

Use of Plastic Waste in Road Construction

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ABSTRACT

In this paper the study of some of plastic waste materials which we can reuse by certain processing and use in road construction. The materials as a result we are equipped with useful and valuable information about these materials. The discussed materials have many advantages over conventional/traditional materials and methods. This project will conduct a study on recycling plastic waste and blending it with bitumen to lay roads in India and compare with the environmental and economic conditions. Some of these materials are relatively cheaper and provide more strength as compared to traditional road materials. This project will come up with useful information and creating awareness amongst the learner in the industry regarding waste material. So that one can have a step towards further detailed information about these materials and thus be able to implement on field which will definitely improve the level of construction.

Keywords

Plastic Waste, Bitumen, Aggregates, Plastic Roads

1. INTRODUCTION

Plastic is everywhere in today's lifestyle. It is used for packaging, protecting, serving, and even disposing of all kinds of consumer goods. With the industrial revolution, mass production of goods started and plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, building construction, been virtually revolutionized by the applications of communication or InfoTech has plastics. Plastic in different form is found, which is toxic in nature. It is commonly collected both urban and rural areas. It creates stagnation of water and associated hygiene problems. Plastic waste hazard to the environment. Plastic waste can be reused productively in the construction of road.

2. REVIEW OF LITERATURE

The director of the Central Road Research Institute (CRRI) said that bitumen mixed with plastic or rubber improves the quality and life of roads. The deputy director of the CRRI said that polymers mixed with bitumen increased the construction cost up to six per cent, but increased the longevity of roads manifold. 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. Al-Hadidy A.I., Yi-qiu Tan (2009), "Effect of polyethylene on life of flexible pavements",

Ms. Apurva Chavan (2013) says that using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road, avoid use of anti stripping agent, avoid disposal of plastic waste by incineration and land filling and ultimately develop a technology, which is eco friendly.

3. DEFINITION

A material that contains one or more organic polymers of large molecular weight, solid in its finished state and at some state while manufacturing or processing into finished articles, can be shaped by its flow.

4. TYPES OF PLASTICS

1. Thermosets.
2. Elastomers.
3. THERMOPLASTICS.



Fig 1: Plastic bitumen road

5. WHY USE OF PLASTIC

Polymers have a number of vital properties, which exploited alone or together make a significant and expanding contribution to construction needs.

1. Durable & corrosion resistant.
2. Good insulation for cold, heat & sound saving energy and reducing noise pollution.
3. It is economical and has a longer life.
4. Maintenance free.
5. Hygienic & problems.
6. Ease of processing/ installation.
7. Light weight.

6. SPECIFICATION FOR PLASTIC WASTE

Plastic waste use

1. Films (carrybags, cups) up to 60 μ thickness. (PE, PP, PS).
2. Hard foams (PS) any thickness.
3. Soft foams (PE&PP) any thickness.
4. Laminated plastic up to 60 μ thickness.

Plastic waste not use

5. PVC sheet
6. Flux sheets

7. BASIC PROCESS

7.1 Segregation

Plastic waste collected from various sources must be separated from other waste. Maximum thickness is 60 microns.



Fig 2: Collection of plastic

7.2 Cleaning Process

Plastic wastes get cleaned and dried



Fig 3: Cleaning & drying of plastic

7.3 Shredding process

Will be shredded or cut into small piece.

The different types of plastic wastes are mixed together



Fig 4: Mixing of plastic

7.4 Collection process

The plastic waste retaining in 2.36 mm is collected.

8. CO-PROCESSING OF PLASTIC WASTE MANAGEMENT

8.1 Plastic Waste Management

1) Conventional Technology

- Recycling
- Incineration
- Land filling

2) New Technology

- Plasma Pyrolysis Technology
- Liquid Fuel
- Polymer Blended Bitumen Roads
- Co-processing in Cement Kiln

8.2 POLYMER BLENDED BITUMEN ROAD

The process of road laying using waste plastics is designed and the technique is being implemented successfully for the construction of flexible roads at various places in India



Fig 5: Polymer Blended Bitumen Road

1. Striping and pothole formation: Bitumen film is often stripped off the aggregate.
2. Leaching: polymer will not leach out of the bitumen layer.
3. Effect of Bleeding: Waste polymer –bitumen blend shows higher softening temperature.
4. Effect of fly ash: It is also observed that the fly ash does not leach from this mixture.

9. FIELD TRIALS

9.2 Dry process

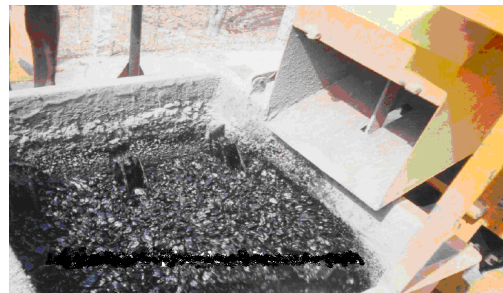


Fig 6: Hot bitumen is added



Fig 7: Shredded plastic waste is added

9.2 Wet process

1. Waste plastics by direct mixing with hot bitumen at 160°C.
2. Mechanical stirrer is needed.
3. Addition of stabilizers and proper cooling.
4. Since the wet process require a lot of investment and bigger plants.
5. Not commonly used..

10. CHARACTERIZATION OF WASTE PLASTICS

Binding property:Plastic is a good Binder.

Table 1: Showing compressive & Bending strength

% of plastic coating over aggregate	Compressive strength (MPa)	Bending strength (MPa)
10%	250	325
20%	270	335
30%	290	350
40%	320	390

11. ADVANTAGES& DIS-ADVANTAGES

11.1 Advantages

1. Strength of the road increased.
2. Better resistance to water & water stagnation.
3. No stripping & have no potholes.
4. Increased binding & better bonding of the mix.
5. Better soundness property.
6. Maintenance cost of the road is almost nil.
7. No effect of radiation like UV

11.2 Dis-Advantages

- 1) Cleaning process -Toxic present in the co-mingled plastic waste start leaching.
- 2) During the road laying process- the presence of chlorine will definitely release noxious gas.

12. HOW MUCH PLASTIC? HOW MANY ROADS?

Each 5-member family’s use of 5 gm plastic bags a week, all-India = 52,000 tons a year.

Assume 50% of this is available for roads.**1.5 tons plastic goes into average 1 km road.**

So resurfacing just 35,000 km of roads a year will absorb all this littered waste. This is just 3.5 % of India’s 1 million km surfaced roads. (1.1 million km more roads are un-surfaced).

13. COMPARISON

1. The durability of the roads laid out with shredded plastic waste is much more compared with roads with asphalt with the ordinary mix.
2. While a normal 'highway quality' road lasts four to five years it is claimed that plastic-bitumen roads can last up to 10 years.
3. Rainwater will not seep through because of the plastic in the tar.
4. The cost of plastic road construction may be slightly higher compared to the conventional method.
5. The maintenance cost is low as compared to conventional method.
6. It initial cost is slightly more as compared to conventional method.

14. CONCLUSION

1. Plastic will increase the melting point of the bitumen.
2. This innovative technology not only strengthened the road construction but also increased the road life.

Plastic roads would be boon for India’s hot & extremely humid climate, where temperature frequently cross 50°C .

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