

**OPTIMIZING THE PLASTIC CONTENT IN THE INNOVATIVE PLAST-BIT
ROADS**

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ABSTRACT

In recent times, the proliferation of plastic waste in both municipal and industrial sectors has escalated due to population growth, development activities, and changing lifestyles. The non-biodegradable nature of plastic waste presents a significant challenge for its disposal in India. To address this issue and contribute to environmental management, researchers have focused on utilizing plastic waste in bitumen road construction. The primary objective of this study is to enhance the properties of bitumen by incorporating a certain percentage of plastic waste into hot bitumen. The addition of plastic waste leads to improvements in penetration value, softening point, and viscosity of bitumen. Consequently, it can be inferred that plastic waste enhances the performance of bitumen in road construction. The increasing production of disposable plastic has become a pressing concern in numerous countries. Non-biodegradability poses a significant problem in managing these solid wastes. One potential solution to this crisis and the need for waste plastic management is the utilization of waste plastic as a secondary material in construction projects. This approach not only helps mitigate the excessive production of waste plastic but also improves the structural characteristics of constructions, particularly their resistance to cracking. This research aims to explore the effects of incorporating plastic in road pavement. Specifically, the study focuses on employing waste plastic, such as Low Density Polyethylene (LDP), as a modifier in preparing samples for testing the properties of modified bitumen. Additionally, the research aims to analyze the impact of waste plastic- modified.

Keywords:

Non-biodegradable plastic, Bitumen, Low Density Polyethylene (LDP, Plastic-modified).

INTRODUCTION

Roadways are essential for facilitating the safe, efficient, and rapid movement of a large volume of passengers and goods throughout the year. Constructed on land, they play a vital role in a country's economic, social, and cultural development. The extent of a nation's transportation network is often indicative of its growth and status. Constructing new roads requires a substantial amount of funding. Therefore, it is crucial to explore cost-effective and sustainable road construction methods by leveraging new technologies. One such technology involves incorporating plastic materials into bituminous mixtures. Bitumen, a black viscous substance derived from petroleum distillation or purification, forms a crucial component of road construction. Plastic is a material that consists of one or more organic polymers with a high molecular weight. It is solid in its finished state and can be melted by flow. Plastic exhibits exceptional durability and degrades slowly. However, waste plastic poses significant environmental challenges. Consequently, researchers from various fields are continuously working on efficient re-use options for different forms of plastic. In India, plastic content bituminous roads, which utilize waste plastic in the wearing course, have gained popularity. The Indian Road Congress (IRC) has issued a code of specifications (IRC SP: 98-2013) on plastic roads, prompting numerous agencies to implement this sustainable method. The Ministry of Road Transport & Highways in India has also undertaken a mission to utilize waste plastic extensively. Presently, more than 100,000 kilometres of roads in India are constructed using waste plastic, and this trend is expanding across different regions. health, poor health-

seeking behaviour and low socio-economic status of clients, and poor to no means of transportation and communication. These wide gaps of health service delivery greatly affect the health status of the community.

SIGNIFICANCE

Plastic roads are a type of road construction that utilizes plastic or plastic composites, either partially or entirely, in combination with other materials. They differ from standard roads, which are typically composed of asphalt concrete containing a mineral aggregate and asphalt binder. In plastic roads, plastic is incorporated as a substitute for traditional materials, often utilizing plastic waste as an aggregate in the asphalt mixture. However, the long-term performance of plastic aggregates in road construction and their potential impact on surrounding ecosystems are not yet fully understood. It remains unclear how these aggregates will fare over time and what consequences their degradation might have on the environment. To ensure the responsible use of plastic in road construction, further research and testing are necessary. These studies should focus on assessing the durability, stability, and environmental implications of plastic aggregates in the mid- to long-term. Understanding these factors is crucial for making informed decisions and adopting sustainable practices when it comes to plastic roads.

LITERATURE SURVEY

The research conducted by suggests that using a blend of polymer and bitumen as a binder in road construction offers advantages over using plain bitumen alone. The polymer bitumen blend exhibits an increased softening point and reduced penetration value, while maintaining suitable ductility. These properties enable the blend to withstand higher temperatures and heavier loads during road usage. The addition of plastic coatings to the aggregate and bitumen mix further enhances the material for flexible pavement construction. The coating helps reduce porosity, minimizes moisture absorption, and improves the overall soundness of the pavement. As a result, the mix demonstrates higher Marshall Stability values and a suitable Marshall Coefficient, which are important factors in assessing the quality and performance of flexible pavements. Therefore, utilizing waste plastics in the construction of flexible pavements is considered one of the most effective methods for achieving easy implementation, pollution prevention, and other benefits.

Utilization of Plastic waste in Bitumen Mixes for Flexible Pavement by Dr S.L Hake, Dr.R.M.Damgir (2017) : In the present research work created procedures to utilize plastic waste for development motivation behind adaptable asphalts will be survey. In regular Street making process bitumen is utilized as folio. Such bitumen can be adjusted with squander plastic pieces and bitumen blend is made which can be utilized as a best layer of adaptable asphalt. The plastics from PET jugs to be utilized in blends for examine work. The measurements of plastic of 5 %, 7.5%, 10 %, 12.5% and 15 % utilized as substitution of bitumen.

Use of Plastic Waste in Bituminous Pavement by R.Manju*; Sathya S; Sheema (2016): The waste plastic used are poly- ethylene, poly-styrene, poly- propylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases its durability. The titanium-di- oxide is used as a smoke absorbent material, which will absorb the smoke from the vehicles. This innovative technology will be boon for Indian hot-humid climate. It's economical and eco-friendly. In this paper, we have discussed about the soil properties to be considered in design of pavement, pavement design, process of construction flexible and plastic-smoke absorbent pavement.

Plastic Roads: A Recent Advancement in Waste Management by Anzar Hamid, Huda Shafiq (2010): Plastics are the non-biodegradable materials and so a means to degrade our environment. Plastic wastes have proved to be a source of health hazard as it is toxic in nature. Plastic waste is a big nuisance in today's world. So, this plastic waste should be reused to eliminate the threat to the surroundings. One such reuse can be in the construction of flexible pavements. Plastic coated aggregates have proved to offer better resistance to abrasion and wear and tear. Moreover the bond between these plastic coated aggregates and the bitumen is also very strong due to increased contact area between plastic (polymers) and bitumen. Such roads show better performance and have increased life spans.

Case Study on Plastic Roads by P. Guruswamy Goud, M. Rajasekhar, N. Vijayakumar, K. Snehalatha, B. Bhanu (2018): Plastic roads are made entirely of plastic or of composites of plastic with other materials. Plastic roads are different from standard roads in the respect that standard roads are made from asphalt

concrete, which consists of mineral aggregates and asphalt. Plastics increase the melting point of the bitumen. The use of this plastic in road construction is an innovative technology which not only strengthens the road but also increases the road life. The analysis in this paper reveals that Durability, strength and cost.

Using waste plastics in road construction by Manu Sasidharan, Dr Mehran Eskandari Torbaghan & Dr Michael Burrow (2017): The idea of using waste plastics in road construction is relatively new. Laboratory tests have shown positive results when a small amount (5-10% by weight) of plastic is incorporated in bituminous mixes (asphalt), resulting in improved pavement stability, strength, and durability. However, international field experience using plastics in actual road construction is quite limited. In this review, we found examples of waste plastics being used in road construction in a few case studies in India, UK, Netherlands, Ghana, Ethiopia and South Africa. While roads constructed using waste plastics have shown good longevity and pavement performance to date, the first roads constructed using this technology are only about ten years old, so long-term outcomes are not yet clear. This review did not find any evidence discussing the maintenance of roads constructed using waste plastics.

Upcycling Plastic Waste for Rural Road Construction in India: An Alternative Solution to Technical Challenge by Andri Heriawan (2012): One of the innovative ways by which the Government of India is addressing the challenges of rural road development is the use of plastic waste as an alternative material for road construction. Under the Pradhan Mantri Gram Sadhak Yojana (PMGSY), or the Prime Minister's Rural Road Program, several implementing state-level agencies have utilized plastic waste as alternative road construction materials in various ways, even though still on a pilot basis. It is expected that India will not only reduce the amount of plastic waste that goes to its landfills or incinerators, but also benefit from more efficient rural road development. Due to the expected increase in road construction and its impact on the environment, the requirement for more sustainable and low-maintenance road infrastructures has become very important.

Plastic Waste Road Construction in Madhya Pradesh by Riya Goyal (2013): Plastic or polythene bags, these non- biodegradable toxic items have been playing a major role in degrading our environment, especially our oceans. But now there might be a solution to tackle this mounting problem, using plastics to build roads. The idea is to create roads that are durable and also to get rid of potholes. Given the current plastic crisis, the aim of this case study is to make sure that plastic waste does not reach the landfills or water bodies and to ensure that the 3 R's – Reduce, Reuse and Recycle are implanted effectively. The plastic mixed with bitumen and aggregates is used for the better performance of the roads.

A Review on Studies and Research on Use of Plastic Waste by Sunil J. Kulkarni (2020): Sustainable development is important aspect of modern development. The minimization of waste is key to many environmental problems. Many investigations are nowadays focused on use of waste material for various applications. Such wastes are being used for ethanol, starch, acetic acid and manufacturing of other chemical. The problem of plastic waste can be minimized by reuse of plastic. Waste plastic can be used for synthesis of products like ethanol. The use of plastic for road construction is widely investigated area. The strength of the roads constructed with plastic mixed bitumen was found to be more than that constructed with usual material.

OBJECTIVE

- Determine the optimal plastic content in PLAST-BIT roads.
- Evaluate the ductility, penetration, softening point value, and flash point value of PLAST-BIT pavement with varying plastic content (0%, 2%, 4%, 6%, and 8%).
- Analyze the potential adverse effects of PLAST-BIT roads on the environment and propose suitable remedies.
- The hypothesis of this study posits that waste plastic, such as polythene and carry bags, when liquefied at a specific temperature, can enhance bitumen properties by acting as a binder or by being mixed with

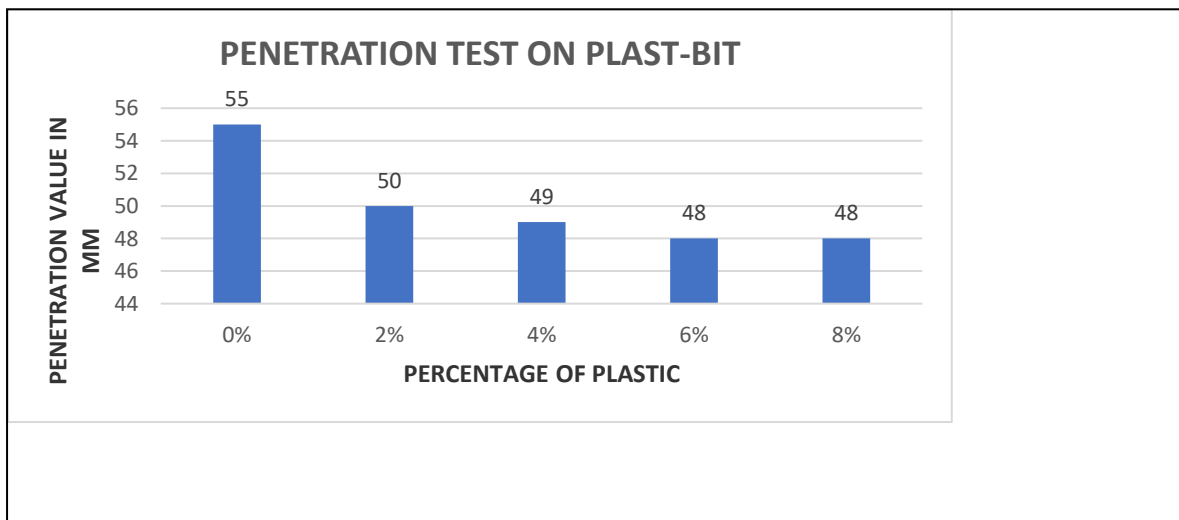
bitumen. This has the potential to improve the durability of bitumen roads and contribute to sustainable waste reduction.

- The significance of this study lies in the fact that incorporating plastic waste with bitumen substantially enhances the strength, fatigue life, and other desirable properties of bituminous mixtures. As a result, the longevity and performance of the pavement are improved, thereby contributing to the construction of environmentally-friendly roads.

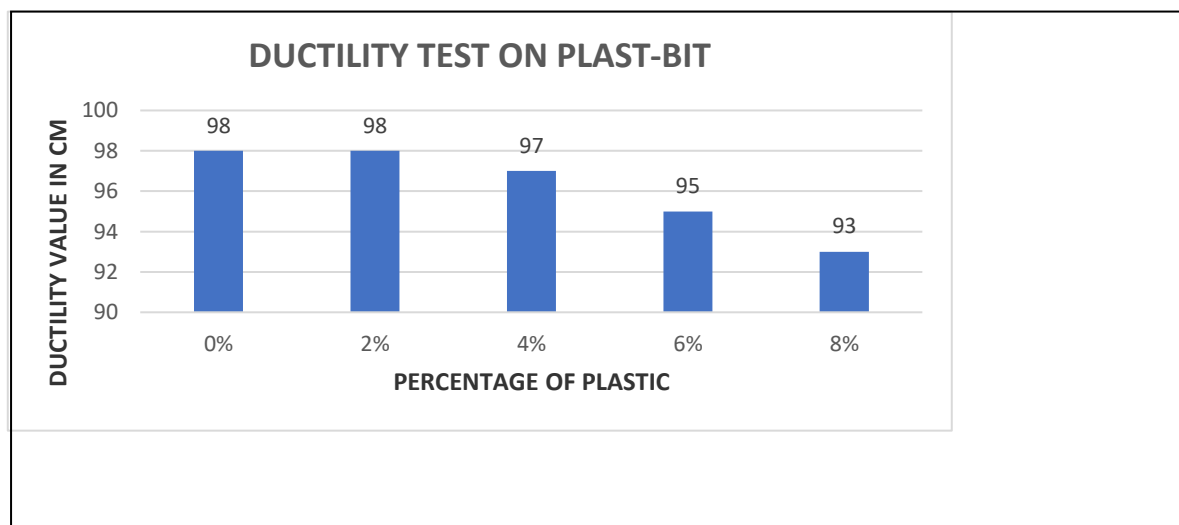
LABORTARY TESTING

We Performed different types of testing using IS73.

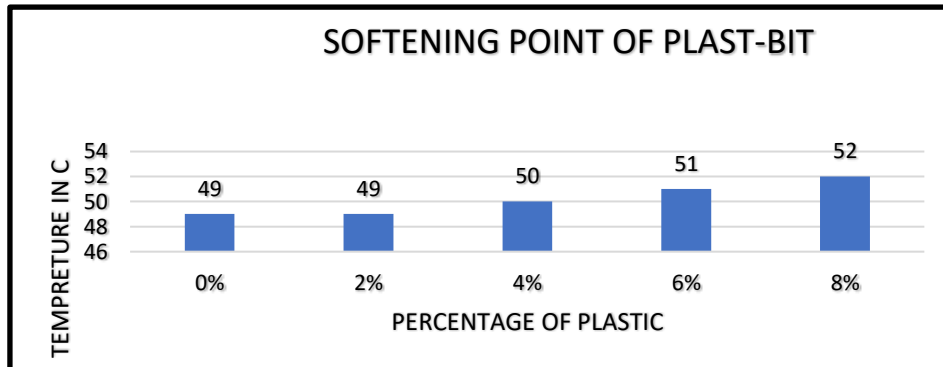
1. Penetration Test



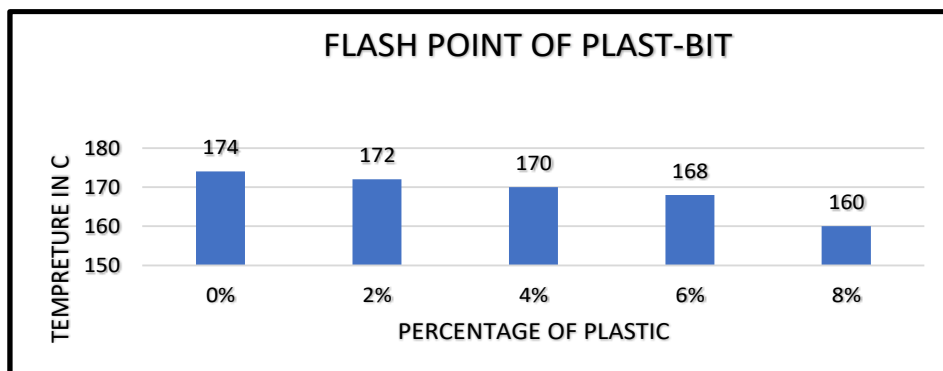
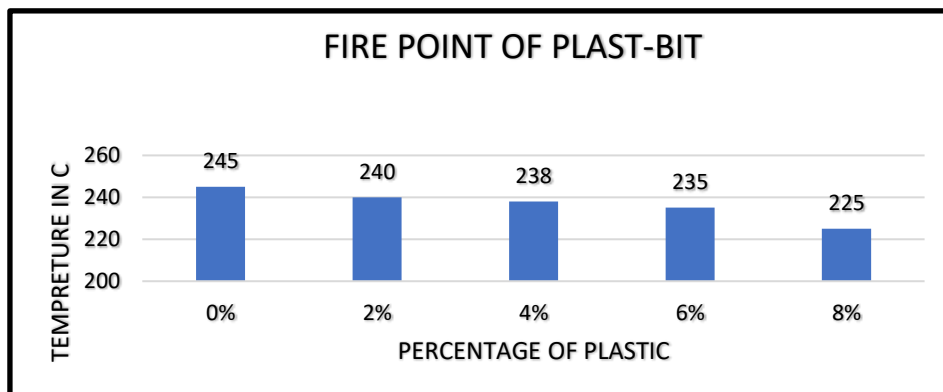
2. Ductility Test



3. Softening Point Test



4. Flash and Fire Point Test



APPLICATION

Waste management: Plastic roads provide a viable solution for managing plastic waste by utilizing it in road construction. This helps reduce the amount of plastic waste that ends up in landfills or oceans, contributing to a cleaner environment.

Durability: Plastic roads are often more durable compared to traditional asphalt roads. The plastic content enhances the strength and longevity of the road, making it resistant to cracks and potholes. Plastic roads can withstand heavy traffic and adverse weather conditions, resulting in reduced maintenance and repair costs.

Reduced carbon footprint: The production of traditional asphalt roads involves the extraction and processing of raw materials, which contributes to greenhouse gas emissions. Plastic roads offer a more sustainable alternative, as they utilize plastic waste that would otherwise release harmful gases if incinerated or left in landfills.

Conservation of natural resources: By incorporating plastic waste into roads, the demand for virgin materials like bitumen, a petroleum-based binder used in traditional road construction, can be reduced. This helps conserve natural resources such as fossil fuels.

Improved drainage: Plastic roads often have better drainage capabilities compared to conventional roads. The plastic waste used in their construction helps create a more porous surface, allowing water to drain more efficiently. This can help prevent waterlogging and reduce the risk of flooding.

Cost-effective: Plastic roads can be cost-effective in the long run due to their durability and reduced maintenance requirements. While the initial construction costs may be slightly higher compared to traditional roads, the long-term savings in maintenance and repairs can offset these expenses.

CONCLUSION

From above study or experiment we can conclude that using liquid plastic waste with bitumen will help to improve the strength and performance of road. The use 6% plastic waste is found to be the optimum percentage for modification of bitumen this percentage could make the road able to resist heavy vehicular and hot climate and to reduce the rutting effect. It does not involve any extra machinery as well as it does not increase the cost of road construction.

REFERENCES

1. Dr. S. L. Hake , Dr. R. M. Damgir, P. R. Awsarmal Utilization of Plastic waste in Bitumen Mixes for Flexible Pavement, 48 (2020) 3779–3785.
2. R.Manju, Sathya, S Sheema, K Use of Plastic Waste in Bituminous Pavement, 804-811, 2017.
3. Huda Shafiq, Anzar Hamid, Plastic Roads: A Recent Advancement in Waste Management SSN,2278-0181 September-2016.
4. P. Guruswamy Goud, M. Rajasekhar, N. Vijayakumar , K Snehalatha , B. Bhanu Case Study on Plastic Roads,2018
5. Andri Heriawan , Upcycling Plastic Waste for Rural Road Construction in India: An Alternative Solution to Technical Challenge by, WPS220610-2,2018.
6. Riya Goyal, Plastic Waste Road Construction in Madhya Pradesh, SSN 2347 – 3983, 2021.

7. Sunil J. Kulkarni A Review on Studies and Research on Use of Plastic Waste ,E-ISSN: 2349-9788; P-ISSN: 2454-2237,2020.

GUIDE



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