

REVIEW PAPER ON COMPARATIVE STUDY OF PLASTIC WASTE ROAD, PATEL NAGAR, ALAMBAGH

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ABSTRACT

Waste plastic from domestic and industrial sectors can be used in production of asphalt mix. Waste plastic which are mainly used for packing are made up of polyethylene, polypropylene and polystyrene. These materials softening vary between 110°C to 140°C. These materials do not produce any toxic gases during the heating process. But softened plastics have tendency to form a film like structure over the aggregate when sprayed over the hot aggregate at 160°C. Plastic coated aggregate (PCA) is a better raw material for construction of flexible pavement. Then PCA was mixed with hot bitumen of different types and these mixes were used for road construction. PCA – Bitumen mix showed enhanced binding property and less wetting property. This sample showed higher Marshall Stability value in the range 18-20 KN. The load bearing capacity of the road is also increased by 100%. The road laid in 2002 using PCA – Bitumen mixes are still performing well. A detailed study on the performance of these roads shows that road constructed with PCA – Bitumen mix are performing well. This method is also eco-friendly and economical.

Keywords - Polyethylene, Polypropylene, Polystyrene, Marshall Stability

I.INTRODUCTION

Plastic is a versatile material and a friend to common man becomes a problem to the environment after its use. To find the proper use of the disposed plastics waste is the need of the hour. On the other side, road traffic is also increasing, hence there is need to increase the load bearing capacities of the road. The use of plastic coated aggregate for asphalt pavement allows the use of plastic waste. Plastic waste scenarios in the

world of various waste materials, plastics are a great concern. Mostly used plastic products are bags, cups, films and foams, made up of polyethylene, polypropylene, or polystyrene. Plastics used for packing are mostly dropped and left to litter the environment after the content has been consumed. The innovative technique to use the waste plastic for the construction of plastic road is a good solution for the waste disposal problem of plastic waste.

Patel nagar, Alambagh is an area in Lucknow city of Uttar Pradesh, India. Length of the road is 500m. Width of the road is 3.75m.

Due to industrial revolution, plastic seemed to be a cheaper and effective raw material. Every vital sector of the economy starting from packaging to agriculture, electrical, electronics and many more sectors have been virtually revolutionized by the application of plastic. Plastic is a non-biodegradable material. Researchers found that plastic can remain in Earth for 4500 years without degradation. Health hazard can be caused by the improper disposal of plastic waste by improper disposal of plastic waste. A complete ban on waste plastic cannot be put although the waste plastic taking the face of a devil for present and the future generation. But we can use the waste plastic for the construction of the road because the performance of plastic road is better than the ordinary road. Plastic is shredded into small sizes and is coated on aggregate of the mix at a specified temperature. Bituminous mix is mixed with plastic coated aggregate/ordinary aggregate.

II.LITERATURE REVIEW

1. R. VASUDEVAN, S.K. NIGAM, R.VELKENNEDY, A. RAMALINGA CHANDRA SEKAR, B. SUNDARAKANNAN (SEPTEMBER 2007)

Polymers like polyethylene, polypropylene, polystyrene, shows adhesion property in their molten state. Molten waste plastic is coated over stone aggregate. The coating of plastic will reduce the porosity, absorption of moisture and soundness improves. The polymer coated aggregate bitumen mix will form better material for flexible pavement construction since the mix shows high Marshall Stability value and suitable Marshall Coefficient. In many respects the use of polymer coated aggregate is better than the use of polymer modified bitumen.



2. SANDHYA DIXIT, Prof. DEEPAK RASTOGI (MARCH 2013)

The addition of waste fiber improves the penetration softening point of bitumen. Optimum dose of fiber was found to be 0.6 percent on the basis of performance grade 70. With increase in percentage of modifier, the ductility value decreases, but rate of decrease is less when fiber is added beyond 0.5 percent. From Marshall test result, it is concluded that Marshall stability value will increase with increase in bitumen content from 5% to 5.5% then it decreases.

3. S. RAJASEKARA N, Dr. R. VASUDEVAN, Dr. SAMUVEL PAULRAJ (2013)

In dry process, aggregate is modified by coating with polymers and it produces a new modified raw material for flexible pavement. The quality of aggregate is improved by coating plastics. Not only the quality of the aggregate is improved but also this technology has helped in using the waste plastics obtained from domestic and industrial packing materials. Thus adding more value to the dry process as this process helps in disposing 80 percentages of the waste polymers usefully by eco friendly method. This has been already accepted by Central Pollution Control Board, New Delhi.

4. VATSAL PATEL, SNEHAL POPLI, DRASHTI BHATT (APRIL 2014)

Plastic roads are stronger with increased Marshall Stability value. Plastic roads provide better resistance towards water stagnation and rain water so no stripping and no potholes. Plastic roads show increased binding and better bonding of the mix which reduces the pores in aggregate and hence less rutting a raveling. There is no leaching of plastics in plastic road and there is no effect of radiation like UV. The load withstanding property of plastic roads is increased.

5. SHWETA N. ROKDEY, P.L. NAKTODE, M.R. NIKHAR (2015)

The road's durability with shredded plastic waste is higher than road with asphalt with ordinary mix. Plastic-bitumen roads can last up to 10 years while a normal 'highway quality' roads last four to five years. Rainwater cannot seep through as there is plastic in the tar. Melting point of bitumen increases by plastic. This innovative technology not only increased the road life but also strengthened the road construction.



6. HUDA SHAFIQ, ANZAR HAMID (SEPTEMBER 2016)

Aggregate coated by plastic offer more resistance to wear and tear and abrasion. Plastics in their molten state show adhesion property. Melting point of bitumen is increased by plastics. Therefore, the waste plastics use for pavement is one of the good methods for disposal of waste plastic. For a country like India, plastic roads are the most feasible as here temperature is around 50°C and there are heavy monsoons that create potholes and ruts in the road.

7. G. PAUL PANDI, S. RAGHAV, D. TAMIL SELVAM, K. UDHAYA KUMAR (MARCH 2017)

There is value addition to the waste plastics from Rs. 4 per kg to Rs.12 per kg. The road construction's cost is also decreased and maintenance cost is almost nil. When we use this technique for road construction, road pavement life is doubled. We have to only pay Rs. 25000/- more instead of paying Rs.10, 80,000/- for the up gradation in just 2 to 3 years, hence saving Rs.10, 50,000/- per km.

8. R. MANJU, SATHYA S, SHEEMA K (2017)

For normal and plastic coated aggregate, the crushing value reduces from 23.32 to 14.22. Value was reduced by 40%. Plastic coated aggregate's abrasion value were 21% less than normal aggregate. Modified bitumen's (10% bitumen replaced by plastic) stability is higher than normal bitumen. The penetration value of bitumen mixed with plastic is less than bitumen.

9. ARJITA BISWAS, AMIT GOEL, SANDEEP POTNIS (OCTOBER 2019)

Plastic roads showed better performance than normal bituminous roads in various experiments such as Marshall Stability, water absorption and stripping test. The results showed satisfactory results in core cutting tests in both type of roads-plastic roads and normal bituminous roads with respect to MoRTH specification. Bitumen Extraction test results were better of plastic roads than normal bituminous roads. Deterioration of roads was early in normal roads with respect to plastic roads.

International Journal of Scientific Research in Engineering and Management (IJSREM)Volume: 07 Issue: 05 | May - 2023SJIF 2023: 8.176ISSN: 2582-3930

10. AZMAT SHAIKH, NABEELO KHAN, FAISAL SHAH, DEVENDRA SHUKLA, GAURAV KALE

Marshall Stability value is increased with plastic content and it is observed that Marshall flow value decreases on addition of polythene, that is, resistance to deformation under heavy wheel load is increased. Addition of plastic waste can enhance various properties of ordinary bituminous road. We can obtain a durable and more stable mix for the pavement by addition of plastic.

III.METHODOLOGY

DRY PROCESS

1. Collection of Waste Plastic

Waste plastic can be collected from road, dumpsites, garbage trucks, or from school collection program, or by purchase from rag picker or waste buyer at Rs. 5 - 6 per kg.

2. Cleaning and Shredding of Plastic Waste

Waste plastic in the form of use and throw cups, thin film carry bag, PET bottles, etc are sorted, de-dusted and washed if necessary.

3. Mixing of Shredded Waste Plastic, aggregate and bitumen in central mixing plant

The aggregate mix is heated at 165°C and then transferred to mixing chamber, and the bitumen is heated to 160°C to result in good binding. It is important to monitor the temperature during the heating process. Then shredded plastic waste is added to the aggregate. It gets uniformly coated over the aggregate within 30-60 seconds, giving an oily look.

4. Laying of Bituminous Mix

The road is laid at the temperature between 110°C to 120°C. The roller of capacity 8 tons is used for road laying.





IV.COMPARISION BETWEEN PLASTIC WASTE ROAD AND NORMAL BITUMINOUS ROAD

• Durability of roads laid out with shredded plastic is much more than normal bituminous road as binding property of plastic makes road last longer. Plastic increase the melting point of bitumen making the road retains its flexibility during winters resulting in its long life. While normal bituminous road lasts four to five years, it is claimed that plastic waste road can last up to ten years.

• Addition of waste plastic in bituminous mixes results in reduction of bitumen consumption, therefore resulting in reduction of cost than normal bituminous road.

• Using waste plastic in roads increases durability and higher resistance to deformation, water induced damage indirectly contributing to accident reduction and user satisfaction than normal bituminous road.

• Addition of waste plastic in small doses (5-10% by weight of bitumen) helps in considerably improved strength, stability, fatigue life and other properties than normal bituminous road.

• No potholes, cracks can be seen in plastic road in long run where as normal bituminous road is subjected to degradation.

• Plastic roads are more flexible than normal bituminous road.

V.TESTS

• Tests to be performed on aggregate are-

1. Aggregate impact value test- Aggregate impact value is the ability of aggregate to resist sudden impact or shock load on it.

2. Los Angeles abrasion test- It is carried out to test the hardness property of the aggregate. Principle of Los Angeles abrasion test is to find the percentage wear caused due to rubbing action between the aggregate and the steel balls used as abrasive charge.

3. Water absorption test- An idea on the internal structure of aggregate is given by water absorption. Aggregates which have more absorption are more porous in nature and are considered unsuitable unless found to be acceptable based on strength, impact, and hardness test.

4. Specific gravity test-Specific gravity is defined as ratio of weight of aggregate to the weight of equal volume of water. Specific gravity of an aggregate is considered to be a measure of quality or strength of the material.

5. Stripping value test-Stripping value of aggregate is defined as ratio of uncovered area observed visually to the total area of aggregate expressed as percentage.

• Test to be performed on bitumen are-

1. Penetration value test-Penetration value is the distance penetrated by the point of standard needle into the bituminous material under specific condition of the load, temperature and time.

2. Ductility test-Property of bitumen to elongate under traffic load without getting cracked in road construction work is known as ductility of bitumen.

3. Flash & fire point test-This test is conducted on bitumen to know the safe mixing and application temperature values of particular bitumen grade.

4. Softening point test-Softening point is defined as temperature at which bitumen softens beyond some arbitrary softness. To determine consistency of bitumen softening point test of bitumen is done.

• **Marshall Stability Test-**Marshall stability of the mix is defined as the maximum load carried by specimen at a standard test temperature of 60°C. Marshall Stability measures the maximum load sustained by bituminous material at a loading rate of 50.8 mm/minute.

VI.CONCLUSION

- The penetration softening point of bitumen is improved on addition of waste fiber.
- The softening increases with increase in percentage of fiber.
- The ductility value also increases with increase in percentage of modifier but the rate of decrease is less when fiber is added beyond 0.5 percent.
- The optimum dose of fiber was found 0.6 percent on basis of performance grade 70.

• It is concluded from Marshall test result that Marshall stability value increases with increase in bitumen content from 5% to 5.5% then it decreases.

• From environmental and economic viewpoint, the use of waste plastic fiber, plastic road may contribute to solving waste disposal problem and improving the quality of road pavement.

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