International Scientific Journal of Engineering and Management (ISJEM)
Volume: 04 Issue: 05 | May – 2025
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata
ISSN: 2583-6129
DOI: 10.55041/ISJEM03600

USE OF PLASTIC BOTTLE IN A DENCE BITUMINOUS MACADAM LAYER OF FLEXIBLE PVEMENT

SHREYAS M S, BINITH GOWDA K C, KARTHIK B P, MOHAMMED JUNED

MOHAMMED JUNED CIVIL ENGINEERING
SHREYAS M S CIVIL ENGINEERING
BINITH GOWDA K C CIVIL ENGINEERING
KARTHIK B P CIVIL ENGINEERING

Abstract – Today, plastic waste and its disposal Such as wrappers of chocolate, chips, carry bags, cold drink bottles and all other forms of plastic create significant environmental and economic problems. The plastic waste is shredded & coated over the aggregate and mixed with hot bitumen and the resulted mix is used for pavement construction this mix will not only strengthen the pavement and also increases its durability. The main objective of this paper is to discuss the importance of plastic in terms of cost reduction, increases the strength and durability when these plastics are heated and coated upon the aggregates to reduce the air voids with plastic and binds with aggregate to provide stability. It's economical and eco-friendly. Use of plastic is rapidly increasing in daily life due to increase in rapid rate of urbanization and development. The waste plastic and its disposal are a major threat to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength.

***Key Words*:** coarse aggregate, fine aggregate(stone dust), marshal stability.

1. INTRODUCTION

Nowadays, incorporating recycled materials into road pavements is not only seen as a sustainable choice but also as an attractive option that enhances performance during service. The use of plastic that is 5–10% of bitumen improves the Marshall stability, strength, fatigue life, and other required properties that go a long way to increase the lifespan of the road whereas some bitumen is saved too. Plastics, predominantly consisting of High-Density Polyethylene (HDPE), Polyethylene Terephthalate (PET), and Polypropylene (PP), are extensively used in packaging. However, the disposal of large quantities of plastic bags has posed a problem due to their non-biodegradable nature. Several studies have been conducted to explore the potential utilization of waste plastic bags and plastics in general for asphalt mixtures. Depending on their chemical composition and physical properties, these materials have been employed as modifiers for binders or as coatings for aggregates. The results have been promising, demonstrating an improvement in the performance of the modified bituminous mixes.

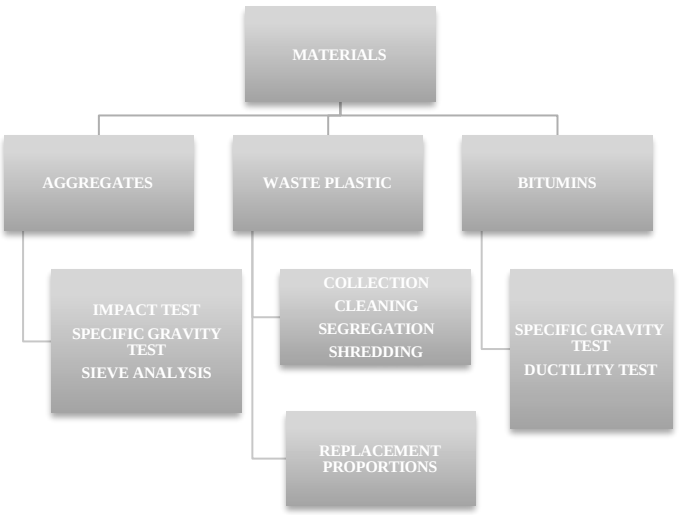
2. LITERATURE REVIEW

DR. R VASUDEVAN (2017): Polymer bitumen blend is better binder to plain bitumen. Blend has increased softening point decreased penetration value with suitable ductility. An Indian scientist who has worked mainly in waste management.

Yash Menaria, RupalSankhla, (2016):,It is made up of various chemical elements and is regarded as a highly pestilent material which does not easily degrade in the natural environment after its usage. Waste plastics are made up of Polyethylene, Polystyrene and Polypropylene. Temperature varying between 120˚C - 160˚C gives the softening point of these plastics.

Mr. Mahesh M Barad(2015),It is necessary to utilize waste effectively with technical development in each field. Many by-products are being produced using the plastic wastes. Plastic waste, consisting of carry bags, cups and other utilized plastic can be used as a coating Cover aggregate and this coated stone can be used for road construction.

3. METHODOLOGY



International Scientific Journal of Engineering and Management (ISJEM)
Volume: 04 Issue: 05 | May – 2025
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata
ISSN: 2583-6129
DOI: 10.55041/ISJEM03600

Materials Selection:

Waste Plastics: Commonly used plastic water waste. (size 2.36mm).

Bitumen: A viscous material used as a binder in road construction. (Grade VG-30).

Aggregates: Coarse Aggregates (size 10 to 20mm) and Fine Aggregates (size 4.75mm) are used as the base material for the macadam and aggregates test conduction specific gravity, sieve analysis and moisture content

Preparation Steps:

Collection of Plastic Waste - Plastic waste is collects from BGSIT Campus.

Segregation of Plastic Waste - Plastic Waste is segregated by Low Density Polyethylene and chemical behaviour test in Mysore university.

Cleaning and Drying Process - Plastic Waste is cleaned by water. Cleaned plastic waste is dried by kept it in sunlight for a day.

Shredding of Plastic Waste - It is completed by with the help of shredding machine of Waste Processing Plant. Shredded size of plastic is about 2.36 mm.

Mixing with Bitumen - Shredded plastic waste is mixed with bitumen about 5 percent.

Heating Process - Polymer modified bitumen is heated for testing and heated to temperature of around.

Heat Aggregate at Temperature from 150°C-160°C

Heat Bitumen at temperature from 155°C-165°C

Set mixing temperature from 145°C-160°C

Testing - Test for conducted from Vidyavardhaka Engineering college in Mysore

1. Marshal stability test.

TABLE 1 TEST RESULT OF AGGREGATE

Designation	Test result	Test method
Aggregate Impact Value Test	11.28%	IS: 2386 Part IV
Specific Gravity of Aggregates (12.5 mm)	2.68	IS: 2386 Part III
Specific Gravity of Aggregates (10 mm)	2.71	IS: 2386 Part III
Specific Gravity of Aggregates (6 mm)	2.69	IS: 2386 Part III
Specific Gravity of Fine Aggregates	2.74	IS: 2386 Part III

TABLE 2 TEST RESULT ON BITUMIN

DESCRIPTION	RESULT
Specific gravity of bitumen	1.10
Ductility test	76cm

MARSHAL STABILITY TEST

The test for conducted from Vidyavardhaka Engineering college in Mysore. The Marshall specimens were kept in water bath These are called conditioned specimens. The specimens kept in thermostatically controlled water bath maintained at 60#1°C for 30 to 40 minutes are called unconditioned specimens. The flow value is the deformation that the test specimen undergoes during loading up to the maximum load. In India, it is a very popular method of characterization of bituminous mixes due to its simplicity and low cost. In the present study the Marshall properties such as stability, flow value, unit weight and air voids were studied to obtain the optimum binder contents (OBC) and then compare mixes to check addition of which of the additive mentioned gives more stability.

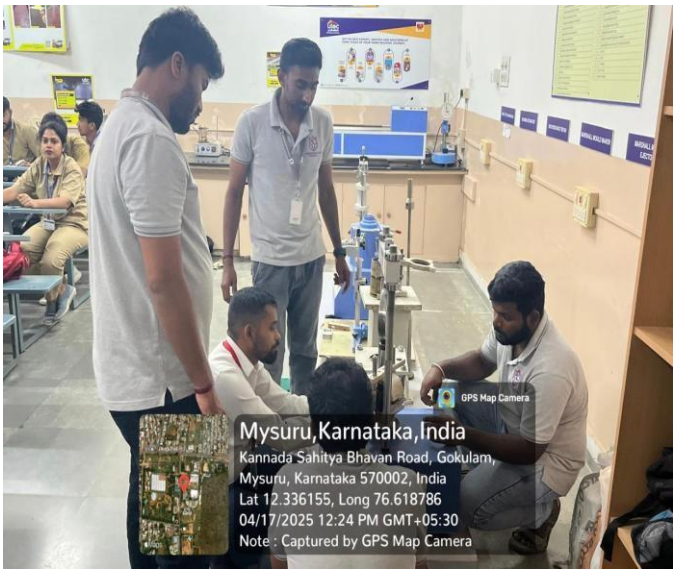
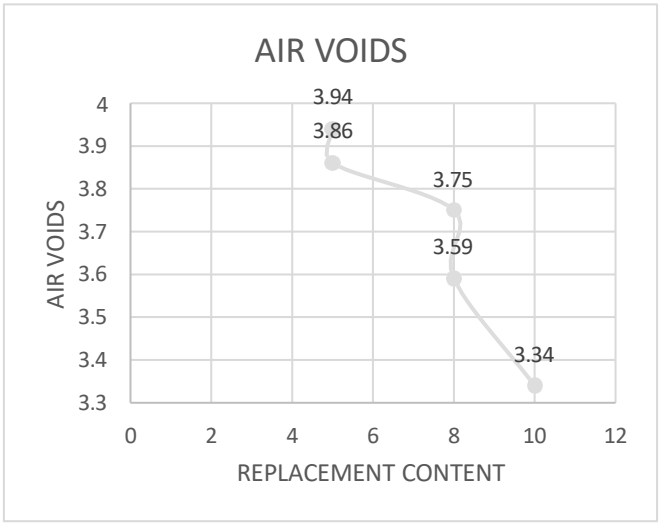


Fig -1: MARSHAL STABILITY TEST

International Scientific Journal of Engineering and Management (ISJEM)
Volume: 04 Issue: 05 | May – 2025
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata
ISSN: 2583-6129
DOI: 10.55041/ISJEM03600

Table 3 Results of Bitumen Mix Sample

REPLACEMENT CONTENT %	DENSITY	AIR VOIDS	VMA %	VFB	STABILITY(KN)	FLOW(MM)
5	2.377	3.94	18.585	78.8	8.252	3.08
5	2.396	3.86	18.235	78.832	10.213	2.9
8	2.418	3.75	17.955	79.115	12.843	2.82
8	2.41	3.59	17.641	79.646	11.25	2.83
10	2.368	3.34	17.186	80.566	10.52	2.872



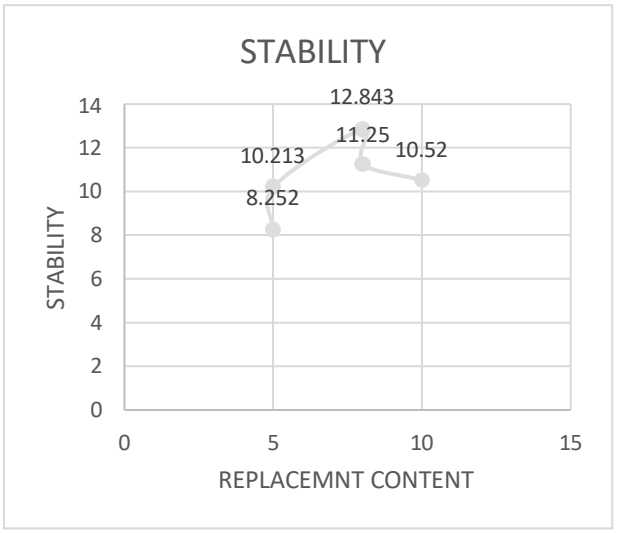
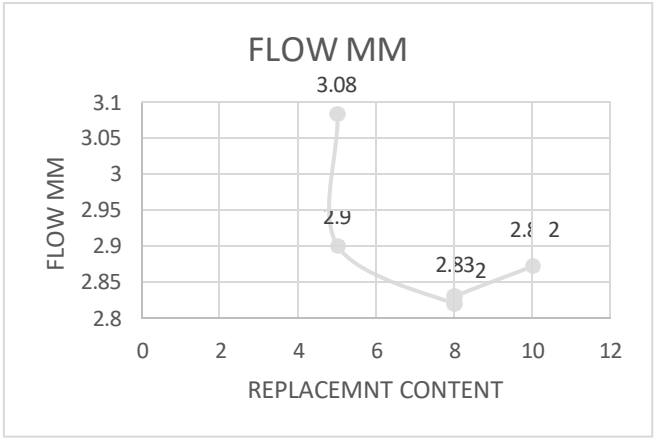
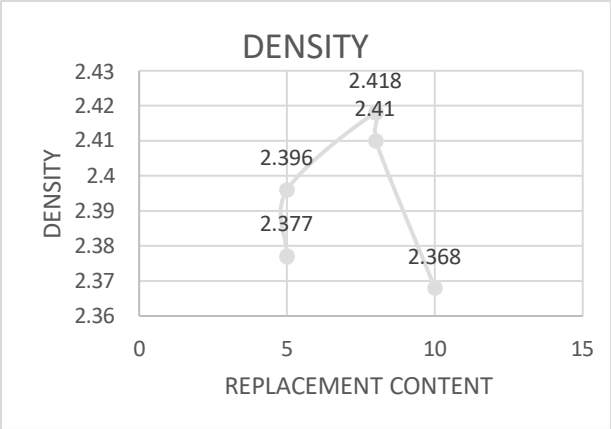


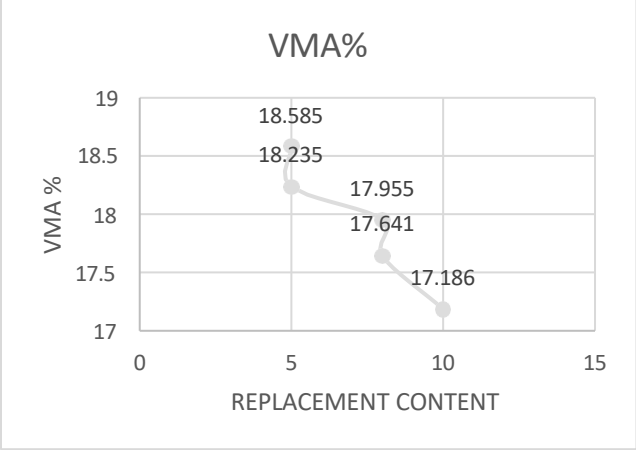
Table 4 Properties of the DBM mix at optimum Bitumen content(5%)

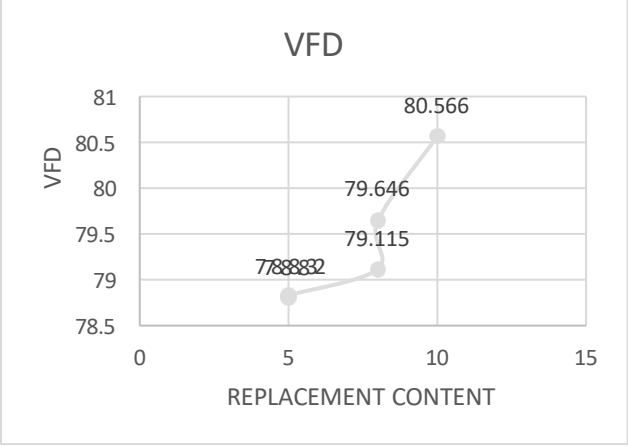
Design parameters	Value	Units
Stability	12.843	KN
Flow	2.82	mm
Density	2.418	gm/cc
Air voids	3.75	%
Voids in mineral aggregate	17.95	%
Voids filled with bitumen	79.115	%



ISSN: 2583-6129
DOI: 10.55041/ISJEM03600







4. CONCLUSIONS

Use of the innovative technology not only strengthened the road construction but also increase the road life

It has been observed that 10% use of waste plastic in DBM mix gives Optimum results of Marshall stability and other properties of the mix.

Use of waste plastic in flexible pavements shows good result when compared with conventional flexible pavements. The polymer coated on aggregates reduces the voids and moisture absorption.

The plastic pavement can withstand heavy traffic and also durable than flexible pavement.

The use of plastic mix will reduce the bitumen content by 10% and increases the performance and strength of the road.

It shows that with the increase of plastic waste in bitumen increases the properties of aggregate and bitumen.

This technique is very eco-friendly as it uses the waste plastic which is being disposed in oceans, landfills etc.

ACKNOWLEDGEMENT

The author is very great thankful to Mrs. Navyashree H R for her guidance, and advice which helped to improve the present paper; Shreyas M S, Binith gowda K C, Karthik B P, Mohammed juned for reading the paper and giving valuable suggestions to improve the paper.

REFERENCES

1.G. Paul Pandi, S. Raghav, D. Tamil Selvam, "Utilization of Plastic Waste in Construction of Roads", International Journal of Engineering Science and Computing, Volume 7 Issue No.3, 2017.

2. Rajesh Mishra, "Use of Plastic Waste in Bituminous Mixes of Flexible Pavements by Wet and Dry Methods: A Comparative Study", International journal of modern engineering research, 2016.

3. Prasad, A. R., & Sowmya, N. J. (2020). Bituminous modification with waste plastic and crumb rubber. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 12(3), 108-115.

4. Menaria, Y., & Sankhla, R. (2021). Use of waste plastic in flexible pavements-green roads. Open Journal of Civil Engineering, 5(03), 299.

5. Prasad, K. V. R., Mahendra, S. P., & Kumar, N. S. (2021). Study on utilization of PET (polyethylene terephthalate) waste in bituminous mixes. International Journal of Electronics & Communication Technology, 4(1), 187-190.