International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

Use of Plastic Waste In Road Construction

[1]Mahesh Dahatonde, [2]Saurabh Gaware, [3]Shubham Dhake, [4]Dhiraj Patil, [5]Prof. Rachana Vaidya

[1234]UG, Department Of Civil Engineering, Alard College Of Engineering And Management, SPPU, Pune, India
[5]Assistant Professor, Department of Civil Engineering, Alard College Of Engineering And Management, SPPU, Pune, India

---

Abstract - *The generation of polymer waste is increasing day by day, and the necessity to dispose of this waste is arising. This waste is disposed of using different methods such as incineration and land-filling, which affects the environment, but adding polymer to roads is eco-friendly. The mixing of polymer into dry bitumen improves the service properties of bitumen. India generates 25,940 tons of plastic waste daily, of which 40% is either left unattended or not appropriately of polymer into dry bitumen improves the service properties of bitumen. At present only 9% of plastic is reused worldwide. Each day, over 8 million fragments of their corpses wash into our seas. Plastic roads are composed of 6–8% plastic and 92–94% bitumen, which is used to construct roadways. This is beneficial for the ecology since roads are constructed using plastic garbage. Increasing various properties of road materials. Plastic waste the number of days today. Polymers polythene, polypropylene and polystyrene, show the adhesion property in a molten state. Plastic will increase The point at which the bitumen will melt. Thus, plastic waste for pavement is one of the best ways to get rid of waste plastic quickly.*

***Key Words*: Plastic, Plastic waste generation, Bitumen Plastic, Grade of Bitumen & Plastic Pavement**

1. INTRODUCTION

Roads are critical for economic growth and provide significant social benefits. It aids in the provision of employment, education, health, and social services to mankind, making the road network essential for a nation's growth and development. The cost of bitumen has increased in recent years as the price of crude oil has risen. Given the high cost of highway construction and maintenance, proper engineering design and the use of waste plastic can save a significant amount of money. When waste plastic is combined with bitumen and aggregate, the properties of the bituminous mix are improved. Plastics are practical, but they are not environmentally friendly. Plastics are feasible but not eco-friendly because plastic is a non-biodegradable. At present in INDIA the plastic consumption is more than 15 M tones, which is 3rd largest plastic consumption in the world. Most of the plastic is used for packaging which are mostly dropped and left to litter the surrounding. The scattered plastics get mixed with domestic waste due to which the solid municipal waste disposal becomes difficult. The solid municipal waste is either disposed or burned. This to method of disposal is not the best way to dispose the waste because both method cause soil and air pollution. Plastics is a lifetime and incinerate under unchecked conditions can cause air pollutants to generations depending upon the polymer type and used additives. Rapid industrialization and enormous population growth resulted in increase of different types of waste materials. For the dumping of the waste material considerable measures have been done. Disposing it into road pavement is an effective way to dispose the plastic by simultaneously improving the pavement properties.[1]

1.1 BITUMEN

Bitumen is the binding material used in road construction. It is non crystalline and dark brown in colour and having sticky properties. It is obtained from crude petroleum. In other words bitumen is any adhesive and solid mixture of hydrocarbons that are found naturally in tar, asphalt, mineral waxes etc.it is used for constructing the road surface and roofing material. It is used for road construction, platforms, runways etc. Water proofing, Mastic flooring, Canal lining, Damp proof course.[2]

1.2 USE OF MILK BAGS(LDPE) IN BITUMEN CONSTRUCTION

LDPE is a a thermoplastic made from monomer ethylene. It is extensively used in day-to-day life due to its versatile nature. After the operation, these LDPE-made materials are dumped in landfills which leads to pollution. The use of recyclable LDPE plastic waste in tiles is a solution to reduce the pollution caused by LDPE plastic. Also, thermoplastics have low melting points and can be recycled or deformed by heat, whereas thermosetting plastics have veritably high melting points that cannot be remoulded fluently. Low-density Polyethylene is a semi-rigid polymer with low crystallinity 50-60 percentage. As compared to HDPE, it has a higher degree of short and long side-chain branching. The LDPE is composed of 4,000-40,000 carbon atoms, with many less branches. LDPE is a veritably flexible material. Its melting point is approximately 120 °C. Properties of LDPE.[2]

2. METHODOLOGY

In this We collected milk bags from akurdi and ravet area from pune, milk bags has been used in variation 5%,10%,15% is replaced by the weight of bitumen which is of LDPE kind of waste plastics identification, for this test we have used 20gram of bitumen. In the first step the collection of plastic is get collected from akurdi and ravet area. Then the process of plastic separation is done. The plastic is properly get washed and then get through cutting process. After this process, the melting process is done at 170^0 C. by mixing bitumen and milk bags. The process of mixture should be continuously in rotational motion. After this process the material is cool at 120^{o}C and mix the aggregate.

2.1 TESTS CONDUCTED ON MILK BAG BITUMEN

i. DUCTILITY TEST

The ductility of plastic mix bitumen is measured by the distance in cm,to which the bitumen sample will elongate before breaking.The test conducted on modified bitumen are 5%,8%,10%,11.5%,12%,15%. We found effective result at 11.5%.[3]

ii. PENETRATION TEST

The hardness of bitumen which is used in road construction has been determined by the penetration test observed as 47mm.[3].

iii. SOFTENING POINT

Bitumen has an ability to become soft at higher temperature. This softening temperature is determined with the help of ring and ball apparatus 58.6 °C.[3]

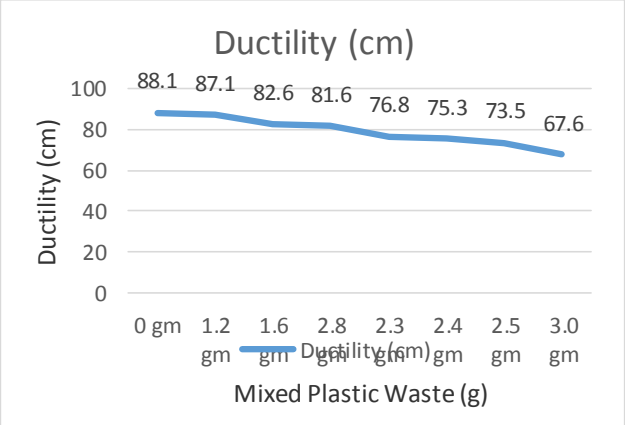
iv. MARSHALL TEST

In this test specimen of bitumen and aggregates mixture has been prepared and then the test is conducted on it. The load has been applied on the specimen and then deformation is been measured.[3]

3. TEST AND RESULT

DUCTILITY TEST ON MILK BAGS BITUMEN

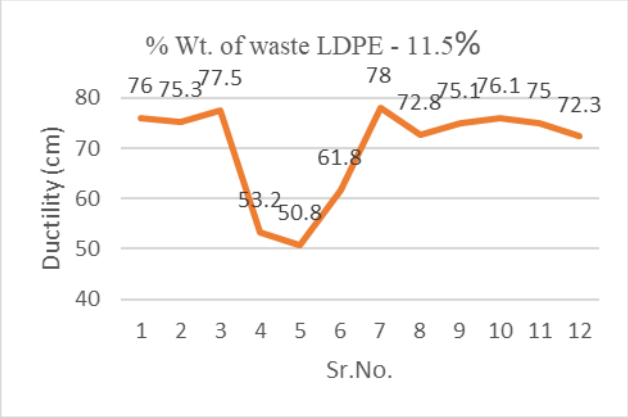
% Wt. of waste plastic (g)	Amount of bitumen(g)	Mixed plastic waste (g)	Ductility (cm)
0	20 gm	0 gm	88.1
5%	20 gm	1.2 gm	87.1
8%	20 gm	1.6 gm	82.6
10%	20 gm	2.8 gm	81.6
11.50%	20 gm	2.3 gm	76.8
12%	20 gm	2.4 gm	75.3
12.50%	20 gm	2.5 gm	73.5
15%	20 gm	3.5 gm	67.6



Graph no. 1 Ductility test on milk bags bitumen

DUCTILITY TEST FOR MILK BAGS BITUMEN of 11.5 %

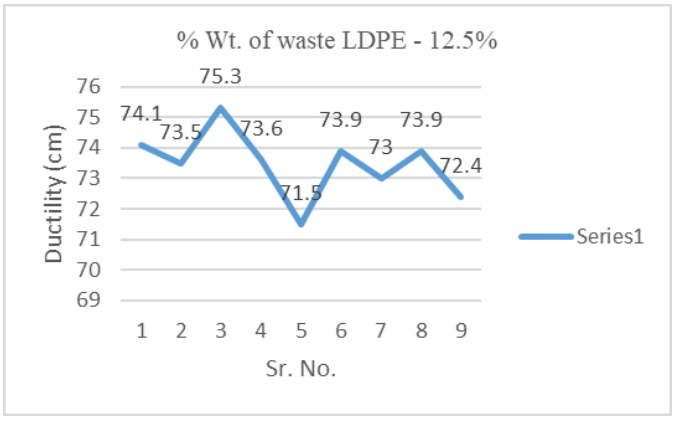
% Wt. of waste plastic (g)	Ductility (cm)	Mean
11.50%	76	76.344444
11.50%	75.3	
11.50%	77.5	
11.50%	53.2	
11.50%	50.8	
11.50%	61.8	
11.50%	78	
11.50%	72.8	
11.50%	75.1	
11.50%	76.1	
11.50%	75	
11.50%	72.3	



Graph no 2 Ductility test for milk bags bitumen of 11.5%

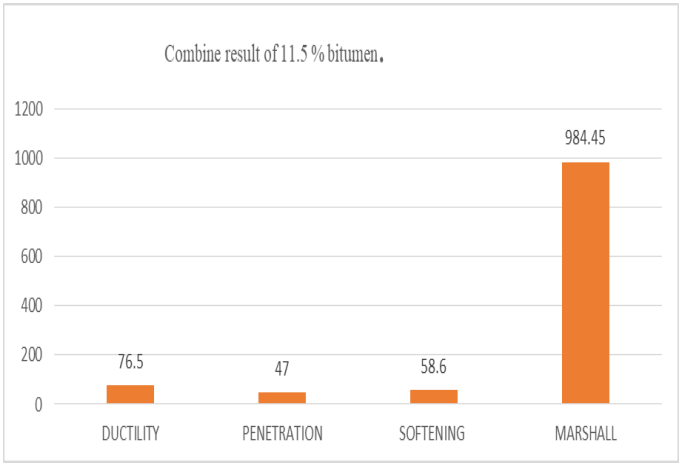
DUCTILITY TEST FOR MILK BAGS BITUMEN of 11.5 %

% Wt. of waste plastic (g)	Ductility (cm)	Mean
12.50%	74,1	73.466667
12.50%	73.5	
12.50%	75.3	
12.50%	73.6	
12.50%	71.5	
12.50%	73.9	
12.50%	73	
12.50%	73.9	
12.50%	72.4	



Graph no 3 Ductility test for milk bags bitumen of 12.5%
Combine result of 11.5 % bitumen.

% Wt. of waste plastic LDPE (g)	Amount of bitumen (g)	Mixed plastic waste (g)	Ductility (cm)	Penetration (mm)	Softening point 0C)	Marshal Stability
0%	20 gm	0 gm	88.1	59.12	50.25	1077.68
11.5%	20 gm	2.3 gm	75.3	47	58.6	984.45



Graph no 4 Combine result of 11.5% bitumen

4 ADVANTAGES

1) Reduce the quantity of bitumen by around 5% to 10%.

2) To increase the life of the road and durability of road.

3) The ecofriendly recycled technology is used in this paper.

4) To reduce the cost of a road construction

5. APPLICATIONS

1) Recycled milk bags are used for manufacturing containers and beauty products packaging.

2) Milk pouches are 100% virgin.it can recycled for irrigation pipes, chairs, dustbins and for slides.

3) The plastic waste is also used in pavement blocks, compound wall and for decoration use.

4) This plastic waste is used in bituminous pavement.

6. CONCLUSION

In this paper we have used 20gm of bitumen for all sample. When we used 11.5% wt of waste plastic mixed in bitumen we observed ductility as 76.8 cm. The small percentage of plastic in bitumen will definitely improve the performance of the constructed roads. Types of roads at different locations will face cardinal external factors like temperature, load factor, waste minimization on road etc, and different parameters discussed above will attain their optimum values at various percentages of the additive. So it is prominent to decide what percent of plastic must be used for a particular road construction keeping all the factors in mind. Also, the major problem which India is facing is an most of waste plastics. These plastic are harm for our environment can be recycled and reuse.

REFERENCES

[1] K. Sarkar, "Analysis of Effects of High-Density and Low-Density Polyethylene Wastes on Bitumen for Highway Construction," Int. Res. J. Eng. Technol., vol. 6, no. 2, pp. 1057–1061, 2019.

[2] R. S. M. BRAJESH MISHRA, "A Study on Use of Industrial Wastes in Rural Road Construction," Int. J. Innov. Res. Sci. Eng. Technol., vol. 4, no. 11, pp. 10387–10398, 2015, doi: 10.15680/ijirset.2015.0411009.

[3] Singh and S. Bhowmik, "Use of Plastic Waste in Bitumen," no. October, pp. 156–188, 2021, doi: 10.4018/978-1-7998-7176-7.ch008.

[4] Rajneesh Kumar and Maaz Allah Khan (2020) 'Use of Plastic Waste Along with Bitumen in Construction of Flexible Pavements.

[5] P. Gaikwad, A. Lahorkar, H. Patil, A. Malgundkar, and S. S. Kerkar, "A Review on use of Plastic in Bituminous Roads / Pavements," vol. 10, no. 05, pp. 972–974, 2021.

[6] H. Mir, "Use of Plastic Waste in Pavement Construction: An Example of Creative Waste management," Int. Organ. Sci. Res., vol. 05, pp. 1–57, 2015, [Online]. Available: www.iosrjen.org.

[7] Sultana, S. K. A., Prasad, K. S. B. and Sultana, S.A., and Prasad, K. S. B. (2012) 'Utilization of Waste Plastic as a Strength Modifier in Surface Course of Flexible and Rigid Pavements.