JOURNAL OF ADVANCEMENT IN
ENGINEERING AND TECHNOLOGY

Journal homepage: www.scienceq.org/JAET.php

Review Open Access

A Review on Use of Plastic in Construction of Roads

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Received: April 04, 2020, Accepted: May 01, 2020, Published: May 01, 2020.

ABSTRACT

The global plastic production is increasing rapidly with rise in population and changes in life style. This makes the disposal of plastic is becoming complicated because of the non-biodegradable property. So it is better to recycle than disposal. One of the trend in recycling of plastic is use in construction of roads. This type of recycling can also help in protecting the environment from the greenhouse gases that are exposed to atmosphere while disposal. The waste plastic in form of bottles, cups, caps, etc are made in form of powder or blended with crusher and coated over the aggregate and bitumen mixture by heating process for roads construction. This polymer coated aggregate and bitumen mixture shows high strength, better binding property, stability, and increase in wear resistance, better durability and tear of roads. This makes the recycle of plastic in an efficient manner.

Keywords: *Aggregate, Bitumen Mixture, Plastic, Composition, Economy, Recycling*

1. INTRODUCTION

Today every sector around the world from agriculture to electrical, packing, automobile, building construction, communication sector are widely using plastic. The usage was started after the industrial revolution and its large scale production seemed to be cheap. Generally plastic is a non-biodegradable and many research found that plastic take around 4500 years to degrade. Several studies proven that the disposal of plastic causes many health problems and also reduces the fertility of soil. The plastic production over the world has crossed 400 million tons and the recycling of plastic is only 10%. Various experiments are being conducted in order to improve the properties of bituminous road. The recent advancement in that study is use of waste plastic in road construction. The use of plastic in road construction is gaining importance mow a days due to its performance, life span and low construction cost.

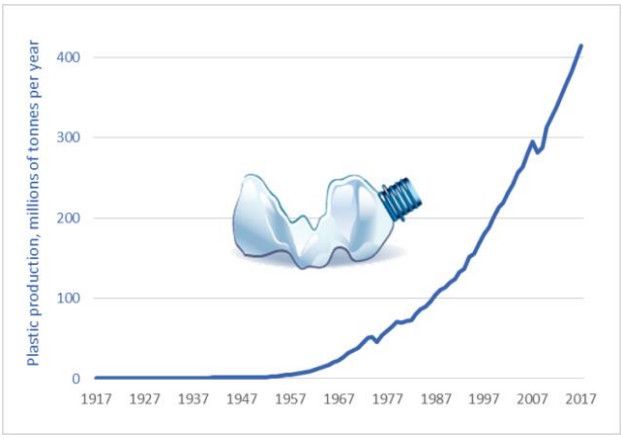

Fig-1:plastic production in million tons

CONSTRUCTION METHODS:

The process of construction of plastic roads are :

1. Dry Process

2. Wet Process

Dry Process:

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

Wet Process:

1. The plastic is collected 60 micron or below sizes preferred for next step. The reason behind this is that less size of plastic can easily mixable with hot bitumen at temperature between 160oC-170oC.
2. The bitumen is heated to 160oC-170oC which is the melting temperature of plastic.
3. The fine pieces of plastic is added to the hot bitumen

At constant temperature mixture was stirred manually for about 20-30min.

COMPOSITION:

The composition of plastic roads mainly depends on the percentage of plastic used, grade of bitumen and size of aggregate. It is suggested to use an aggregate of size 10mm - 20mm. 60/70, 80/100 grade of bitumen and maintaining the laying temperature between 110oC to 120oC. As the percentage of plastic increases softening point, flash point and fire point increases whereas penetration value and ductility decreases. From the experimental results the percentage of plastic is given as 10%. The porosity should be less than 2%. Due to this porosity the air is accumulated in bitumen and it causes oxidizing of bitumen. This makes bitumen hard. The coating of plastic reduces the porosity. Also stone dust and lime are used as filler

materials. The Impact value and Los Angeles abrasion value decreases with increase in percentage of plastic.

S.No	Properties	Plastic coated Bituminous Road	Ordinary Bituminous Road
1	Marshall Stability Value	More	Less
2	Binding Property	Better	Good
3	Softening Point	Less	More
4	Penetration Value	More	Less
5	Tensile Strength	High	Less
6	Rutting	Less	More
7	Stripping	No	More
8	Seepage of Water	No	Yes
9	Durability	Better	Good

COMPARISION OF PROPERTIES IN ORDINARY ROAD AND PLASTIC ROAD

ECONOMY:

One of the main factors to be considered in any technology and global market is economy. In order to compare the cost of construction between ordinary road and plastic coated bituminous road, consider a road of dimensions 3.75m width and 1Km distance.

Cost of Waste plastic = Rs. 5/- per Kg

Cost of bitumen = Rs. 50/- per Kg

Generally, for 1 Km of road 10 tons of bitumen is required.

Cost of bitumen per Km = 50 × 100000

= 50,0,000/-

For plastic coated bituminous road,

It is already discussed above that 10% of plastic is required.

Amount of bitumen required for

Plastic coated bituminous road = 9000Kg

Amount of plastic required = 1000Kg

Cost of bitumen in plastic coated bituminous road+Cost of plastic required = 9000×50+5,000

Total cost = 4,55,000/-

Savings in construction per Km = (cost of bitumen per ordinary road - cost of plastic coated bituminous road per Km)

= 5,00,000 - 4,55,000

= 45,000/- per Km.

ADVANTAGES:

1. Disposal of waste plastic will no longer be a problem.
2. The up gradation cost is less compared to normal roads.
3. The load with standing property also increased.
4. The cost of road construction also reduced.
5. Road strength also increases.
6. Plastic roads could have a hollow space to facilitate wiring, pipe lines, etc.
7. Plastic roads have less moisture absorption than normal roads.
8. Better resistance to rain water and stagnation.
9. Increases binding strength of the aggregate and bitumen.
10. Durability of road is increases when compared to normal road.
11. Reduced construction time on site

DISADVANTAGES:

1. The heat treatment of plastic may leads to release of harmful gases to atmosphere.
2. Roads made of pure plastic may leads to decrease in strength with small variation in temperature.
3. The plastic may break into micro plastic particles due to atmospheric oxidation.

CONCLUSION:

The generation of waste plastics is increasing rapidly. Also the disposal of plastic is becoming complicated. So, using of the waste plastic in construction is a eco-friendly manner. The plastic coated bitumen increases the melting point. Polymer Modified Bitumen is used due to its better performance. The plastic coated bitumen helps in binding strength and increases the area of contact between the aggregate and bitumen. It also helps in eliminating of the voids. Due to the elimination of voids, road show the resistance towards the oxidation of bitumen by entrapped air. This property makes the plastic coated bitumen road to withstand heavy traffic and show better durability

REFERENCES

1. Huda Shafiq, Anzar Hamid, “Plastic Roads: A Recent Advancement in Waste Management”, International Journal of Engineering Research & Technology,Vol. 5 Issue 09, September-2016.
2. Vatsal Patel, Snehal Popli, Drashti Bhatt, “Utilization of Plastic Waste in Construction of Roads”, International Journal Of Scientific Research, Volume : 3, Issue : 4, April 2014.
3. Mr. Mahesh M Barad, “Use Of Plastic In Bituminous Road Construction”, Journal Of Information, Knowledge And Research In Civil Engineering, Volume 3, Issue 2, 2015.
4. Amit p. Gawande, “Economics And Viability Of Plastic Road : A Review”,Journal of Current Chemical and

Pharmaceutical Sciences,volume 3, Issue 4, 2013.
5. Ahmed Trimbakwala, "Plastic Roads Use of Waste Plastic in Road Construction", International Journal of Scientific and Research Publications, Volume 7, Issue 4, April 2017.
6. Rajasekaran S., Vasudevan R. and Paulraj S., Reuse of Waste Plastics Coated Aggregates-Bitumen Mix Composite for Road Application—Green Method. American Journal of Engineering and Research,2013
7. Bindu C , Dr.K.S.Beena,"Waste plastics as a stabilising additive in Stone Mastic Asphalt", International Journal of Engineering and Technology, Vol.2(6),2010.
8. D N Little, "Enhancement of asphalt concrete mixtures to meet structural requirements through the addition of recycled polythene, use of waste materials in hot mix asphalt", ASTM Special Tech Publication, 1193(1993).
9. L.Flynn, "Recycled Plastic finds it home in Asphalt Binder", Roads and Bridges , (1993).
10. Vatsal Patel, Snehal Popli, Drashti Bhatt, "Utilization of plastic wastes in construction of roads", International Journal of Scientific research, Volume 3, April 2014.
11. Anzar Hamid, "Use of Plastic Wastes in Pavement Construction: An Example of Creative waste management", IOSRJEN, Vol 5, Issue 2 ,2015.
12. Amit gawande, g. S. Zamre, V. C. Renge, g. R. Bharsakalea and Saurabh tayde, "utilization of waste plastic in asphalting of roads", Scientific Reviews and Chemical Communications, volume 2, issue 2, 2012.
13. Dr. Abhaykumar S Wayal1, Mudassir. D. Wagle, "Use of Waste Plastic and Waste Rubber in Aggregate and Bitumen for Road Materials", International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 7, July 2013.
14. Rema devi, Leni Stephen, "Reduction of optimum bitumen content in bituminous mixes using plastic coated aggregates", International Journal of Innovative Research in Science, Engineering and Technology, Volume 2, Issue 3, March 2013.
15. Miss Apurva J Chavan, "use of plastic waste in flexible Pavements", International Journal of Application or Innovation in Engineering and Management, Volume 2, Issue 4, April 2013.
16. S.Rajasekaran, Dr. R. Vasudevan, Dr. Samuvel Paulraj, "Reuse of Waste Plastics Coated Aggregates-Bitumen Mix Composite For Road Application – Green Method", American Journal of Engineering Research,Volume 2, Issue 11,2013.
17. Mrs. Vidula Swami,Abhijit Jirge,Karan patil,Suhas patil,Karan salokhe, "Use of waste plastic in construction of bituminous roads",International Journal of Engineering Science and Technology,Volume 4,Issue 5,2012.
18. Afroz Sultana. SK, K.S.B. Prasad, "Utilization of Waste Plastic as a Strength Modifier in Surface Course of Flexible and Rigid Pavements", International journal of engineering research and application,Volume 2,Issue 4,2012.

Citation: Chada Jithendra Sai Raja *et al.* (2020). A Review on Use of Plastic in Construction of Roads. J. of Advancement in Engineering and Technology, V7I4.01. DOI: 10.5281/zenodo.3780333.