

CURRENT SCENARIO ON USAGE OF WASTE PLASTIC FOR FLEXIBLE PAVEMENT CONSTRUCTION

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Abstract: *Plastic waste is generated from industrial as well as domestic sectors. Since plastic is non-biodegradable, the management of plastic wastes especially in urban areas are a major cause of concern in today's world. Mostly, the plastic waste comprises of poly ethylene, poly propylene, poly styrene. The softening point of these compounds varies from 1100°C to 1400°C and no harmful gases are produced.*

Softened plastic has got an unique property of forming a coating around aggregates. This aggregate coated with polymer (ACP) when mixed with different grades of heated bitumen can be used for the construction of flexible pavements, where plastic acts as a raw material. It makes highly durable pavements with nil pothole, waterproof and reduces the amount of bitumen required by up to 10 kgs by weight. This paper intends to present the various steps involved in the procedure of such plastic road construction, points to be cautious while using the plastic waste, ecological situations withstanding the steps. The strength of roads achieved can be 100 percent.

Key words: *aggregate coated with polymer (ACP), bitumen, poly ethylene, poly propylene, poly styrene, waste plastic*

1. INTRODUCTION

The thrust area of solid waste management is plastic waste and municipal solid waste. Proper disposal of plastic wastes is the most urgent concern in today's scenario. It has been observed that with the increase in the traffic intensity, the load bearing capacity of pavements are to be increased. Usage of plastic-coated aggregates in asphalt pavement construction helps in reusage of waste plastics as well as road strength improvement. Plastics which are an excellent packaging material of daily use became a major source of concern after its usage. Most commonly used plastic items are bags, cups, foams and films commonly made of poly ethylene, poly propylene, poly styrene. Approximately 55 percent of plastic materials find its usage as packing material. Mostly these are disposed off after use. These non-biodegradable wastes mixes up with domestic waste causes difficulty in municipal solid waste disposal.

Most common methods of municipal waste disposal are incineration and land filling. Both of these techniques contribute to land as well as air pollution [1-3]. Poly vinyl chloride waste present in municipal waste on burning releases hazardous gases like dioxins [1]. Hence eco-friendly method of waste plastic disposal is the thrust area of research. These plastic wastes can be utilized in asphalt pavement construction. This method helps in eco-friendly waste disposal as well as adds in value of waste plastics.

2. LITERATURE SURVEY

R. Vasudevan et al(2012)[4] modified aggregates with polymer coating to construct flexible pavement which is known as Dry process. The polymer coating over aggregates helped in improving aggregate quality as well as pavement quality. This process used high plastic waste percent reducing bitumen usage by 10 percent by increasing road strength and performance. It proved highly economic by carrying in situ construction without industry involvement, thus helping to generate job for rag pickers adding value to waste plastics thus developing eco-friendly technology. He found that pavement gave good performance in weather variations was found due to better binding capacity.

Shweta N. Rokdey et al(2015)[5] have discussed the reuse of waste plastic materials by certain processing to use them in road construction. They used dry mix process by using shredded waste plastics which helped in increasing road durability in comparison to roads constructed using asphalt with ordinary mix.

Amit Gawande et al (2012)[6] conducted case studies and found that usage of bitumen modified with processed plastic addition of about 5 to 10 percent of bitumen helped in considerable improvement of Marshall Stability, strength, fatigue life and all other properties of bituminous concrete mix by considerable saving of bitumen usage. They also showed that using waste plastic for road and laminated roofs helps in considerable plastic waste consumption by giving high quality infrastructure.

Tatýrek Václav et al (2021)[5] conducted studies by replacing part of aggregates by recycled aggregates in asphalt mix along with plastic waste. It was found that this recycled mix considerably increased strength of road bed and unbound layers. This use will more sustainable in the absence of natural stones which forms an important constituent in asphalt mixtures and other building materials like concrete. It proved more economical and viable method of road construction.

3. ISSUES FACED

- i) Burning of poly vinyl chloride plastics leads to the emission of hazardous gases leading to the formation of hydrochloric acid. Also burning of poly propylene and poly styrene contributes to the emission of carbon monoxide, acrolein, formic acid and ethyl benzene which creates potential harmful effects on the environment as well as human health.
- ii) Extensive research works carried out showed that only poly propylene, poly styrene, poly ethylene can be consumed from plastic wastes whereas polyvinyl chloride cannot be used for such road construction purposes. Polyvinyl chloride plastics are available in abundance in the market and also it is hard to distinguish amongst poly propylene, poly styrene, poly ethylene and poly vinyl chloride as their physical appearance is same. Hence careful selection from the waste heap needs to be done.
- iii) While carrying out the road construction procedure, presence of chlorine will lead to the formation of harmful hydrochloric acid gas formation.

4. OBJECTIVE OF THE PROCESS

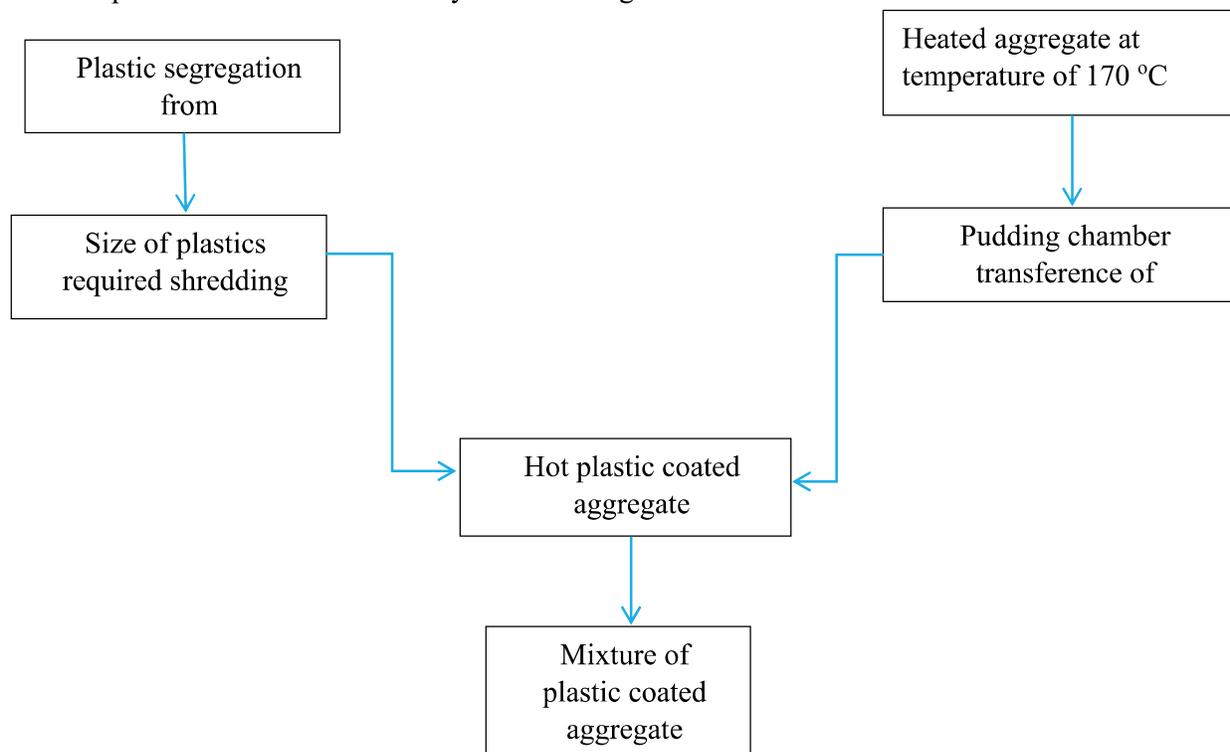
- i) To increase strength and better performance of the road to a considerable extent, high density poly ethylene (HDPE) is used in flexible pavement construction.
- ii) The various properties of the materials used for road construction is augmented.
- iii) Promote environmental protection by reducing plastic waste accumulation in nature.
- iv) Comparison amongst normal bituminous road and plastic bituminous roads can be done.

5. SCOPE OF THE PROCESS

- i) Promoting eco-friendly environmental conditions.
- ii) Strength and durability of rods can be increased considerably.
- iii) It is economic as repairing and maintenance cost is almost nil.
- iv) As plastic waste is collected from residential, industrial, commercial, institutional places, plastic management becomes easier.
- v) It enhances employment opportunities of rag pickers.

6. METHODOLOGY

The procedure is demonstrated by the following flowchart:



Procedure of construction of plastic coated aggregate bituminous roads are as follows:

Step 1: Waste plastic comprising of poly ethylene, poly propylene, high density poly ethylene are converted to sizes ranging from 2.36mm to 4.75 mm with the aid of shredding machine.

Step 2: The mixture of aggregate is heated at a temperature of 165o C and put inside the mixing chamber. Addition of plastic quantity depends upon the bitumen percentage according to studies.

Step 3: To facilitate good binding and bonding property, the bitumen mixture is heated to a temperature of 160oC .

Step 4: The shedded waste plastic needs to be added in the mixing section forming ua uniform coating over the aggregate in about 30 to 60 seconds giving an oily appearance.

Step 5: Aggregate with coating of waste plastic is mixed with hot bitumen and this mixture is used for road construction.

Step 6: The road construction is done at a temperature of about 110oC to 1200C. Roller of about 8 tons capacity is used in the process.

7. CONCLUSION

The studies reveal that the plastic bituminous roads constructed shows better performance in terms of binding capacity, strength and good surface condition even when exposed to high climatic variation. It was found that poly vinyl chloride plastic wastes cannot be used in the process whereas they are abundantly available in the market. Hence further scope lies in development of improvised techniques to utilize these poly vinyl chloride plastic wastes to develop suitable binding material which can be used for road constructions.

Most importantly the entire process helps in disposing off plastic waste efficiently ,easily and in eco-friendly way

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