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UTILIZATION OF PLASTIC WASTE FOR ROAD CONSTRUCTION

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Abstract - The Rapid increase in plastic waste has led to environmental concerns and challenges in waste management. In response, researchers and engineers have explored innovative and sustainable solutions to address this issue. One such solution is the incorporation of plastic waste into road construction materials. This thesis provides an overview of the utilization of plastic waste in road construction, focusing on its environmental benefits, engineering properties, and economic feasibility. The increasing generation of plastic waste poses a significant environmental challenge, necessitating innovative and sustainable solutions. This study explores the utilization of plastic waste in road construction as an eco-friendly alternative. Additionally, environmental impact assessments will be performed to analyses the reduction in plastic waste disposal and evaluate the carbon footprint of plastic-modified road construction. The study aims to provide insights into the feasibility and effectiveness of utilizing plastic waste for road infrastructure, contributing to sustainable waste management practices and environmentally friendly construction materials.

***Key Words*:** carbon monoxide, sustainable, waste management .

1. INTRODUCTION

The escalating global challenge of plastic waste necessities innovative and sustainable solutions to mitigate environmental impact. One promising avenue is the integration of plastic waste in road construction-a practice that not only addresses the issue of plastic pollution but also contributes to the development of durable and eco-friendly infrastructure. The Utilization of plastic waste in road construction offers several environmental benefits by incorporating plastic waste into roads, we divert plastic from landfills and prevent it from polluting the environment. Plastic roads provide a practical solution for managing plastic waste, especially in countries with high plastic consumption. Using plastic waste as a construction material reduces the need for virgin materials like sand, gravel, and aggregates. This conserves natural resources and minimizes the environmental impact of mining and extraction. Plastic-modified roads often require less energy during construction compared to traditional asphalt. The process of melting plastic and mixing it with bitumen consumes less energy than producing cement or other construction materials. Plastic-modified asphalt is more resistant to water damage, cracking, and rutting. Roads built with plastic waste have shown increased durability and require fewer repairs, reducing maintenance costs. Plastic roads contribute to a lower carbon footprint due to reduced energy consumption.

2. Experimental Design

- 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 accountof use of waste plastic.
- Waste Plastic content -Permissible quantity of waste plastic is 8% by weight of bitumen.
- 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 environmenteffects. Therefore, care should be taken to handle the material in judicious manner to ensure strict temperature control of mixing and heating.

R&D scheme related to Plastic waste inroad 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

Table -1: R&D Scheme by MoRTH on waste plastic use in Highway sector

3.1 Methodology and Process Adopted:

The utilization of plastic waste for road construction involves a systematic approach to ensure effectiveness and sustainability. Here's an outline of the methodology and process:

Define Objective: Define the objectives of the thesis, including waste management, environmental conservation, sustainability, community engagement, and public perception. These objectives guide the implementation and evaluation of plastic waste utilization in road construction.

Literature Review: Conduct an extensive literature review by gathering data and findings from various articles, journals, and research papers related to the utilization of plastic waste in road construction.

Gap Identification: Identify gaps in the existing literature to understand challenges and potential negative impacts of using plastic waste in road construction.

Experiment: Perform different experiments like sieve analysis, penetration test, softening test, marshal test, ductility test to analyse the results which will help to reach to conclusion.

Analysing Data: Analyse the data from various experiment conducted to draw conclusions and insights regarding the utilization of plastic waste for road construction.

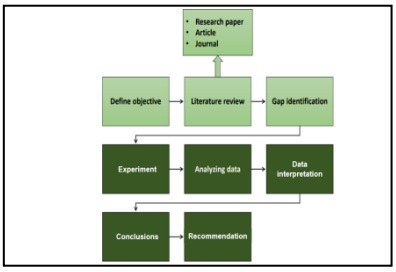


Fig -1: Waste plastic collection

Fig-2: Waste plastic collection segregation

Fig -3: segregation

Fig 5: Central mixing plant

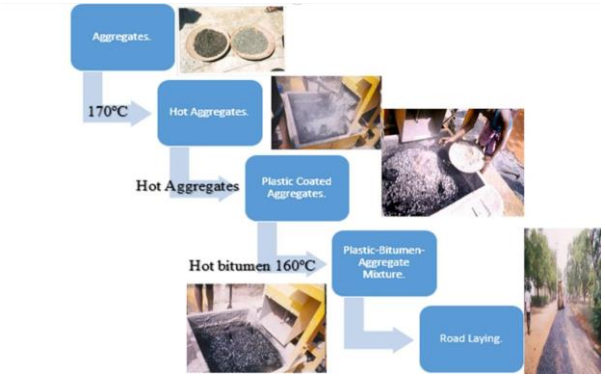


Fig 2.6 Schematic Diagram of Dry Process

3. RESULTS AND DISCUSSION

In this research paper different type of test are conducted like ductility, softening, penetration, marshal test etc. so that literature can be validated.

Table 2

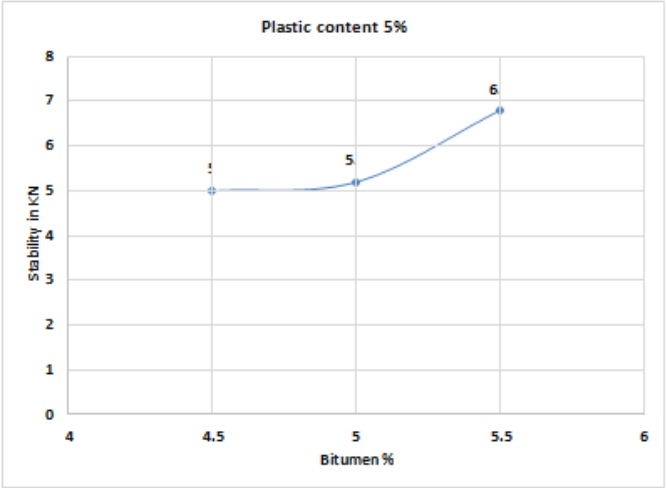
Sieve size (in mm)	Cumulative passing	Weight (in gm)
20	100	297.15
12.5	79-100	580.15
10	59-79	198.1
4.75	52-72	481.1
2.36	35-55	254.7
1.18	28-44	254.7
0.6	20-34	169.8
0.3	15-27	169.8
0.15	10-20	169.8
0.075	5-13	113.2
<0.075	2-8	141.5
		Total= 2.83 kg

Ductility Test

This test is done to determine the ductility of distillation residue of cutback bitumen, blown type bitumen and other bituminous products as per IS: 1208 – 1978. The principle is : The ductility of a bituminous material is measured by the distance in cm to which it will elongate before breaking when a standard briquette specimen of the material is pulled apart at a specifiedspeed and a specified temperature.

3.2 Flow curve diagram

The Softening Point of bitumen or tar is the temperature at which the substance attains particular degree of softening. As per IS: 334-1982, it is the temperature in ºC at which a standard ball passes through a sample of bitumen in a mould and falls through a height of 2.5 cm, when heated under water or glycerin at specified conditions of test. The binder should have sufficient fluidity before its applications in road uses.



Dig 3- Flow Curve

4. Conclusion

Marshall Test was conducted on three normal mix specimens prepared with bitumen contents of 4.5 percent, 5 percent and 5.5 percent respectively. From the results following observationcan be seen.

- 5% of bitumen content gives the highest stability.
- The flow is low for 5% bitumen content.
- From the above results it is concluded that 5% bitumen content is optimum for roadmaking.

Marshall test was conducted on three plastic mix specimens prepared with bitumen contents of 4.5 percent, 5 percent and 5.5 percent and plastic percent of 3 percent and 5 percent respectively. From the results following observation can be seen.

- From the results it can be seen that 3% plastic in 5% bitumen gives the highest stability and the lowest flow.
- From the above results it is concluded that 3% plastic in 5% bitumen content is optimum for road making.
- The generation of waste plastics is increasing day by day. The major polymers namely polyethylene, polypropylene, polystyrene show adhesion property in their molten state Plastics will increase the melting point of the bitumen. The waste plastic bitumen mix forms better material for pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for pavement is one of the best methods for easy disposal of waste plastics.
- The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income.
- Plastic roads would be a boon for India's

hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

- Optimum plastic content was obtained as 3 percent by weight of bitumen.
- The Marshall Stability value of plastic modified mix was found to be 48 percent morethan that for the normal mix which indicates an increase in load carrying capacity.
- The softening point test was found out be 47ºC.
- The ductility test was found out to be around 95.5cm.
- The optimum bitumen content was found to be 5% from marshal test.

REFERENCES

1. USE OF PLASTIC WASTE IN FLEXIBLE PAVEMENTS, Miss Apurva J Chavan,Volume 2, Issue 4, April 2013.
2. Use of Plastic Waste in Road Construction, Shweta N. Rokdey, Sevagram P. L.Naktode, Sevagram M. R. Nikhar.
3. PLASTIC WASTE: IT'S USE IN CONSTRUCTION OF ROADS, KurmadasuChandramouli, Allipilli Satyaveni, Vol. No. 5. Issue 01, Feb 2
4. IRC SP 98:2020 Guidelines for the Use of waste plastic in Hot Bituminous Mixes
5. NHAI FY 2021-2022: Sustainability Report for building a sustainable RoadInfrastructure
6. MORTH PPT on Plastic waste, OP Shrivastava, MORTH, Feb 17 2024
7. CPCB Annual Report 2020-21: On Implementation of Plastic waste Management Rules2016
8. Plastic Waste in Road Construction, Pawan Patil, Natalya Stankevich, Nina Tsydenova,Zoie Diana, World Bank Document.
9. Chakraborty, A. and S. Mehta (2017). "Utilization & Minimization of Waste Plasticin Construction Pavement.
10. Assistant Professor Er. Paramjeet and Huda Shafiq A REVIEW STUDY OF USING PLASTIC WASTE IN THE CONSTRUCTION OF BITUMINOUS PAVEMENTS (2018**)** Volume 5,issue 5
11. Prof. Avadhut Kulkarni1, Baibhav Kumar2, Ronak Tripathi3, Samarth Mathur4, Sumesh Karanje Use of Plastic Waste in Road Construction For Sustainable Development May 2019 Volume 7 Issue V
12. Sasane Neha. B, Gaikwad.Harish, Dr. JR Patil and Dr SD Khandekar APPLICATION OF WASTE PLASTIC AS AN EFFECTIVE CONSTRUCTION MATERIAL IN FLEXIBLE PAVEMENT June 2015 Volume 02 Issue 03.