Construction of Road by Using Waste Plastic

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Abstract : Plastics are now widely used in every industry around the world, from agricultural to the automotive, building, electrical and communication industries. The amount of plastic trash produced nowadays is enormous since it is almost hard to recycle every single piece of used plastic .To save our ecosystem, the majority of waste plastic must be recycled. Waste plastic materials might enhance the needed bituminous mix qualities for repairing and building flexible pavements such as improving the Marshall Characteristics. Three tests on the bitumen and plastic mixture are carried out in this paper to enhance properties of traditional bitumen mix and modified bitumen mix. Then results of traditional bitumen mix and modified bitumen mix are compared.

Index Terms : Marshall Characteristics

I. INTRODUCTION

All The economic and technical revolutions of the nineteenth and twentieth century's were largely fueled by plastic. Because of its durability, light weight and affordable production, plastic utilized broadly over past 30 years in a variety of industries, including clothes, housing, transportation, construction, medicine, leisure and many more. The amount of plastic trash produced nowadays is enormous since it is almost hard to recycle every single piece of used plastic. The current methods of disposing of waste plastic have a direct and significant impact on the ecosystem of our planet because they involve digging or excavating the earth and filling it with waste plastic, which reduces soil fertility. Another method is to burn the waste plastics, which has a significant negative impact on air pollution and the ozone layer of our planet's ecosystem.

To save our ecosystem, the majority of waste plastic must be recycled. The use of plastic road construction is gaining importance now days due to its performance, long lifespan and low construction cost and less maintenance cost. The construction of plastic road plays a major role in recycling and reuse of plastic waste and it also helps us reduces the total percentage of plastic wastes.

II. LITERATURE SURVEY

Waste plastic materials might enhance the needed bituminous mix qualities for repairing and building flexible pavements. Therefore, a literature review was conducted to know various aspects of using waste plastic for road construction. The results are summarized as follows

1. Utibe J. NKanga, Johnson A. Joseph, Feyisayo V. Adams, Obioma U. Uche Finding effective strategies to reuse discarded plastic particles as bituminous mix for a better road surface is the main objective of this work. The results indicated that the 50:50 ratio of aggregate to quarry dust was preferable for carrying out the blending. By modifying the plastic waste's weight percentage to between 5 and 15 percent, this reengineered bituminous mixture benefits bitumen by enhancing its Marshall Stability, flow, bulk, density, strength, and fatigue life. The bituminous mix also gains other qualities, which enhances durability and exhibits great performance.
2. Rohit Jain, Sourabh Gupta and H.S.Goliya has looked into a number of areas to better understand how bituminous concrete performs and how it compares to plain bituminous mix used in flexible pavement. Waste plastic was used to make certain samples of bituminous concrete mix, which were then examined for mechanical capabilities and rutting characteristics. When considering economy and performance as the most important design factors, the ideal dosage of waste plastic was found to be 4 percent, 7 percent, and 10 percent in various grading and process (dry process & wet process), with an optimal binder content of 5.49 percent for I- Grade bitumen concrete layer.

III. OBJECTIVES

The principal intent of this study is to workout problem of waste plastic and utilizing verities of plastic products in construction work. The principal objectives of this study are as listed below

- To workout the complications of environmental pollution caused by land filling and open dumping.
- To utilize various plastic outcomes that become waste after their single utilisation such as plastic bottle, polythene bags & plastic wrappers etc., as partial substitute in bitumen mix as it decreases demand for bitumen in road construction.
- To settle effects of plastic replacement in bitumen on Marshall properties of the mix.
- To enhance original bitumen quality such as bitumen softening by utilizing plastic waste.
- To enhance properties of traditional bitumen mix and modified bitumen mix.
- To recognize strength and performance of bitumen/plastic blends.

IV. EXPERIMENTAL METHODOLOGY

Three tests on the bitumen and plastic mixture are carried out in this paper. The bitumen content of the test specimen is varied in 2.5 percent supplements over a reach that provides clearly defined max value for specimen stability and density. To test impact of plastic replacement on the mix's Marshall Characteristics, 7.5, 10, 12.5, and 15 percent of plastic are added to the increased

bitumen content. The behaviour of the plastic percentage on bitumen is shown by the fluctuation in bitumen % with air spaces, VMA, Marshall Stability, density and value of flow.

The characteristics of bituminous materials can be evaluated using a variety of tests. In this task, the following tests are often run.

- Penetration test
- Viscosity test
- Marshall stability test

To mix the waste plastics in bitumen, methodology carried out in this study was as follows.

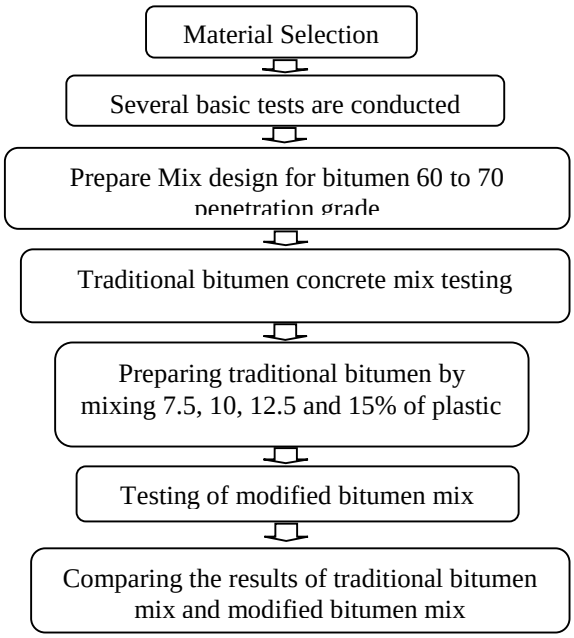

Fig.1 Chart of methodology followed in this study

V. ANALYSIS, RESULTS AND DISCUSSION

In this study 3 tests are conducted to enhance the property of modified bitumen mix (bitumen plastic mix). The bitumen content of the test specimen is varied in 2.5 percent increments over a span that provides clearly defined max value for specimen stability & density. To test impact of plastic substitution on the mix's Marshall Characteristics, incremental amounts of bitumen with plastic content of 7.5, 10, 12.5 &15 percent are adding on.

1. Penetration test results

Table.1 Comparison of penetration test results and discussions

Si.No	0% Waste plastic	7.5% Waste plastic	10% Waste plastic	12.5% Waste plastic
1	48	32	31	28
2	53	40	34	30
3	56	35	30	26

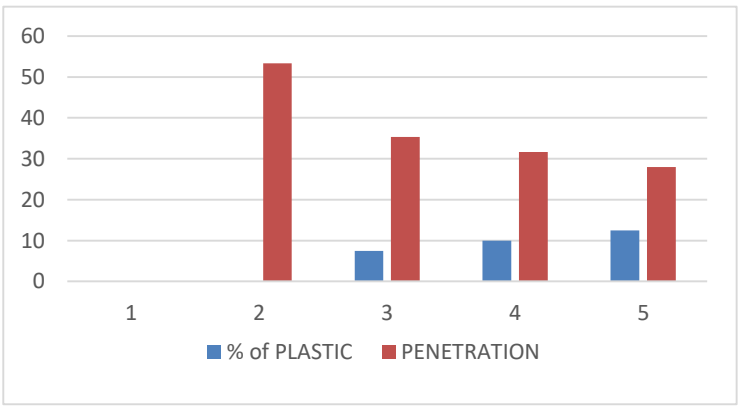

Fig. 2 Comparison of penetration test results

- According to the test results, bitumen containing 0% plastic has a 52.33mm penetration value. The penetration values for bitumen with 7.5 percent, 10 percent, and 12.5 percent are 35.33 mm, 31.67 mm, and 28 mm, respectively.
- The penetration test on bitumen with changing plastic content demonstrates that adding waste plastic to bitumen decreases penetration values, increasing bitumen hardness.

2. Viscosity test results

Table .2 Viscosity test values

% Plastic waste	Cp at 135°c	Cp at 165°c
0	600	200
7.5	1000	200
10	1400	200
12.5	1600	200

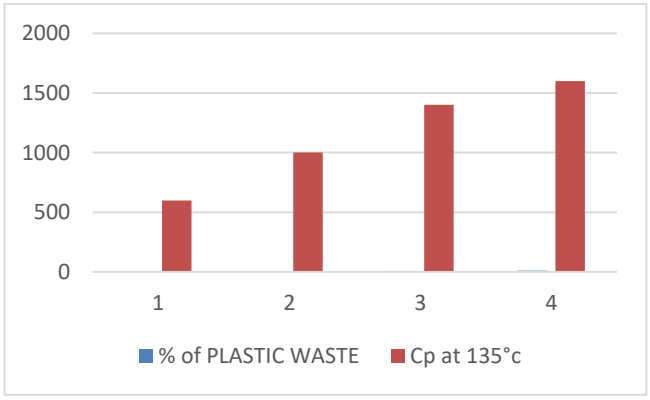

Fig. 3 Viscosity test results at 135°c

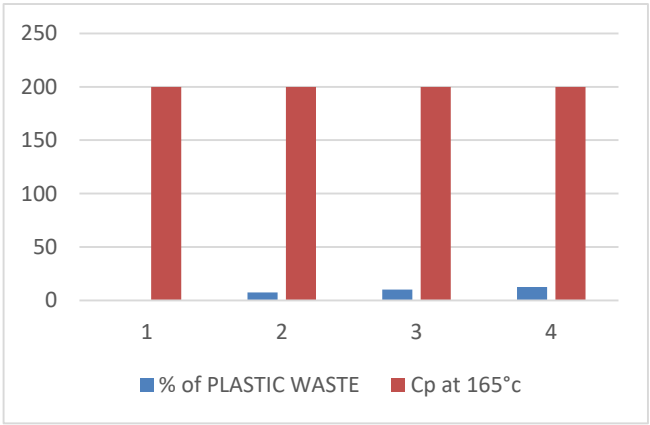

Fig. 4 Viscosity test results at 165°c

- The viscosity increased as the percentage of plastic waste grew, indicating that the binder is becoming more viscous.
- According to the graph, the original bitumen 60–70 has a viscosity of 600cP at 135°C, which is less viscous than the addition of 12.5% plastic waste, which has a viscosity of 1600cP at the same temperature.
- The original and modified binder both kept the 200cP constant at 165oC.

3. Marshall stability test results

Table .3 Air voids and Bitumen%

Si.No	%Bitumen	0% Waste plastic	7.5% Waste plastic	10% Waste plastic	12.5% Waste plastic
1	4.5	6.5	6.9	6.95	6.8
2	4.75	6	6.4	6.5	6.35
3	5	5.6	6	6.1	5.9
4	5.25	5.25	5.5	5.5	5.4

5	5.5	4.9	5.25	5.25	5
6	5.75	4.5	4.8	4.9	4.7

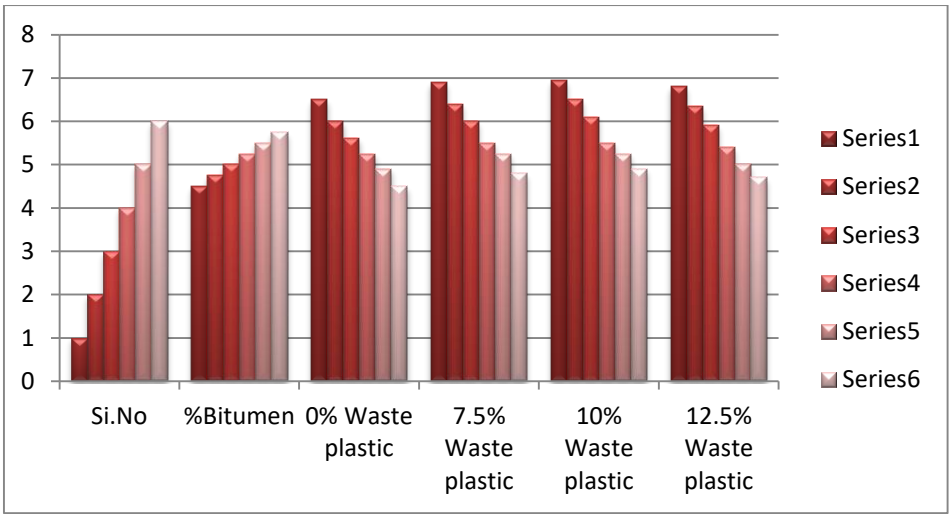

Fig. 5 Air voids and Bitumen%

Table .4 Bitumen % and Marshall stability

Si.no	%Bitumen	0% Waste plastic	7.5% Waste plastic	10% Waste plastic	12.5% Waste plastic
1	4.5	900	920	930	915
2	4.75	910	930	939	921
3	5	920	955	959	945
4	5.25	960	970	975	965
5	5.5	980	990	995	985
6	5.75	965	960	975	965

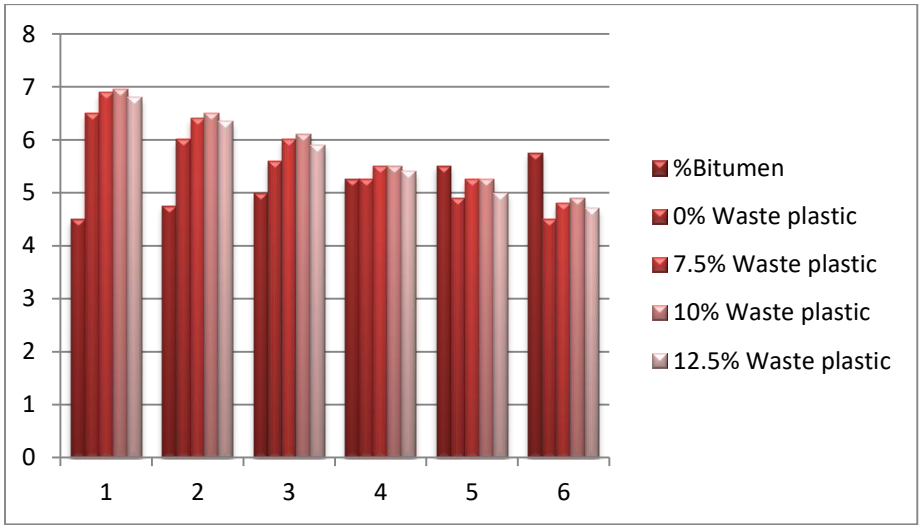

Fig. 6 Bitumen% and Marshall stability

Table .5 Bitumen % and Flow value

Si.no	%Bitumen	0% Waste plastic	7.5% Waste plastic	10% Waste plastic	12.5% Waste plastic
1	4.5	8	7.8	8	8

2	4.75	8.1	8	8.25	8.1
3	5	8.3	8	8.4	8.3
4	5.25	8.5	8.3	8.6	8.4
5	5.5	8.3	8.3	8.5	8.2
6	5.75	8.5	8.6	9.7	8.65

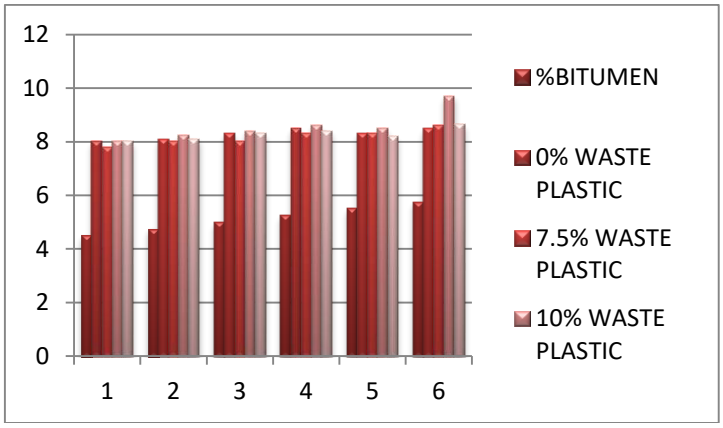

Fig. 7 Bitumen% and Flow value

Table .6 Bitumen % and Density

Si.no	%Bitumen	0% Waste plastic	7.5% Waste plastic	10% Waste plastic	12.5% Waste plastic
1	4.5	2.3	2.29	2.28	2.3
2	4.75	2.31	2.3	2.31	2.24
3	5	2.31	2.3	2.3	2.311
4	5.25	2.31	2.3	2.305	2.31
5	5.5	2.31	2.3	2.30	2.31
6	5.75	2.3	2.29	2.29	2.31

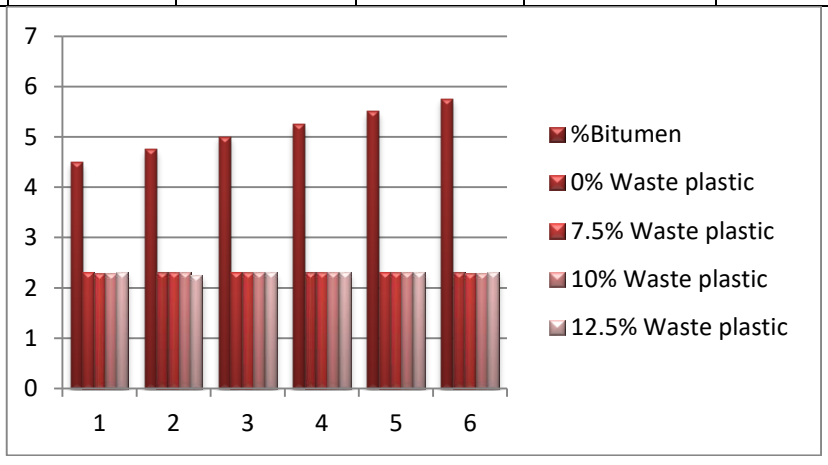

Fig. 8 Bitumen% and Density

VI. CONCLUSIONS

This work is carried to recognize % of plastic mix which influence the certain characteristics of bitumen. In this work various tests are conducted on bitumen with varying % of plastic that is 0%, 7.5%, 10% and 12.5%and from this test results subsequent conclusions are drawn.

- The complications regarding environmental pollution created by land filling and open dumping is drop up to some extent.
- The utilization of several plastic products that incline waste later their single use such as plastic bottle, polythene bags & plastic wrappers etc., as partial substitute in bitumen mix as it decreases demand for bitumen in road construction.
- The effect of plastic replacement in bitumen on Marshall Properties is settled.

- According to the graph, the original bitumen 60–70 has a viscosity of 600cP at 135°C, which is less viscous than the addition of 12.5% plastic waste, which has a viscosity of 1600cP at the same temperature.
- More viscous the bitumen lowers the rutting
- According to the findings of a penetration test, 0% plastic bitumen has a penetration value of 53.22 mm, while 12.5% plastic bitumen has a higher penetration value of 28 mm.
- The penetration test on bitumen with changing plastic content demonstrates that adding waste plastic to bitumen decreases penetration values, increasing bitumen hardness.
- The air voids volume of semi dense bitumen is 8.1% lower when compared to bitumen plastic mix.
- At the optimum bitumen content the Marshall stability of semi-dense bitumen mix is 1.7% lower when compared with bitumen with waste plastic.
- The flow value of semi dense bitumen mix is 9% high compared to bitumen by waste plastic.
- The density of semi-dense bitumen mix is 0.45% higher than bitumen with waste plastic.

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