



REVIEW PAPER ON COMPARATIVE STUDY OF CONVENTIONAL BITUMINOUS ROAD AND PLASTIC ROAD

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ABSTRACT

The waste plastic and its disposal is a major threat to the environment, which results in pollution and global warming. The use of plastic waste in bituminous roads enhances its properties and also its strength. Moreover, it will also be a solution to plastic disposal & various defects in pavement viz., corrugation, cracks, potholes, rut, etc. the waste plastic used is poly-ethylene like high density and low-density poly-ethylene, poly-propylene. The waste plastic is shredded and coated over aggregate mixed with hot bitumen and the resulted mix is used for pavement construction. This will not give strength to the pavement but also increases its durability. Titanium dioxide is used as a smoke absorbent material, which will absorb the smoke generated from the vehicles. This innovative technology will be boon for the Indian hot-humid climate. It is economical and eco-friendly as well. This concept tells us the details about utilizing plastic waste in the construction of bituminous pavements. This technology is not a new concept but is quite not practiced widely. This information makes us conversant with the technology and methods of this evolutionary method for reducing plastic waste.

Index term: Bitumen, Mixture, Plastic, Composition, Economy, Recycling;

1. INTRODUCTION

We all know the problems related to plastic waste which is a non-biodegradable material. Today the availability of waste plastic is enormous and we all are dependent on plastic because of its affordable, versatile, and durable material. They easily get mixed with municipal solid waste and otherwise thrown out into landfills and the ocean. This generates plastic waste which leads to plastic pollution and adversely affects wildlife and humans. This is why it is necessary to find some solutions to the disposal of plastic waste and here is the best solution is the use of plastic waste in road construction.

In road construction, bitumen is used as a binder which is available at different grades on basis of their penetration value. But increase in high traffic intensity in terms of commercial vehicles and a serious change in daily and seasonal temperature demand improvement in road construction. This leads, to a need for improvement in binder properties, and here is the solution use of plastic waste.

Heating to plastic waste at 160°C it becomes soft. A theory called thermo gravimetric analysis shows that there is no gas evaluation at a temp between 130°C to 180°C. besides, softened plastic has a binding property. Hence molten plastic waste can be used as a binder and it can be mixed with binder-like bitumen to enhance its binding property.

2. LITERATURE REVIEW

- 2.1 Zahra Niloofar Kalantar(2012): Many kinds of research on PMA mixture have been conducted for the past two decades. However, the addition of virgin polymers to asphalt for enhancing the properties of asphalt over the temperature range in applications regard quite some time ago, recycled polymers added to asphalt shows the same result in improving the road pavement performance as well as compared to virgin polymers. This paper gives a review of brief knowledge of using waste polymers in asphalt pavement. In this study, a critical review of the history and benefits of using waste and virgin polymers in asphalt is introduced by a general study on using polymers in asphalt for improving the properties of road pavement.
- 2.2 BrightAforlaetal(2015): Adding waste plastic the property of bitumen has increased. Two percent of polymer framework with AC-10 bitumen can give AVC-20bitumen properties that will finally help in improving the marshal stability design life strength and other desirable properties. The asphalt pavement indicates saving in the usage of bitumen as the consumption of waste plastic increases. The disposal of waste plastic in the bituminous pavement construction is therefore a lifelong solution and hence presents a safe and healthy Nature.
- 2.3 Sasane Neha. B et al (2015): It is proving that the addition of plastic is an innovative technology that enhances road construction and also improves the survival of roads. As the plastic content increase, the characteristic of bitumen and aggregate also increases compared to the conventional flexible pavement the flexible pavement with the added plastic has better results. According to the marshal stability test, the optimum usage of plastic is up to 10%.
- 2.4 Manan Gupta and Mudit Sharma (2016): In their research paper, they give brief information on plastic types, and their uses and also give an expansion of plastic waste examples and their causes. Also, state how can plastically waste be used in road construction by using 5%, 7%, 9%, 12%, and 15% plastic wastage mixed with bitumen and aggregates to enhance their properties. They give a case study on a 2 km modified bituminous road using plastic waste in Bangalore. They performed the various tests in laboratories using plastic waste in proportions of 5%, 7%, 9%, 12%, and 15% mixed with bitumen and aggregates. After performing various tests like ductility test, softening point specific gravity, and another modified aggregate test it shows that adding plastic waste in bitumen and aggregate it amplify the properties of normal bitumen road.
- 2.5 Manu Sasi Dharan, Dr. Mehran EskandariTarhaghan and Dr. Michael Burrow (2019): studied various countries that modified bituminous roads using plastic waste for road construction like India, the United Kingdom, Ghana, Ethiopia, and the Netherlands. During their research work, they face problems related to the use of plastic waste in road construction like Health and environmental hazards, collecting and sorting plastic waste, training for construction workers, and Regulatory framework. They also did a cost analysis on plastic waste used in modified bituminous roads vs normal roads made by the above countries. They mention that in India, the cost saved by using plastic waste in road construction was \$ 670 per km. In Netherland, in 2018 a 30m cycle pathway was made by modular and hollo blocks manufactured through plastic waste by Zwolle municipality.
- 2.6 Ammu B. Cruscho and vincyVergheese: They research the use of Bio-medical waste in road construction. They did a comparison between two methods which are coated aggregates with biomedical syringe plastic waste and using biomedical syringe plastic waste as a modifier in bitumen. Biomedical waste is not like other waste materials. It can't be disposed of in the environment. But some Bio-medical waste can be reused like glucose bottles, syringes, etc. In kanji Kode, located in Kerala in kanji Kode IMAGE is responsible for collecting and treatment of Bio-medical waste materials. They are buried deep underground, examples are metal sharp objects like needles, knives, etc. In their comparison they found, Bio-medical plastic waste if coated with aggregates is more suitable than used as a modifier in bitumen. And proved that Bio-medical plastic waste like syringes also can be used in road construction to modify Normal bituminous roads.

3. METHODOLOGY

CONSTRUCTION METHODS:

The process of construction of plastic roads is:

1. Dry Process:

- The plastic waste is dried and cleaned to remove the impurities. Then cut into 1.18mm - 4.36mm in a shredding machine. The PVC should be eliminated from the plastic waste in the cleaning process.
- As per HRS specifications the aggregate is heated to 165oC and the bitumen is heated to an extent of 160oC to have good binding property. In the mixing chamber, the cut plastic is added to hot aggregate to apply coating uniformly over aggregate for 30 to 45 seconds.
- The plastic-coated aggregate is added to bitumen at a temperature between 150oC - 165Oc.

2. Wet Process:

- The plastic is collected 60 microns or below the sizes preferred for the next step. The reason behind this is that less size of plastic can easily mixable with hot bitumen at a temperature between 160oC-170oC.
- The bitumen is heated to 160oC-170oC which is the melting temperature of the plastic.
- The fines pieces of plastic are added to the hot bitumen at a constant temperature mixture were stirred manually for about 20-30min for composition.

4. RESULT AND DISCUSSION

Reusing Plastic waste in Road construction can contribute to environmental aspects and economical aspects like the following –

- It can create a new way of disposal of plastic waste.
- It can help to reduce plastic pollution and its causes and create a healthy environment.
- It can help to reduce excessive use of natural resources.
- It can give better infrastructure.
- It increases the strength of the road.
- In rainy seasons, helps to resist seepage of water on the surface of the road.
- It increases the binding properties of bitumen.
- It can prevent forming of potholes or path holes.
- It is lightweight so, can help to reduce costs in terms of burning less fuel during transportation.
- It is a good insulator for heat, cold, and water so, it can withstand all three seasons in India.

There are some problems related to the use of plastic waste in road construction-

- The main problem is the collection of plastic waste and its separation; it requires a large amount of manpower.
- If there is no proper training for workers and a proper workplace for constructing plastic roads it can cause health issues to workers, by inhaling chemical gaseous.
- The major problem with plastic roads is they can break down into micro plastic which can spread out into soil and underwater recourses.
- When melting various types of plastics together create a single composite plastic that may separate and cause structural defects leading to premature failure.

5. CONCLUSION

We read many research papers and found out the benefits of plastic waste used in road construction how can it helps to modify normal road, helps to improve environmental issues related to plastic waste also in terms economic and social growth. In Laboratory, test on the addition of 5%, 7%, 9%, 12%, and 15% plastic waste in bitumen concludes that ductility increases with the addition of plastic waste in bitumen which also results in another test like softening point, specific gravity test, penetration test and another test on modified aggregate. Coated aggregates are more suitable for road construction than plain aggregates.

6. REFERENCES

1. Manan Gupta And Mudit gupta, "use of plastic waste in construction of bituminous road", JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY WAKNAGHAT, SOLAN.
2. Manu Sasidharan, Dr. Mehran eskandariTorghnan University of Burningham, "Use of waste plastic in road construction",
3. "A review on plastic bituminous road/Pavements, IJERT ISSN: 2278-0181 vol-10 Issue 05, May-2021.
4. "Medical plastic waste disposal by using in bituminous road construction", Ammu B. Crush, IRJMT ISSN: 2582-1082, 2019.
5. Sweta N. Ropkdev, "Use of plastic waste in road construction", IJCA (0975-8887).
6. "Study on utilization of plastic waste in road construction, (ICFiDCe '13)- April 18-20, 2013.
7. "A review paper on plastic road", Er. Ravi Kamboj, Er. Ashoke Anand, IJARIE-ISSN-2395-4396.
8. Performance comparison of waste plastic modified versus conventional bituminous road in pune city. A case study, Arjita Biswas, Amit Goel, www.elsevier.com/locate/cscm.
9. Utilization of plastic waste in Bituminous Road Construction to Achieve Sustainability, Dr. J.S. Sudharshan Haseeb, Journal criteria Review ISSN- 2394-5125,
10. R. Vasudevan, S. Rajasekaran, S. Saravanavel, Reuse of waste plastics for road laying, Indian Highways, Indian Road Congress (2006).
11. Code of Practice for Maintenance of Bituminous Road Surface, Indian Road Congress IRC: SP:82, 2015.
12. Guidelines for the Use of Waste Plastic in Hot Bituminous Mixes (Dry Process) in Wearing Course, Indian Road Congress IRC: SP, 2013.
13. Verma, S. S. 2008,"Roads from plastic waste." The Indian concrete journal".