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PLASTIC WASTE PARTIALLY REPLACEMENT IN BITUMEN AND MARBLE WASTE PARTIALLY REPLACEMENT IN AGGREGATE

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ABSTRACT

All of us are aware of the environmental problems caused by discarded plastic. To deal with these difficulties, many researchers from different fields are always researching new ways to effectively reuse various types of plastic. Plastic roadways are bituminous roads that use trashed plastic as the wearing surface. They are currently widely used in India. Since the Indian Road Congress (IRC) developed a code of standards on plastic roads (IRC SP: 98–2013), a number of organizations have moved forward to bring about them in India because they are both a sustainable option and an essential one. The Indian Ministry of Road Transport and Highways is currently working on a program to make significant use of discarded plastic. India presently has over 100,000 kilometers of waste plastic-constructed highways, with more regions set to follow. The road network in India has proven to be effective in offering a foundation for the development of the nation's economy. India is a multicultural nation, and its highways serve as a source of unity, providing the glue that brings people together, no matter where possible. India's road network, particularly in places that are farther away, helps development by connecting them to cities nearby and providing access to new regions. Roads in India have aided in the improvement of productivity in some places, as well as the growth of capital and more globally competitive industries. In India, where the climate is hot and humid, plastic plaster is very useful. Prepared with the use of 13 mixing proportions in this study VG-30 bitumen may be used to bind materials together. By using, melted plastic from plastic bags, bitumen has been substituted with varied quantities of 0%, 6%, 12%, 18%, and 24% in this analytical study. A marble piece with a varied proportion of zero to thirty-six percent is used to replace the aggregates in the formula. Testing with melted plastic and aggregates was done for the examination of bitumen and aggregates testing. This can be seen that for most of parameters till 12% addition of melted plastic shows normal result but further addition fluctuate the results. 18% addition of marble waste in coarse aggregate improves the impact, crushing and abrasion values of material.

Keywords: Marble Pieces, Melted Plastic From Polybags, Inventive Binder, Sustainable Pavement Material, Mechanical Property, Functional Pavement.

I. INTRODUCTION

Road transport is frequently the most expensive means of transportation with regard to maintenance and function. This has a major effect on our economy. Traffic is a mode of transport for a lot of people. Import traffic is decreasing. The use of vehicles has grown significantly as a result of the sharp growth in traffic. Road transport is the transport of both individuals and goods across a network of roads. A road is a path that links two sites and has been built or renovated to allow both motorized and non-motorized vehicles. Road transport refers to moving people and goods along a road network. Road is a path that connects two points and has been paved or improved to allow travel in both motorized and non-motorized carriages. Comparing road transit to other modes of transport, there are many benefits. In comparison to other forms of transportation like trains and planes, road transportation requires a far smaller expenditure. Compared to railroads, highways are less expensive to build, operate, and maintain.

Bitumen

Bitumen is a substance made by refining crude oil. Bitumen is frequently utilized in construction, notably for roads and highways, because of its moisture and adhesive features. The process of distillation separates lighter parts of crude oil, such as diesel and gasoline, and leaves only the heavier asphalt. Bitumen is a byproduct of crude oil. It includes calcium, iron, sulfur, and oxygen and is made up of complicated hydrocarbons. The type and origin of crude oil utilized to produce a substance impacts its quality and simplicity of manufacture. It was initially utilized for its repellent to water and adhesive characteristics, which made it ideal for sealing boat

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bottoms and bonding construction equipment. This is also used as a medication. Bitumen is used in road construction because of its numerous benefits over all other paving materials. Bitumen develops various properties as it is manufactured.

Melted Plastic from Plastic Bags

The majority of the polyethylene used to build these roads is common post-consumer material, including product packaging. The most popular polymers for packaging include huge and little density polyethylene, polypropylene (PP), and polyethylene terephthalate (PET or PETE) (HDPE and LDPE).

Marble Pieces

In fact, marble has been used as a building material since ancient times. The management of raw materials for the production of refined marble is today's most important eco-friendly concerns in the world. Marble dust can be used in various industries, including paper, agriculture, glass and construction, to help protect the environment. Marble dust is considered a by-product of the extraction and polishing of marble. Research has shown that marble can be used as a building material. Many developed countries have introduced construction waste management laws to reduce waste and ensure that waste is recycled. Marble dust is a solid waste from marble processing that can be used as a cement filler or fine aggregate in construction.

II. OBJECTIVES

- To enhance the characteristics of bitumen with mix by replacing plastic waste and aggregate with marble pieces.
- To increase the strength, durability and other properties of road construction.
- To overcome the plastic wastes dumped in landfills.

III. METHODOLOGY

In this section, we describe the study and begin the preparation of 13 mixed-measure research papers. VG-30 bitumen was used as a binder in this study. The research project replaced asphalt with 0%, 6%, 12%, 18% and 24% melted plastic from plastic bags. 0%, 9%, 18%, 27%, 36% are replaced by pieces of marble in different percentages.

Table 1: Prepared Samples by Replacement of Bitumen by 6% of Melted Plastic bags

Name of Sample	Melted Plastic bags	Marble Piece
Standard	0%	0%
B-6-A-0	6%	0%
B-6-A-9	6%	9%
B-6-A-18	6%	18%
B-6-A-27	6%	27%
B-6-A-36	6%	36%
B-12-A-0	12%	0%
B-12-A-9	12%	9%
B-12-A-18	12%	18%
B-12-A-27	12%	27%
B-12-A-36	12%	36%
B-18-A-0	18%	0%
B-18-A-9	18%	9%
B-18-A-18	18%	18%
B-18-A-27	18%	27%
B-18-A-36	18%	36%
B-24-A-0	24%	0%
B-24-A-9	24%	9%
B-24-A-18	24%	18%
B-24-A-27	24%	27%
B-24-A-36	24%	36%

Table 2: Standard Marshall Stability Test Result for 18% Optimum Bitumen and Varying Percentage of Aggregate

Name of Sample	Density	% Air Void	% VMA	% VFB	Stability (Kg)	Flow
B-18-A-0	2.610	4.118	14.854	72.870	1116.430	3.400
B-18-A-9	2.688	4.242	15.300	75.056	1149.923	3.502
B-18-A-18	2.741	4.324	15.597	76.514	1172.252	3.570
B-18-A-27	2.793	4.406	15.894	77.971	1194.580	3.638
B-18-A-36	2.714	4.283	15.448	75.785	1161.087	3.536

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Here,

B-Replacement of Bitumen; A= Replacement of Aggregate

IV. RESULT AND DISCUSSION

In this section data concluded from test of aggregates and bitumen comparison made on strength, cost of construction.

Test Result of Bitumen

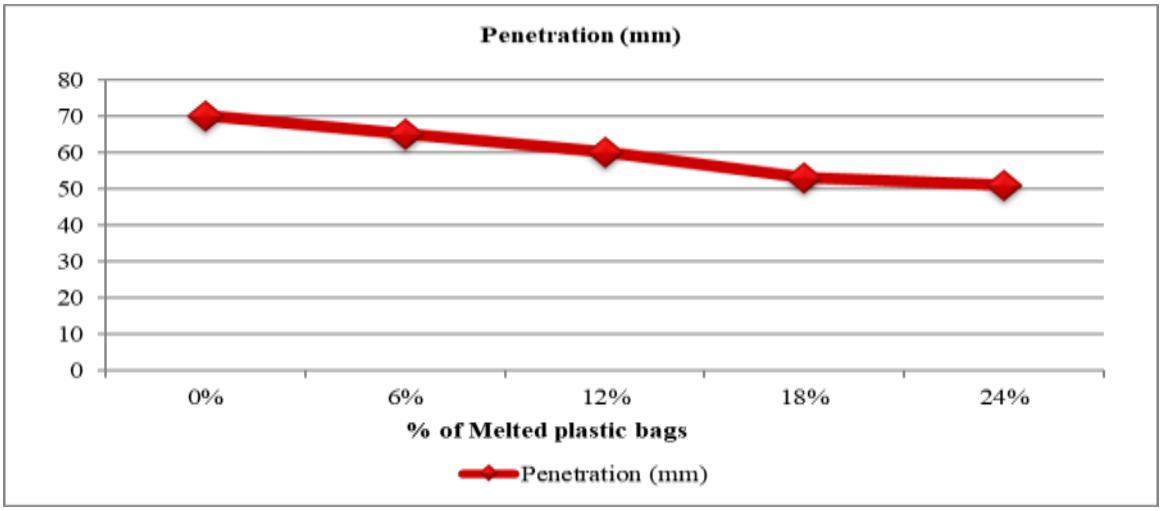

Figure 1: Penetration test of Bitumen Due to varying % of Bitumen Replaced with Melted plastic Bags

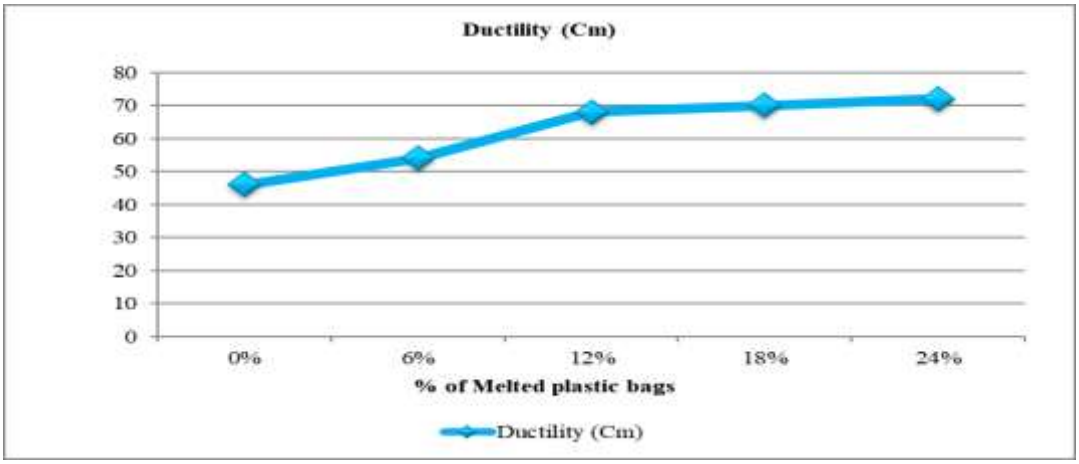

Figure 2: Ductility test of Bitumen Due to varying % of Bitumen Replaced with Melted plastic Bags

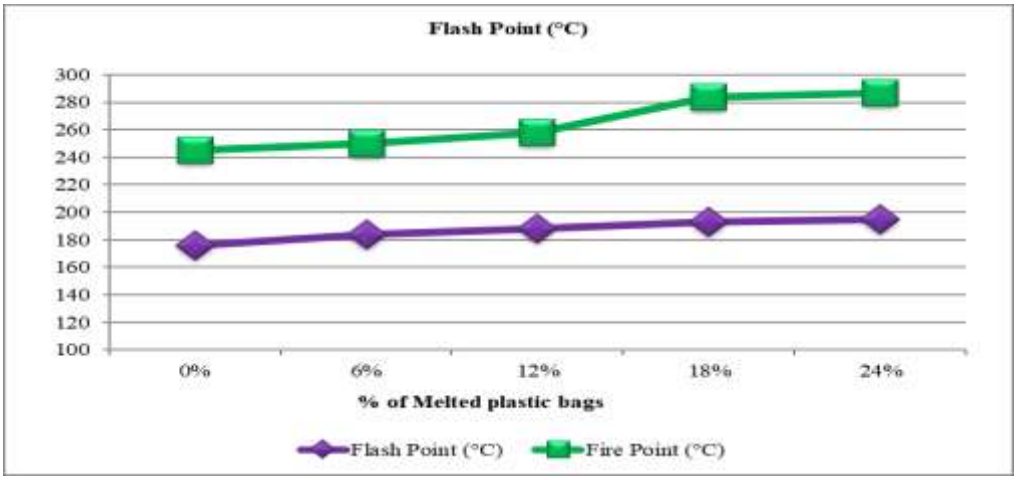

Figure 3: Flash and fire point of Bitumen Due to varying % of Bitumen Replaced with Melted plastic Bags

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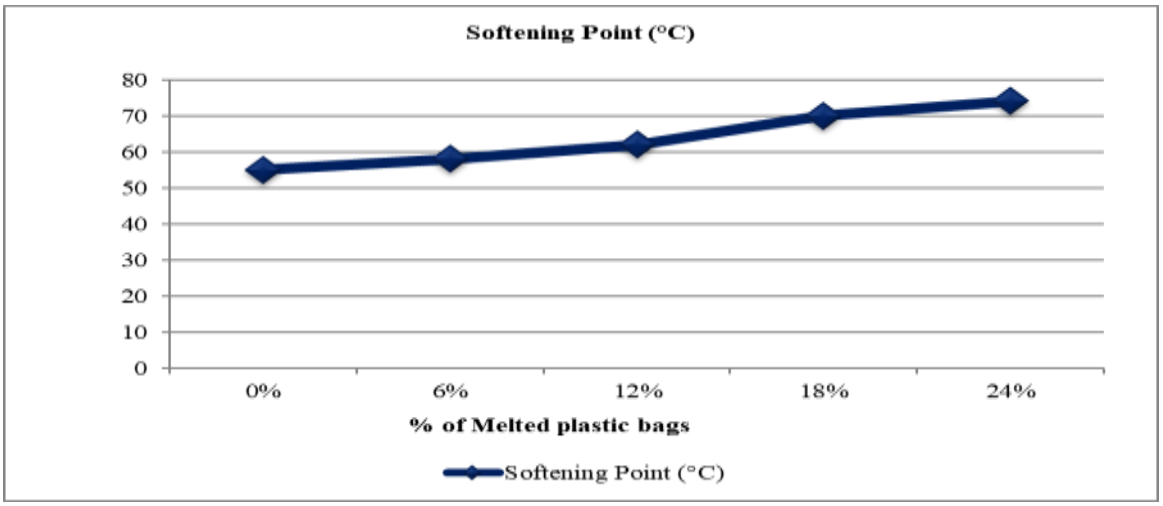

Figure 4: Softening point of Bitumen Due to varying % of Bitumen Replaced with Melted plastic Bags

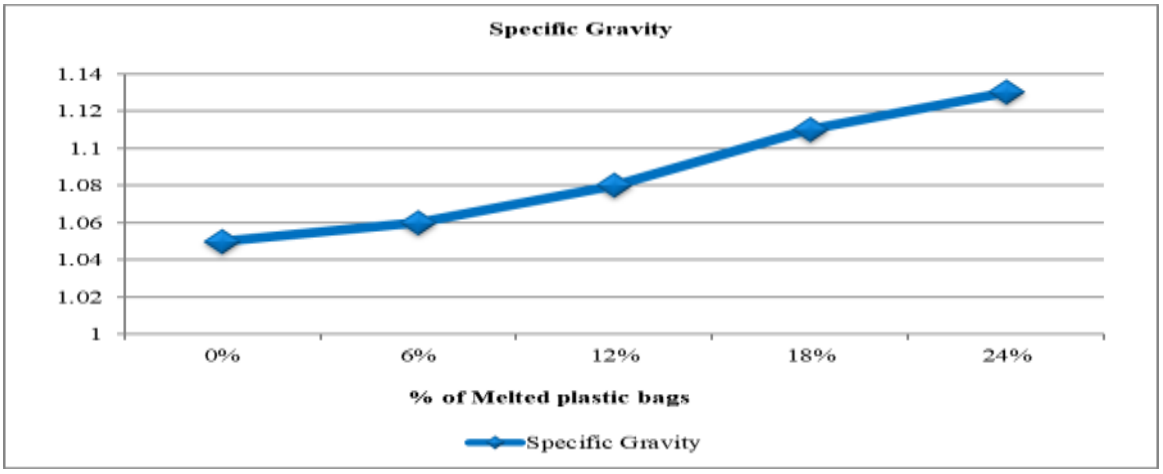

Figure 5: Specific gravity of Bitumen Due to varying % of Bitumen Replaced with Melted plastic Bags

Test Result of Aggregate

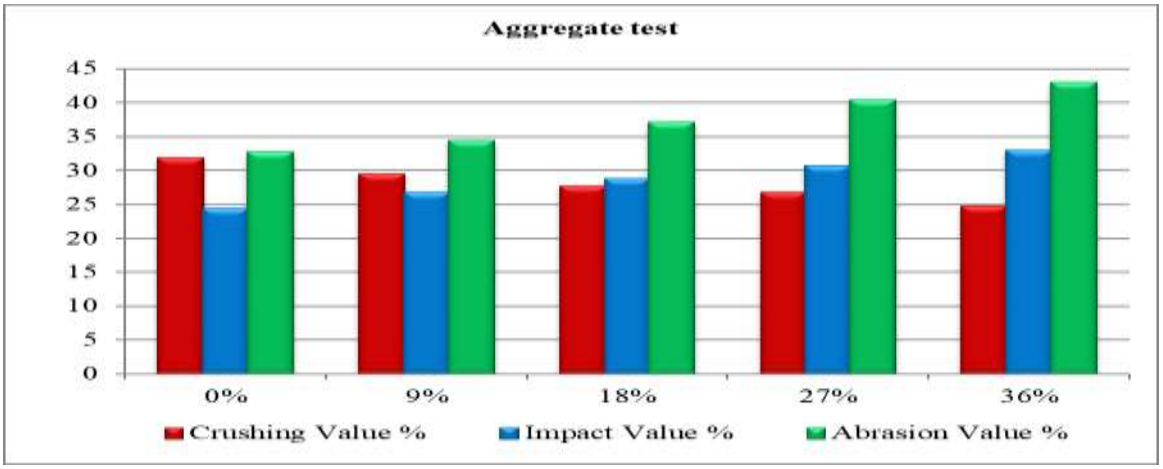

Figure 6: Tests on Aggregate Replaced With Marble Piece

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Test Results of Standard Marshall Stability

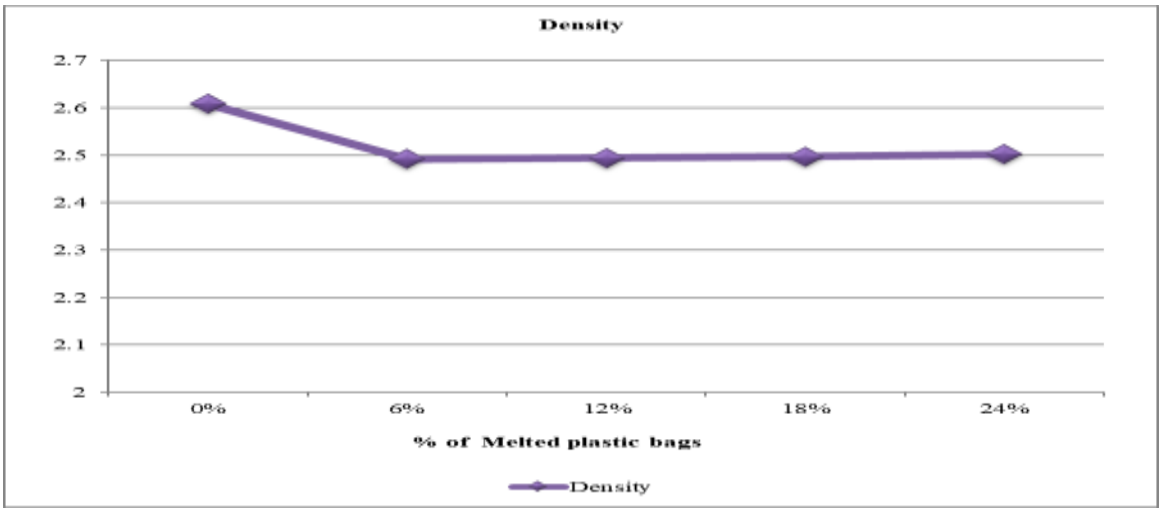

Figure 7: Density test of Melted plastic Bags as replaced by Bitumen

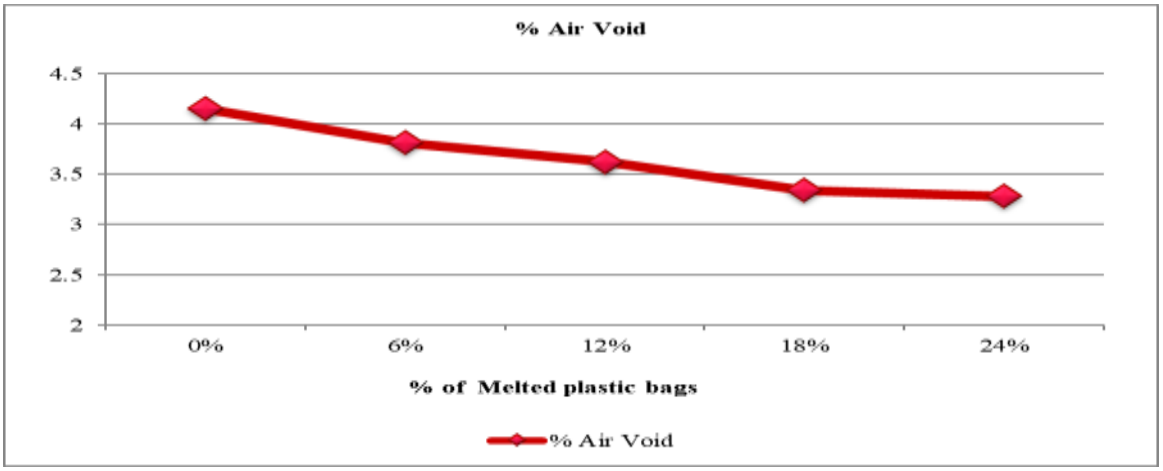

Figure 8: Air Void test of Melted plastic Bags as replaced by Bitumen

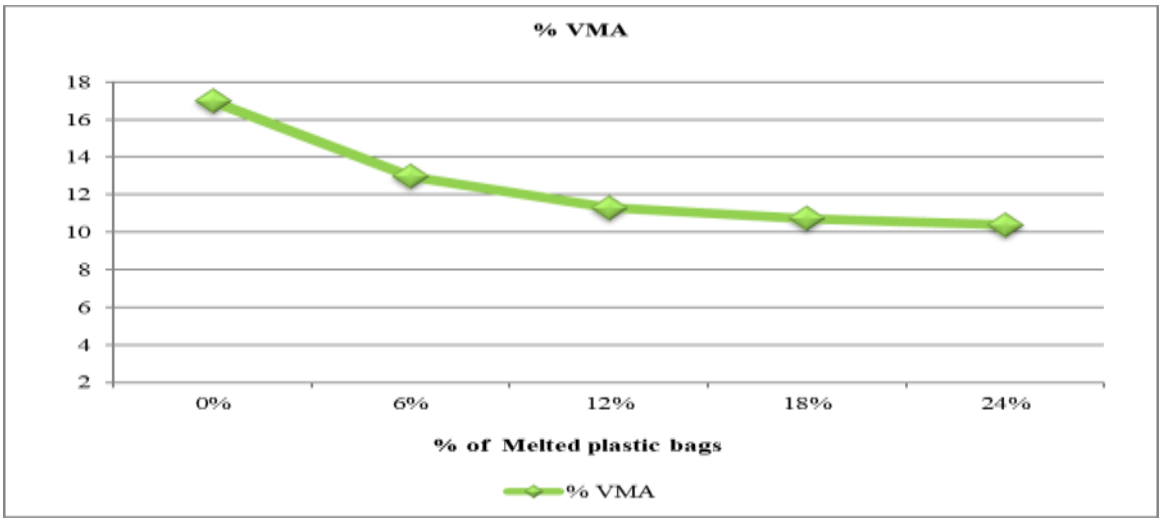

Figure 9: VMA (%) test of Melted plastic Bags as replaced by Bitumen

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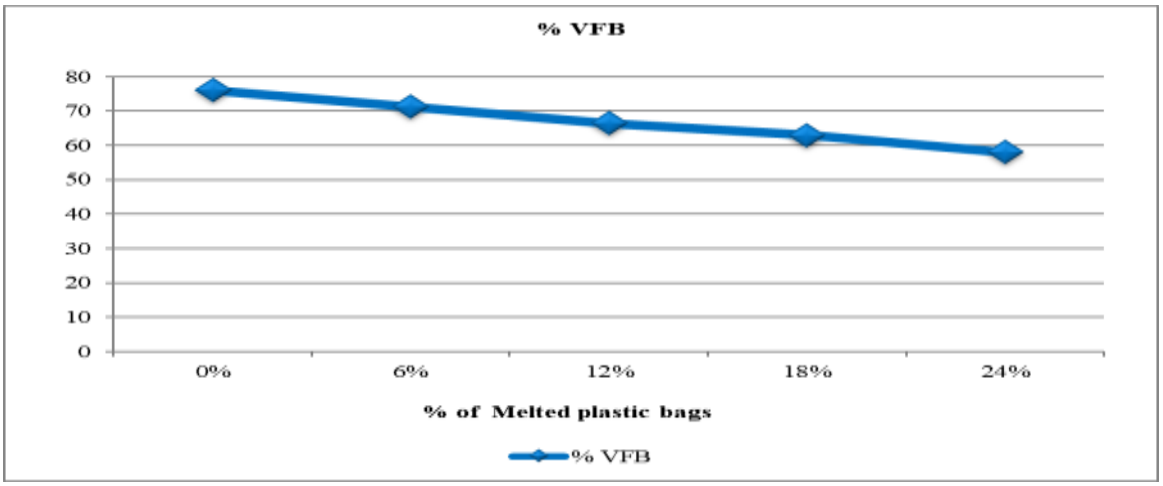

Figure 10: VFB (%) test of Melted plastic Bags as replaced by Bitumen

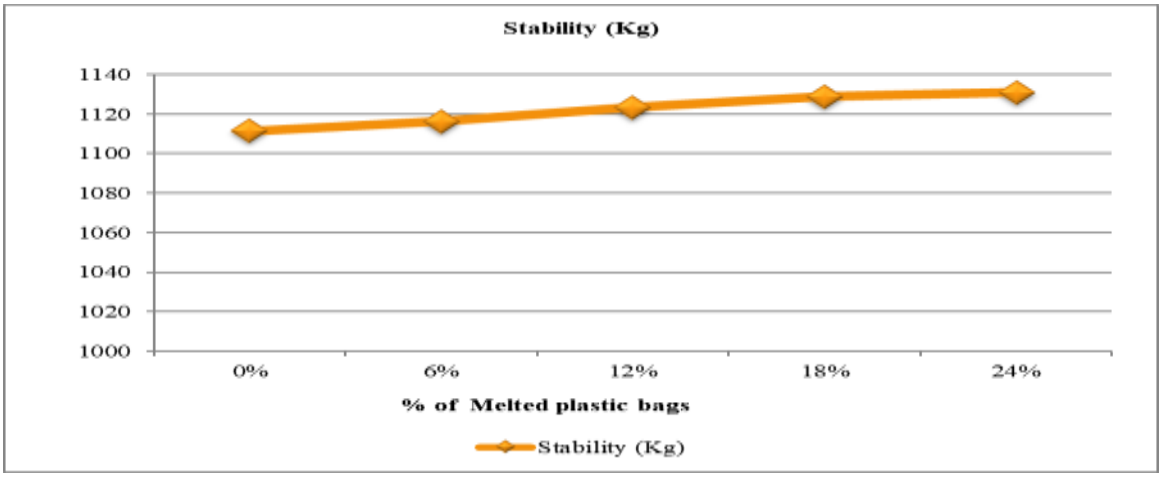

Figure 11: Stability (Kg) test of Melted plastic Bags as replaced by Bitumen

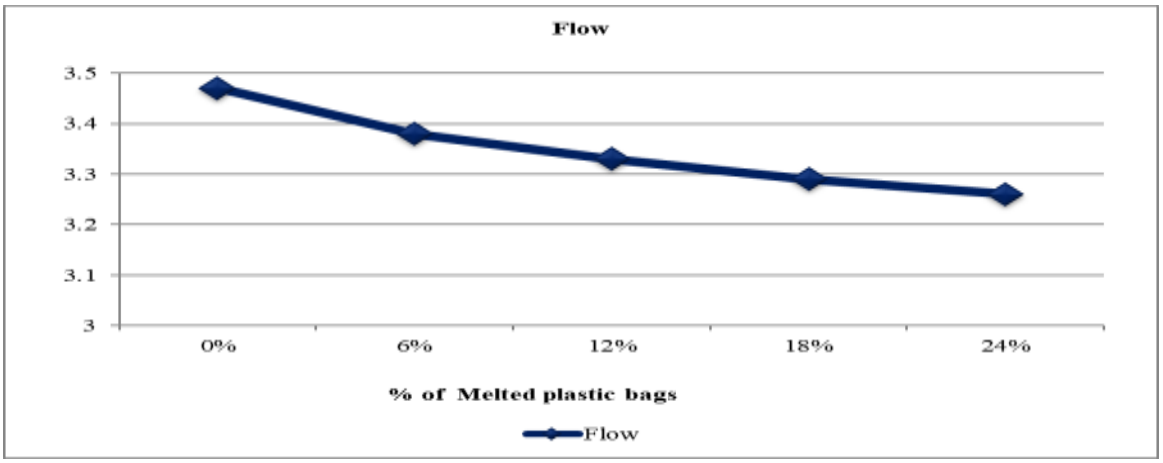

Figure 12: Flow test of Melted plastic Bags as replaced by Bitumen

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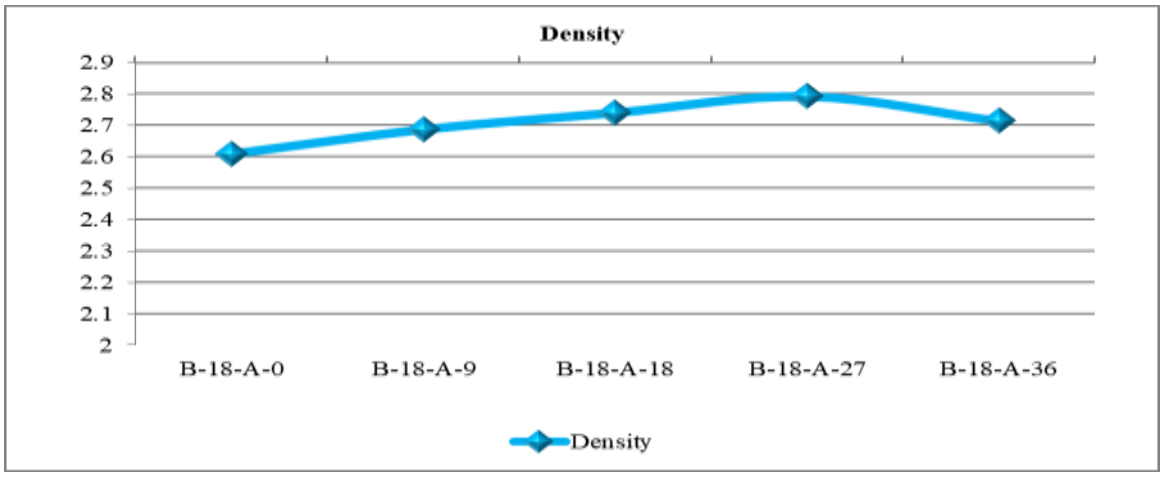

Figure 13: Density of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

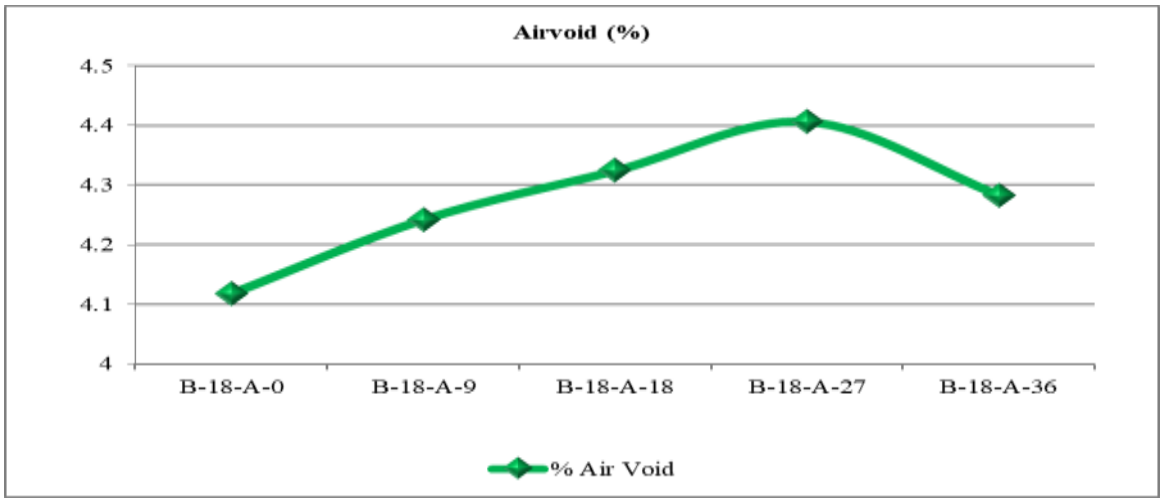

Figure 14: Air void of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

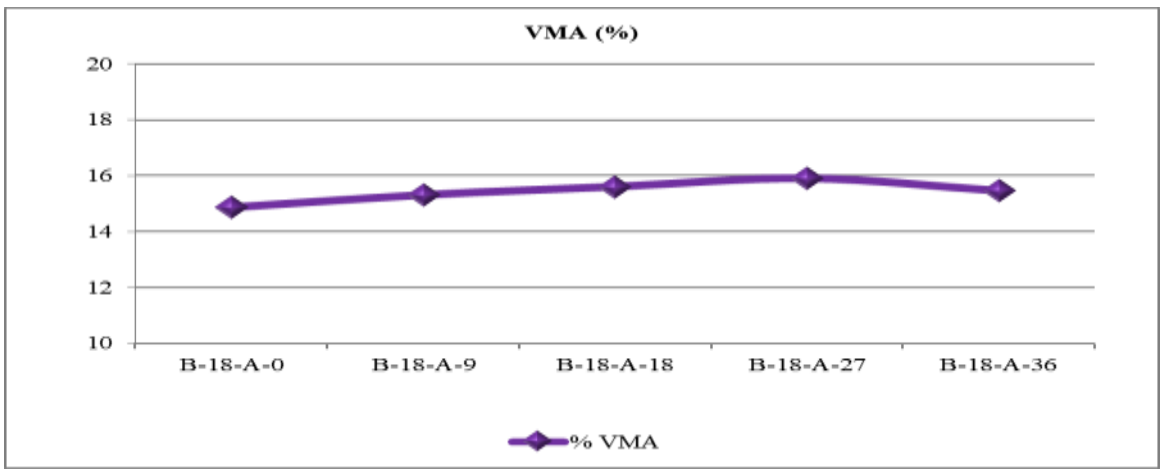

Figure 15: VMA of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

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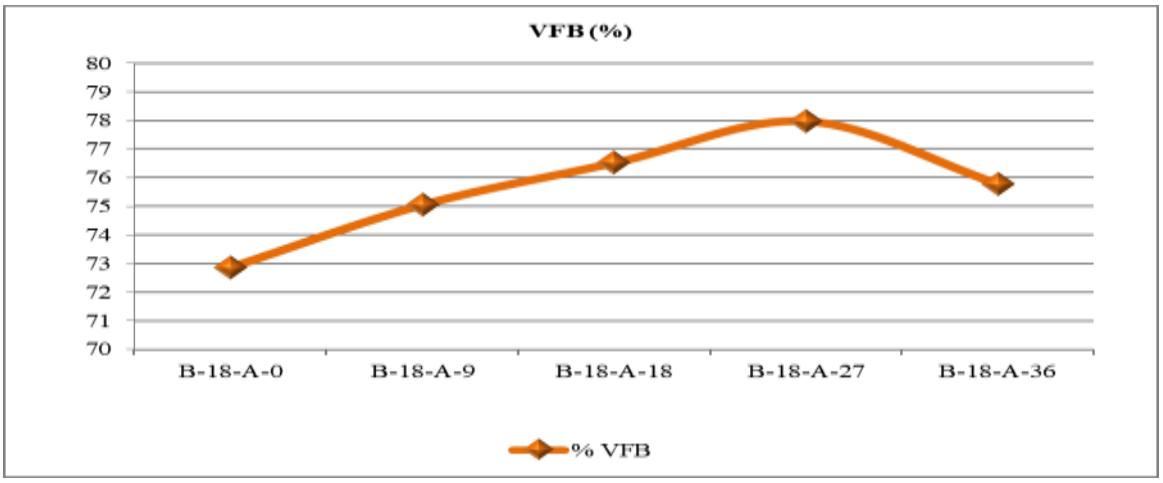

Figure 16: VFB of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

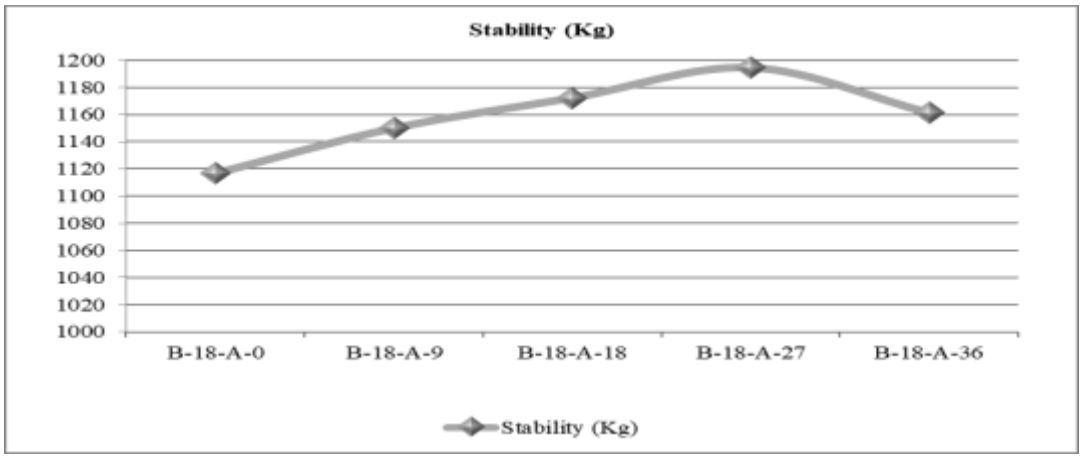

Figure 17: Stability of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

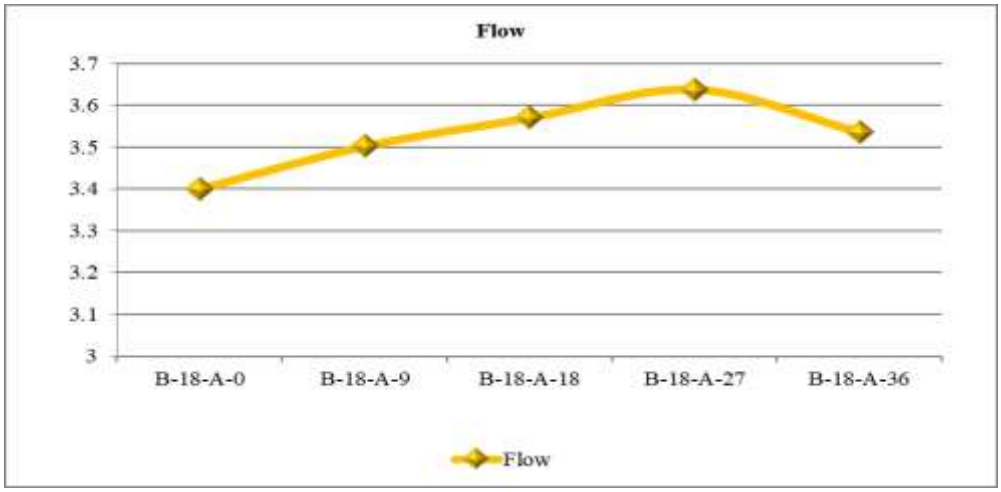

Figure 18: Flow of Standard Marshall Stability for 18% Optimum Bitumen and Varying Percentage of Aggregate

V. CONCLUSION

- Maximum penetration of bitumen when replaced with melted plastic bags is up to 70 mm at 0% replacement, while lowest penetration is down to 51 mm at 24% replacement.
- Maximum ductility of bitumen when replaced with melted plastic bags is up to 72 cm at 24% replacement, while lowest ductility is down to 46 cm at 0% replacement.

- Maximum flash point of bitumen when replaced with melted plastic bags is up to 195 °C at 24% replacement, while lowest flash point is down to 176 °C at 0% replacement.
- Maximum fire point of bitumen when replaced with melted plastic bags is up to 287 °C at 24% replacement, while lowest fire point is down to 245 °C at 0% replacement.
- Maximum softening point of bitumen when replaced with melted plastic bags is up to 74 °C at 24% replacement, while lowest softening point is down to 55 °C at 0% replacement.
- Maximum specific gravity of bitumen when replaced with melted plastic bags is up to 1.05 at 0% replacement, while lowest specific gravity is down to 1.13 at 24% replacement.
- When marble fragments are used to replace aggregate, the maximum crushing value increases to 31.66 % at 0% replacement and the lowest crushing value decreases to 24.56% at 36% replacement.
- When marble fragments are used to replace aggregate, the maximum impact value increases to 32.81 % at 36% replacement and the lowest crushing value decreases to 24.32 % at 0% replacement.
- When marble fragments are used to replace aggregate, the maximum abrasion value increases to 42.83 % at 36% replacement and the lowest abrasion value decreases to 32.57 % at 0% replacement.
- As more melted plastic bags are included in the bitumen mixture, the density result rises.
- As more of the plastic bags are melted and added to the bitumen mixture, the amount of air spaces decreases.
- As more plastic bags in the bitumen mix melt, the percentage VMA outcome declines.
- As more plastic bags are melted in the bitumen mix, the percentage of VFB results decreases.
- As more melted plastic bags are used in the bitumen mix, the stability result increases.
- In proportion to the ratio of melted plastic bags in the bitumen mix, the flow result decreases.

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