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Utilization of Waste (Plastic) Material in Road Construction

Rajiv Pazare[1], Bhagyashree Chelani[2], Swati Gedam[3], Sakshi Rana[4], Rohit Tembhare[5], Rohit Meshram[6], Rushikesh Garodi[7]

[1, 2]*Assistant Professor, Department of Civil Engineering, Priyadarshini College of Engineering, Nagpur, Maharashtra, India*
[3, 4, 5, 6, 7]*Student, Department of Civil Engineering, Priyadarshini College of Engineering, Nagpur, Maharashtra, India*

Abstract: ***The disposal of plastic garbage is the most serious issue this type of garbage is not biodegradable. In the developing countries disposal of plastic garbage is also one of the challenging issues and in the developing countries like India such type of garbage disposal problem has been encountered. The most suitable method of utilization of these waste materials is to adopt them in road construction, which is both economical and durable. With the help of the presentation, we are attempting to introduce various ways in which plastic can be utilized, and because our project is primarily focused on plastic roads, we've also gone over the many processes to take while using plastic on roads. With this technology, a major problem of plastic waste disposal may be tackled at the same time. Using plastic in roadways boosts the strength and longevity of roads while also being cost-effective, pollution-free, and safe. Plastic technology encompasses a wide spectrum of applications. Since this can be used to make textiles, rail sleepers, and plastic can also be used as a construction material, if plastic roads become more common, the demand for transportation engineers who are familiar with this technology will expand. Increased demand for plastics will result in more plastic pickers being employed, therefore resolving the job issue.***

Keywords: ***Environmental Pollution, Waste Material, and Road Pavement***

I. INTRODUCTION

When adjusted for population size, India has fewer than 3.8 kilometers of road per 1,000 inhabitants. This applies to both paved and unpaved roads. The use of municipal plastic waste as a binder in flexible pavements is one such way. It primarily consists of residential or domestic waste, although it may also include commercial or industrial waste. Municipal plastic garbage accounts for 65-75 percent of India's total plastic waste production. The coastal population is a major polluter, dumping up to 3.53 million tonnes of plastic trash into the waters each year. The procedure for paving a plastic road begins with the collection of plastic trash (bags, cups, and thermocol) made of PE, PP, and PS, which is segregated, cleaned if necessary, and shredded into small pieces (passing through a 4.35mm sieve). In the Mini Hot Mix Plant, the aggregate (granite) is heated to 170°C before the shredded plastic waste is added, softening and coating the aggregate. When compared to roads made of regular asphalt, the durability of roads made of plastic waste is significantly higher. Plastic waste mixed roads have been found to be superior to traditional roads. Plastic's binding property extends the life of the road while also increasing its strength, allowing it to handle greater loads. Many poor countries have been considering the use of plastic trash in road construction in recent years with great enthusiasm. Data on plastic consumption and trash creation show that there are two types of plastics: (a) thermoplastics and (b) thermosetting plastics. Thermoset plastics are a type of thermoplastic. Thermoplastics account for about 80% of all post-consumer plastic waste created, whereas thermoset accounts for about 20%. Plastic waste disposal is a big issue. The burning of these discarded plastic bags pollutes the environment. Laboratory tests confirm that waste plastic improves the properties of the mix. Bitumen roads made of plastic waste disposal are a big issue. The burning of these discarded plastic bags pollutes the environment. Waste plastic, according to studies, improves the mix's properties.

II. METHODOLOGY

Roads, garbage trucks, dumpsites, and compound plants were used to collect waste plastic bags, which were sold to waste buyers for Rs. 5–6 per kg. Household plastic, such as empty milk bags and used plastic bags, was also collected for the project's work. The collected plastic waste was separated according to thickness requirements. In most cases, 60-micron polyethylene is employed in the subsequent step. At higher temperatures (160–170 °C), less micron plastic easily dissolves in the bitumen. It can be cleaned by de-dusting or washing if necessary. As much as possible, the collected plastic was chopped into fine bits. The plastic bits were sieved through a 4.75mm sieve and then gathered at a 2.36mm sieve.

To begin with, bitumen was heated to a melting temperature of 160 °C to 170 °C. Pieces were gently put on the heated bitumen, which was around 160–170°C. For around 20–30 minutes, the mixture was manually mixed. Temperatures were kept steady between 160 and 170 degrees Celsius during that time period.

Waste Plastic	Origin
Low Density Polyethylene (LDPE)	Bags, sacks, milk pouches, bin liners, and cosmetic and detergent bottles
High Density Polyethylene (HDPE)	Bags, bottle tops, and other household items
Polyethylene Terephthalate (PET)	Bottles of water for drinking, etc.

Table-1

A. Collection of Waste Plastic

Waste plastic is collected from roadways, garbage trucks, dumpsites, and compost plants, as well as from school collection programs, or purchased for Rs. 5–6 per kg from rag-pickers or waste-buyers.

B. Cleaning and Shredding of Waste Plastic

Thin-film carry-bags and use-and-throw cups are examples of waste plastic litter. These are sorted and de-dusted PET bottles, among other things. If required, wash the garments. Plastic garbage that has been cleaned is shredded to a size of 1.18 mm.

C. Central Mixing Plant Mixing of Shredded Waste Plastic, Aggregate, and Bitumen

1) At the central mixing plant, the aggregate mix is heated to 165 °C (as per HRS specifications). In the same way, the bitumen should be heated to a maximum of 160°C.

2) An 8% waste plastic to bitumen weight ratio is added to the conveyor belt, or a specific mechanical mechanism is constructed to spray the plastic inside the chamber to efficiently coat the plastic.

3) A central mixing plant allows for improved temperature control and material mixing, resulting in a more uniform coating. Heated bitumen is also sprayed.

D. Bituminous Mix Laying

The plastic trash-coated aggregate is mixed with hot bitumen and utilized in road building. The temperature for laying the roads is between 1100 °C and 1200 °C. The roller in question has an 8-ton capacity.

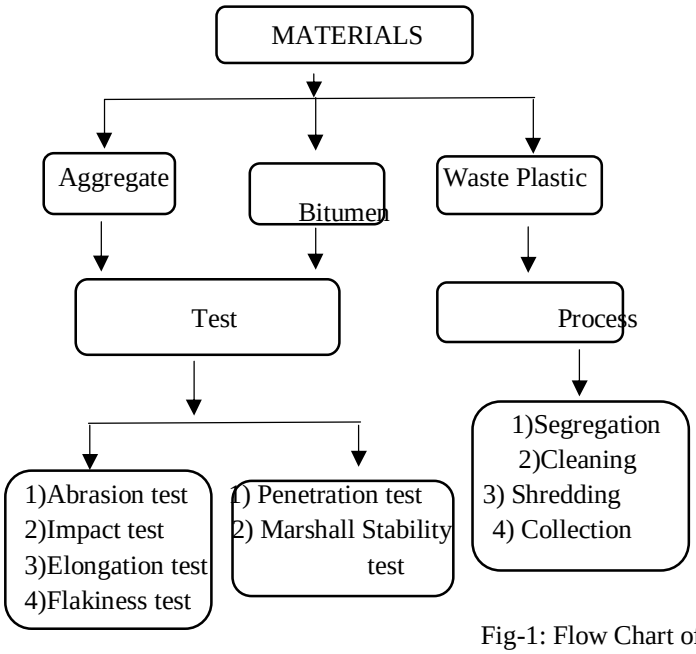

Fig-1: Flow Chart of Methodology and Testing

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III. TESTING AND RESULTS

A. Aggregates

Sr. No.	Test	Permissible value
1	Test of shipping (max)	25%
2	Absorption of water (except in the case of slag) max	1%
3	Soundness test: 5 cycles of sodium sulfate loss (in case of slag only) max	12%
4	Bulk density or weight unit (in slag alone)	1120 per m3

Table-2

Test On Aggregate with and Without Plastic Coating

B. Impact Test

Description	Sample	
	Normal Aggregate	Plastic Coated Aggregate
Weight of dry sample (gm) 'W1'	540	540
Weight of sample passing through 2.36 sieve 'W2'	102	60
Impact Value $\frac{W2}{W1} \times 100$	18.88 %	11.11 %

Table-3

The impact value of aggregate is 11.11%, it is more suitable for road construction.

C. Los Angeles Abrasion Test

Description	Sample	
	Normal Aggregate	Plastic Coated Aggregate
Weight of total material (kg) 'W1'	5	5
Weight of fraction passing through 1.7mm sieve 'W2'	1.215	0.502
LA Abrasion Value $\frac{W2}{W1} \times 100$	24.30 %	10.04 %

Table-4

The Los Angeles value of plastic-coated aggregate is loss only 10.04%

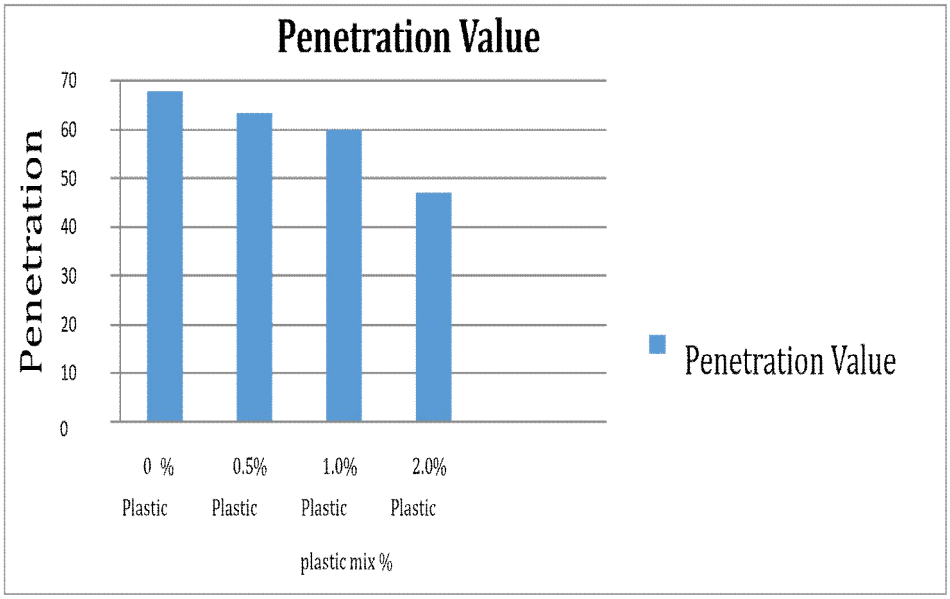
Fig-2: Plastic Coated Aggregate

D. Penetration Test

A different percentage of plastic (percent) was added to the original bitumen in this test. The test revealed that the penetration value varies with the proportion of plastic modified bitumen added and that uniformity improves with the addition of plastic.

% of polymer added	Penetration Value
0	67
0.5	64
1.0	60
2.0	47.6

Table-5



Penetration value with plastic mixed Bitumen

Fig -3: Penetration value with plastic mixed bitumen

E. Marshall Stability Test

In this test, the results of conventional bitumen specimens and plastic-modified bitumen specimens with varying percentages of plastic admixture are compared. For each varied percentage of bitumen, three specimens were prepared and examined in a Marshall Testing Machine. The Optimal Bitumen Content (OBC) is calculated by averaging the percentage of bitumen with the highest Marshall Stability, Density, and 4% air void bitumen content.

Fig-4: Mixing of Bitumen

Fig-5: Fill MixBitumen in mould

Fig-6: Demoulded Specimens

Fig-7: Marshall Stability

% Plastic	4%	6%	8%
% Bitumen Content	4.5%	4.5%	4.5%
Weight of core in Air (gm)	1270	1271	1275
Weight of core in Water (gm)	760	752	765
Saturated surface dry core weight (gm)	1288	1280	1289
Volume of core	528	528	524
Density of core (gm/cc)	2.40	2.407	2.43
Marshall Stability (KN)	9.30	12.12	14.30
Flow Value	3.102	3.187	3.219

Table-6

The high stability value is 14.30 at 8% of plastic.

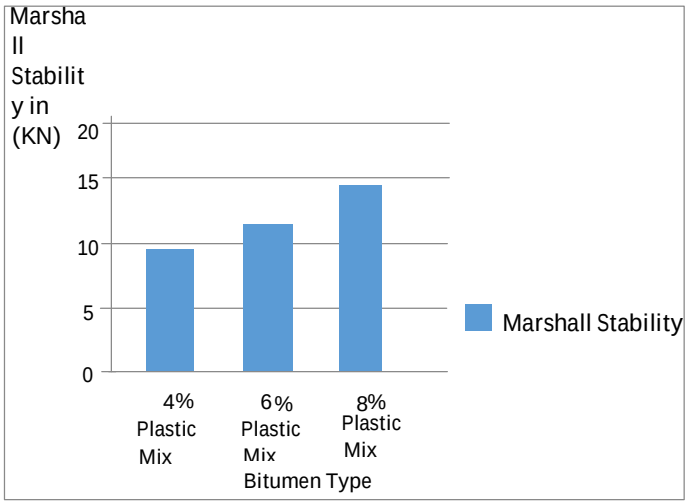


Fig -8: Graph of Marshall Stability of different types of Bitumen

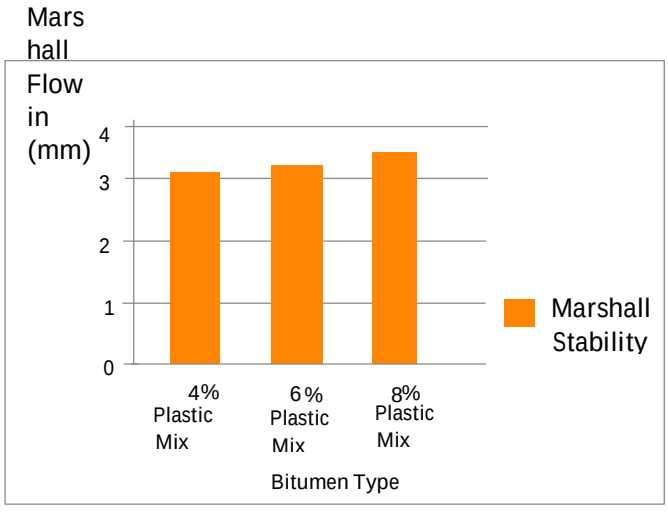


Fig -9: Graph of Marshall a Flow value of different types of Bitumen

IV. CONCLUSIONS

1) After carrying out the test, the elongation index of the collected sample is determined. The flakiness index of the collected sample is determined by knowing the elongation index is 17.7%. By knowing the average index of about 7.49%, the sample collected is very suitable for bitumen mix.

2) The water absorption value of an aggregate is 0.65%, making it suitable for road construction. And the specific gravity is 2.88, making it suitable for road construction. As per IS 1124.

3) The average impact value of a normal aggregate is 18.88% and the average impact value of a plastic-coated aggregate is 11.11%. The plastic-coated aggregate is more useful and suitable for road construction.

4) The Los Angeles Abrasion Test results indicate that the abrasion degradation of the normal aggregate is 24.30% and the plastic-coated aggregate is 10.04%. meaning that plastic coated aggregate had a tendency to lose only 10.04% of its original mass.

5) The grade of bitumen is 60/70 grade and after adding % of the polymer, the penetration value decreases from 64 at 0.5%, 60 at 1.0%, and 47.6 at 2.0% with the original value being 67. The decrease in penetration value indicates that the strength of bitumen has increased, which is due to better binding between the molecules of bitumen.

6) In the Marshall Stability test, the high stability value is 14.30 at 8% of plastic. The Marshall Stability has increased significantly for the PE-modified bitumen. This also indicates that the pavement can serve better for a long time and at high traffic loads it will have less deformation compared to unmodified bitumen.

REFERENCES

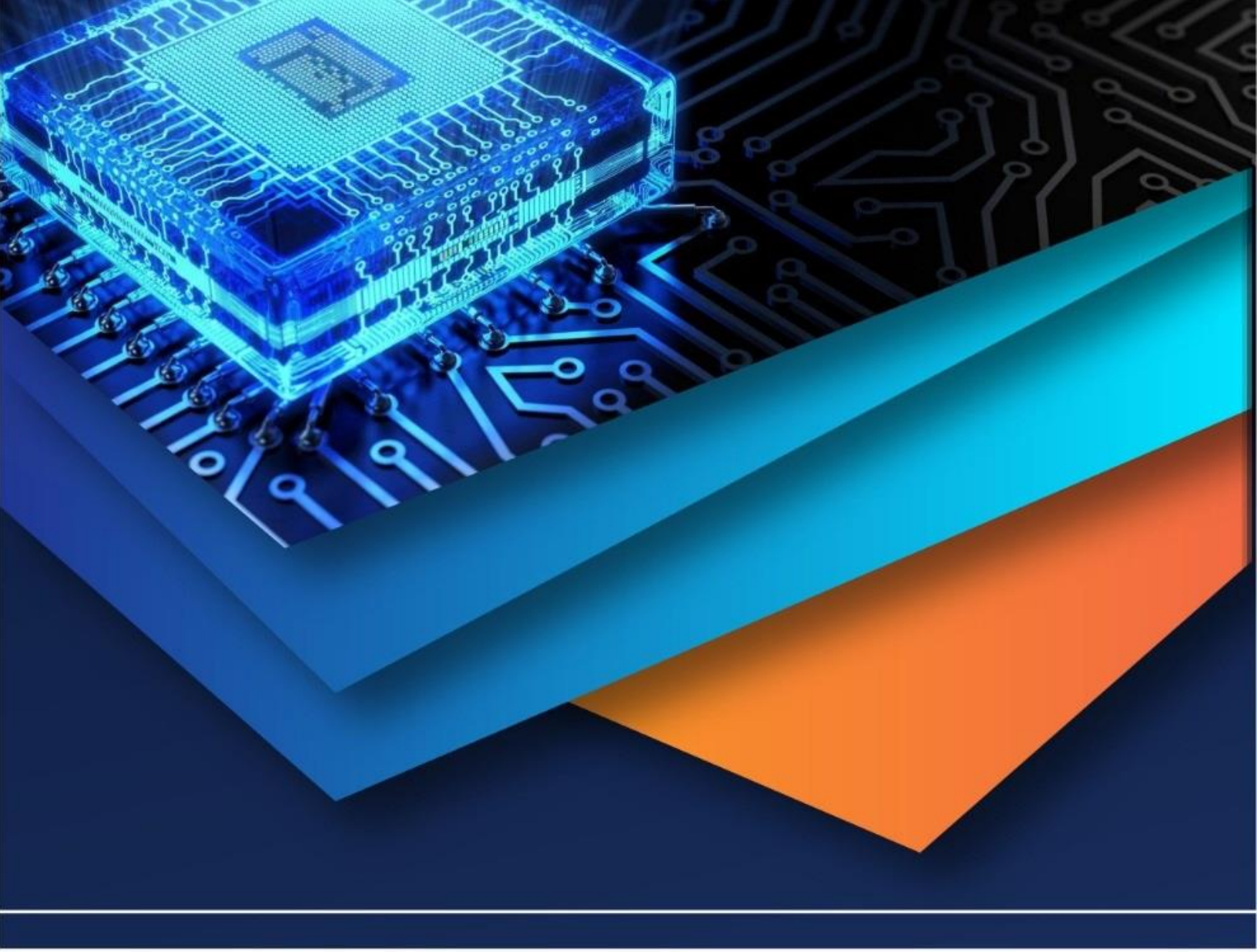
[1] Johnson Kwabena Appiah, Victor Nana Berko-Boateng, Trinity Ama Tagbor "Use of Waste Plastic Materials for Road Construction in Ghana", a case study in construction materials 6(2017)1-7.

[2] Amit Gawande, G. Zamare, V.C. Renge, Saurabh Tayde, G. Bharsakale "An Overview On Waste Plastic Utilization in Asphalting of Roads", Journal of engineering research and studies E-ISSN0976-7916Vol. 3/Issue, 2/April-June, 2012/01-05.

[3] Imran M. Khan, Shahid Kabir, Majed A. Al-Hussain, Feras F. Almansoor "Asphalt Design using Recycled Plastic and Crumb-rubber Waste for Sustainable Pavement Construction", Procedia Engineering 145(2016).

[4] Apurva J. Chavan- "Use of Plastic Waste in Flexible Pavement", - ISSN 2319-4847, Volume 2, Issue 4, April 2013.

[5] Ayush Verma – "Utilization of Recycled Plastic Waste in Road Construction", (IJERT) ISSN:2278-0181, Vol.10, Issue 5, May-2021.



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