (PVA)	Melamine
Poly Vinyl Chloride (PVC)	Polyester
Polystyrene (PS)	Urea - Formaldehyde

Low Density Polyethylene (LDPE)	Alkyd
High Density Polyethylene (HDPE)	

Plastics can also be classified according to their chemical sources. According to sources of plastic, there are six general groups: Cellulose Plastics, Synthetic Resin Plastics, Protein Plastics, Natural Resins, Elastomers and Fibers. Table 2 gives the source of waste plastic generation. Only plastic conforming to Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), PET and Polyurethane shall only be used in pavement construction.

Table 2 Waste Plastic & its Source

Waste Plastic	Origin
Low Density Polyethylene (LDPE)	Carry bags, sacks, milk pouches, bin lining, cosmetic and detergent bottles.
High Density Polyethylene (HDPE)	Carry bags, bottle caps, house hold articles etc.
Polyethylene Terephthalate (PET)	Drinking water bottles etc.
Polypropylene (PP)	Bottle caps and closures, wrappers of detergent, biscuit, wafer packets, microwave trays for readymade meal etc.,
Polystyrene (PS)	Yoghurt pots, clear egg packs, bottle caps. Foamed Polystyrene: food trays, egg boxes, disposable cups, protective packaging etc.
Polyvinyl Chloride (PVC)	Mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, furniture, folders and pens, medical disposables; etc.

There are two processes namely dry process and wet process for manufacturing bituminous mixes using waste plastic. In the dry process, processed waste plastic is added after shredding in hot aggregates where as in the wet process, processed waste plastic in the form of powder is added in the hot bitumen.

5.1 SCOPE

These guidelines deal with the specifications and use of waste plastic in wearing course using dry process, their advantages, application, manufacturing, transportation, storages, and quality testing requirements.

5.2 ADVANTAGES AND LIMITATION OF USING WASTE PLASTIC AS MODIFIER AND BINDER

Laboratory as well as field performance studies/investigations carried out in India (**Appendix-1**) identifies following advantages in using waste plastic in bituminous mixes.

- Higher resistance to deformation.
- Higher resistance to water induced damages.
- Increased durability and improved fatigue life.
- Improved stability and strength.
- Disposal of waste plastic and thereby environment friendly.

However, following need to be ensured in order to achieve the advantages of these specifications;

- The material shall consist of only low density polyethylene (LDPE) or high density polyethylene (HDPE), PU (available in limited quantity as waste) and PET.
- Black coloured plastic waste is a result of repeated recycling and should not be used.
- PVC shall not be used since they release lethal levels of dioxines.
- The Thermo Gravimetric Analysis (TGA) of thermoplastics has revealed gas evolution and thermal degradation may occur beyond 180°C. Thus misuse or wrong implementation of this technology may result in release of harmful gases, premature degradation, if the temperatures are not maintained during construction.

5.3 MATERIALS

i) Bitumen

The bitumen for bituminous mixes for wearing course with waste plastic shall comply with the Indian Standard Specifications for viscosity graded paving bitumen IS 73. Guidelines for selection for grade of viscosity graded paving bitumen shall be in accordance with the IRC:111-2009.

ii) Aggregates

The aggregates shall comply to IRC:111-2009, for dense graded mixes and IRC:14-2004, IRC:SP:78-2008 and IRC:110-2005 for open graded mixes respectively.

ii) Filler

The filler for dense graded mixes shall comply with IRC: 111-2009.

iv) Waste Plastic

- The waste plastic shall conform to the size passing 2.36 mm sieve and retained on 600 micron sieve.
- Dust and other impurities shall not be more than 1 percent. The process is indicated in **Appendix-2**. An easy method to determine the quantity of impurity is to determine the ash content at 600°C.
- To ascertain the ability of plastic to mix with the binder, the melt—flow value shall be tested as per ASTM D 1236-2010, for which the range shall be as follows:

For LDPE: 0.14-58 gm/10 min

For HDPE: 0.02-9.0 gm/10 min

5.4 DESIGN OF MIX

The requirements for waste plastic modified design and open graded mixes are as follows:

5.4.1 Dense Graded Mixes

The properties for dense graded mixes are indicated in Table 3.

Table 3 Requirements for Waste Plastic Modified Dense Graded Bituminous Pavement
Layers

Minimum stability (kN at 60°C)	12.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Marshall Quotient (kN/mm)	2.5-5
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3—5
Retained Stability (%)	98
ITS (min) MPa	0.9
VMA	16
VFB	65-75
Quantity of Waste Plastic % by weight of bitumen	6 to 8 depending on low rainfall or high rainfall areas

5.4.2 Open Graded Mixes

Waste Plastic @ 6 to 8 percent of the weight of the bitumen can be used for Open-Grade Premix Surfacing and Mix Seal surfacing mix. Quantity of bitumen can be reduced correspondingly.

5.5 MANUFACTURING OF BITUMINOUS MIX USING WASTE PLASTIC

The scope of the present guidelines is restricted to dry process only for the following reasons;

- Plastic is coated over stones - improving surface property of aggregates.
- Coating is easy & temperature required is same as road laying temp.
- Use waste should be 6-8 percent by weight of bitumen depending on the climatic conditions of high and low rainfall areas.
- Flexible films of all types of plastics can be used.
- Doubles the binding property of aggregates.
- No new equipment is required.
- Bitumen bonding is stronger than normal.
- The coated aggregates show increased Stability of the mixes.
- Better performance after construction based on the experience gained from medium level city traffic.
- No evolution of any toxic gases as maximum temperature is 180°C.

5.5.1 Dry Process

In order to ensure that the quality of the finished waste plastic product is consistent the following process (Appendix-1) must be adhered to before considering its use in bituminous construction:

- a) Collection of waste plastic
- b) Cleaning and shredding of waste plastic
- c) Shredding Machine
- d) Mixing of shredded waste plastic, aggregate and bitumen in central mixing plant.

5.6 CONSTRUCTION

Construction operation shall be in accordance with the IRC:111-2009, IRC:14-2004, IRC:110-2005 and IRC:SP:78-2008 for dense graded and open graded mixes respectively.

5.7 CONTROLS

Controls shall be in accordance with the IRC:111-2009, IRC:14-2004 and IRC:110-2005 and IRC:SP:78-2008 for dense graded and open graded mixes respectively. Besides, plastic shall be tested for impurity and melt flow value. Three sample be tested for each day work or when there is change in the source of plastic.

Appendix-1 (Refer Clause 3)

Case studies in India

- In Tamil Nadu, length of roads around 1000 m in various stretches were constructed using waste plastic as an additive in bituminous mix under the scheme “1000 km Plastic Road”, and found that, the performance of all the road stretches are satisfactory.
- The performance of the road stretches constructed using waste plastic in Bangalore (Karnataka) are also found to be satisfactory. More than 2000 km have been laid so far.
- In Delhi a number of test sections about 50 km were laid and most of them are performing well.

Appendix-2 (Refer Clause 4.4)

Processing details: -

- i) collection of waste plastic
- ii) cleaning and shredding of waste plastic
- iii) mixing of shredded waste plastic, aggregate and bitumen in central mixing plant
- iv) laying of bituminous mix

a) Collection of waste plastic:

Waste plastic is collected from roads, garbage trucks, dumpsites or compost plants, or from school collection programmes, or by purchase from rag-pickers or waste-buyers



Fig. 1 Collection of Waste Plastic

b) Cleaning and shredding of waste plastic:

Waste plastic litter in the form of thin-film carry-bags, use-and-throw cups, PET bottles, etc. these are sorted, de-dusted, washed if necessary.



Fig. 2 Cleaning Process

c) Shredding machine

Plastic waste which is cleaned is cut into a size between 2.36 mm and 600 microns and of maximum size 2.36 mm length and 2.00 mm width using a shredding machine.



Fig. 3 Shredding Machine

d) Mixing of shredded waste plastic, aggregate and Bitumen in Central Mixing Plant:

The aggregate mix is heated to 140-175°C in Central mixing plant. The requisite percentage of waste plastic to the weight of bitumen is injected with a pipe under compressed air in the drum of a drum mix plant through a pipe at 2/3 length of the drum or through an opening over the pug mill in the case of a batch mix plant. The waste plastic initially coats the heated aggregates. In the next stage bitumen is added to the aggregates, the temperature of the binder shall conform to the temperature depending on the grade of binder and the type of mix. The plastics waste coated aggregate is mixed with hot bitumen for 15 secs and the resulting mix transported for road construction.

Central mixing plant helps to have better control of temperature and better mixing of this material thus helping to have a uniform coating and heated bitumen is also sprayed.

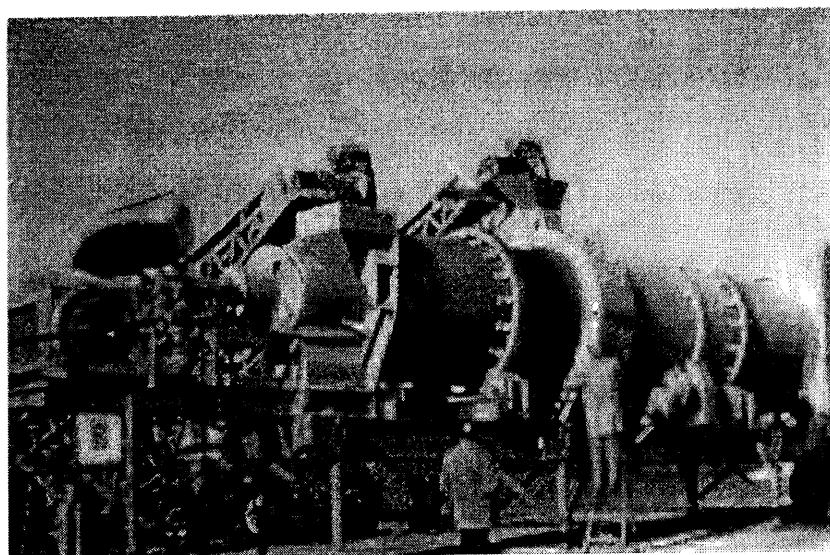


Fig. 4 Central Mixing Plant

e) Laying of bituminous mix:

The road laying temperature is between 110°C to 120°C for waste plastic bituminous mix. The roller used can be of any specified capacity.