International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

CONTRIBUTION OF PLASTIC ROAD CONSTRUCTION IN MANAGING NON-BIODEGRADABLE PLASTIC WASTE

Ar. Anushka Likhar

M. Arch student, School of architecture, IPS Academy, Indore.

likharanushka8@gmail.com

ABSTRACT

Waste affects every part of society and is not only environmentally damaging but also expensive. Businesses, local authorities, government and members of the public plays a part in the creation, management and disposal of waste and it is vital that they all recognize the benefits of reducing waste and the roles they must play in doing this. Whilst much attention has been paid to re-use, recycling and waste management, in this research we focus on plastic waste reduction and there is now a need for government and the media to promote the importance of this message solely focusing on use of these plastic generated waste, understanding its composition and properties to be used for road construction.

Roads must reliably carry heavy loads, often under challenging environmental and geotechnical condition. It follows that the roads are routinely designed to contain high quality, newly produced materials.

This research reviews the use of plastic wate materials in road construction and will give an understanding of plastic waste reduction and reusing it into a durable development.

Keywords- *Plastic waste, bitumen mixed plastic, reducing environmental impacts*

1. INTRODUCTION

A material that contains one or more organic polymer of large molecular weight, solid in its finished state, can be shaped by its flow is called as “plastic”. Plastic is a non-degradable waste, causes greenhouse effect and global warming. Non biodegradability of plastic in the environment has created numerous challenges for both urban and rural India. Common problems associated with mismanagement of plastic waste includes choking of drains, threat to marine life and release of toxic gases upon open burning. The durability of plastic is high and it degrades very slowly. And also, plastic has high resistant to degradation.

In India’s cleanest city Indore, which is presently recycling half of its plastic waste daily, utilizing elements of plastic in road making is slowly gaining a momentum. Of the 13 tonnes of plastic waste that the city generates daily, nearly 30 per cent of it is being used for road construction.

1.1 PROPERTIES

Plastic can be divided into two major categories- thermosets and thermoplastics. Thermosets have high durability and strength because it solidifies irreversibly when heated, henceforth can be used primarily in construction application. In a highway, the potholes and corrugation are the major problem. Plastic pavement can be a better solution to the above stated problems. The plastic when added to hot aggregates will form a fine coat of plastic which when combined with binder is found to have higher strength, higher resistance and better performance over a period

of time. Bitumen is most popularly used binder in construction of roads. But it offers poor resistance to water. This can be overcome by improving the rheological properties of bitumen using plastic.

Following are some advantages of this waste plastic bituminous mixture, • Better resistance towards rainwater and water stagnation.

• Increase binding and better bonding of the mix.

• The strength of the road increases. Waste plastic like plastic carrying bags, PET bottles, and water bottles etc. can be used in this process.

The main idea of this work is to study methods to use waste plastics in construction and as an additive for road surfacing or waste plastic bituminous mixture

2. SWOT ANALYSIS

Strengths	Weakness
The addition of the plastic waste strips in subgrade pavement layers facilitates the flow of water in the embankment layer, which minimizes porewater development. The utilization of plastic waste in such an environmentally friendly way reduces the plastic environmental pollution that saves the life of many living organisms. It helps to minimize the cost of construction by preventing the replacement of weak soil with selected materials.	The smoothness and hydrophobic surfaces of plastic waste reduce the adhesive strength between plastic waste and soil particles. In addition to this, plastic waste and soil are made up of material with different grades and types, which might result in non-isotropic performance. All kinds of plastics have different physical and chemical properties, which might become a challenge in utilizing plastic waste in pavement construction. The environmental impacts and long-term performance of the plastic waste utilization method are not understood yet, which affects the usage and acceptance of this method.

Opportunities	Threats
The program provides employment opportunities for local waste collectors and for those who work in circulation centres. It creates the establishment of a centre where plastic wastes are collected. In addition, it needs government/non-governmental organization supports and public participation, which create public awareness on plastic waste management. It promotes the sustainable waste management system in the construction industry that the construction industry practices the usage of construction waste.	Cutting large volumes of plastic waste may require advanced technology that might be expensive. The cost of collecting, transporting, energy consumption, and recycling technology required has to be compared with the usage of the local selected materials. There is no fixed common standard for the application of plastic waste utilization in pavement construction yet. Identifying the suitable and unsuitable plastics for utilization in road construction is difficult. During plastic waste collection and identification, it may expose workers to health problems if safety is not assured.

3. METHODOLOGY

The methodology involves utilizing participatory and applied research methods in achieving objectives identified earlier.

1. Qualitative analysis of its benefits in terms of durability.
2. Quantitative Analysis of its benefits /advantages when increased in % towards its contribution in managing plastic waste when plastic % is increased
3. Comparative analysis between ordinary bituminous roads and waste plastic bituminous roads
4. Conclusion
5. Limitations

3.1 Plastic Road – TEJAJI NAGAR, INDORE

Plastic mixed road-
Image time – 12:30 p.m.
Weather – summer (March month),
Temperature- 36 °C

Image of road - Bhawarkua to Tejaji nagar

ROAD DISCRIPION – 4% TO 6% PLASTIC SCRAP IS USED WITH MIXTURE BY THE WEIGHT OF BITUMEN
WIDTH –15 M
TOTAL LENGTH – 6.5 KM
THICKNESS 14”

Impression: Amount of plastic waste reduced during construction of road – 24 tonnes When 4-6% of plastic waste is used by the weight of bitumen in 6.5 km road construction

3.2 TESTS AND ANALYSIS FOR QUALITY
By this analysis of strength and stability understanding the improvements in quality of road at different % of plastic waste used when amount of plastic waste is increased to 8% and 10%

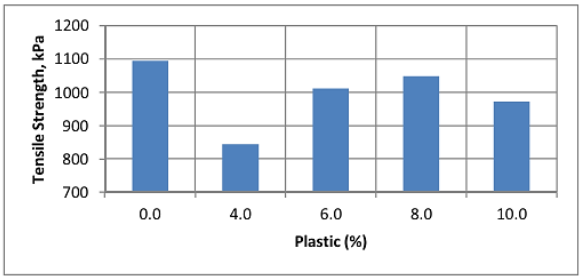

Fig. 1 Different % plastic for tensile strength
(reference - ISCEE 2016 Effect of Waste Plastic as Bitumen Modified in Asphalt Mixture)

Tensile Strength: The TS results of conventional and modified asphalt mixture are graphically presented in Fig. 1. From the bar chart, the tensile strength of plastic mixed asphalt mixture is lower than conventional asphalt mixture.
Tensile strength among the modified asphaltic concrete is more with 8% plastic, which is 4% lower than the conventional asphalt mixture tensile strength (without plastic).
The lowest tensile strength is with 4% plastic, which is 23% lower than the conventional asphalt mixture.

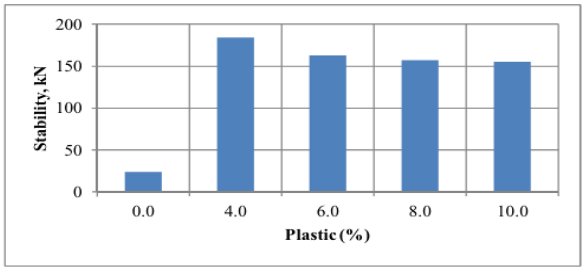

Fig. 2 Different % plastic for stability

(reference - ISCEE 2016 Effect of Waste Plastic as Bitumen Modified in Asphalt Mixture)

Stability: Fig. 2 shows the relationship between stability and percentage of plastic. The stability of 4% plastic is the highest (i.e., 184kN), and it slightly decreases with the increase of plastic addition.
The results showed that plastic can increase the stability of the asphalt mixture up to certain percentages and after that it will decrease.

Conclusions Based on the analysis:

a. The highest tensile strength is gained among the modified asphaltic concrete with 8% plastic added.
b. Since 8% plastics added give the highest value for tests, it can be concluded that 8% plastic added is the optimum value.
c. It is observed that Plastic value in % can't be increased more than 8%

3.3 Comparative analysis between ordinary bituminous roads and waste plastic bituminous roads

S. NO.	PROPERTIES	PLASTIC ROAD	ORDINARY ROAD
1.	MARSHALL STABILITY VALUE	MORE	LESS
2.	SOFTENING POINT	LESS	MORE
3.	BINDING PROPERTY	BETTER	GOOD
4.	PENETRATION VALUE	MORE	LESS
5.	TENSILE STRENGTH	HIGH	LESS
6.	STRIPPING	NO	YES
7.	DURABILITY	BETTER	GOOD

4 LIMITATIONS

- The research is limited to road construction only. Residential projects have already started using plastic waste.
- The plastic which we used in the road construction may turn into micro-plastics and can be able to pollute the soil and water bodies beneath it.
- Further studies are recommended for footpaths and cycling paths.
- Research is recommended to use waste materials such as waste rubber and glass in roading, which cause sustainability issues. Research can be done for individual materials or when they are used in combination with each other.

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