

Waste Plastic as an Effective Construction Material in Flexible Pavement

Research Scholar Kalvala Abhiram, Assistant Professor Dr. G. Prashanth

Department of Civil Engineering
Chaitanya Deemed to be University,
Warangal, TS, India

Abstract- Safeguarding of street foundation requires an orderly methodology for the great presentation of streets remembering the future condition and upkeep situations. Presently a-days asphalts are exposed to different sorts of stacking which influences the asphalt execution condition that causes different troubles. These upset incorporate rutting, weakness breaking, and temperature breaking. Anticipating the natural condition, total prohibition on plastic can't be made. Hence, utilizing of plastic as an imaginative innovation reinforced the street development as well as increment the street life. This paper incorporates the consequences of the different lab tests directed on bitumen, total and bitumen-total plastic blend.

Keywords-Waste plastic, Total, Bitumen, plastic-bitumen-total blend, plastic changed bitumen and plastic altered total.

I. INTRODUCTION

Today, for the non-industrial nations, Adaptable asphalts are perhaps the main foundations. Any harm to this may make loads of burden the traffic which at last will influence the future situation of nations. Presently a-days it is been seen that because of expansion in axel burden and traffic power the ability of the bituminous fasteners is been diminished causing seeping in blistering environment, breaks in cool environment, rutting and pot openings. This makes a centrality in change of bitumen cover to fulfill the expanding need of axel loads and traffic power.

Fast mechanical and tremendous populace development has brought about expanding the different kinds of waste materials. Significant measures have been accomplished for the removal of these byproducts. These plastics are extensively non-biodegradable accordingly can be utilized as a modifier in bitumen and totals to build their solidarity. This examination presents the appropriate use of waste in hot bitumen and total to improve asphalt execution, to secure climate and to give ease streets.

II. MATERIALS

1. Bitumen:

Bitumen is very well known as the binders in pavement construction. It is one of the major highway construction materials. The important quality of bitumen which has made bitumen a popular binding material is its excellent binding property and gets softens when heated.

Figure 2 Bitumen of grade 60/70 Plastic are known by their chemical structure which is generally known as polymer's backbone and side chain. There are usually two types of plastic's "Thermoplastic and Thermosetting polymers" (Refer Figure 3).

Plastic is one of the materials which enhanced its binding property when softened. Hence, this softened plastic material can be used as an effective binder in bitumen.



Fig 1. Plastic on road sides.

III. RESEARCH METHODOLOGY

The research methodology for present study has adopted various tests to investigate the results on aggregate, bitumen and plastic and aggregate-bitumen-plastic mix. The tests conducted were Water Absorption, Aggregate Impact, Loss Angeles and Aggregate Crushing Test [IS: 2386 (part 4)- 1963] for aggregates and Softening Point, Penetration Test and Ductility Test [IS: 1203-1978] for bitumen.

For mixing the ingredients of road mix, dry process was adopted. In this process, waste plastic is mixed with aggregates and blends of polymer modified aggregate are prepared by mixing bitumen in it. These blends are later tested in laboratory and required optimum results are obtained.

The blends using aggregates and bitumen were prepared along with the use of different percentage of waste plastic in it separately (See Figure 4) and were kept for water bath at least 24 hrs. Later these blends were tested under marshal stability apparatus to check its stability for road pavements.



Fig 2. Blends of Aggregate and Bitumen and blends of Aggregate-bitumen- plastic mix.

The results of various tests conducted on aggregate and bitumen and aggregate- bitumen-plastic mix are given in subsequent section.

IV. RESULTS AND DISCUSSIONS

1. Laboratory Tests on Aggregate:

For the asphalt pavement, stone aggregate with specific Characteristics are used for road laying. The aggregates are chosen on their strength, porosity and moisture absorption capacity.

The shredded waste plastic was sprayed over the hot aggregate which got coated on aggregate when molted. The extent of coating was varied by using different percentage of plastic. Increase in the percentage of plastic increases the properties of aggregates.

Following are the tests conducted in laboratories

2. Impact Test (IS: 2386 Part IV.1963)

Toughness is the property of a material to resist impact. Due to traffic load and intensity, the road stones are subjected to various actions leading in formation of pounding impact or breaking into smaller pieces. Thus, road stones should therefore be tough enough to resist fracture under impact. Hence, a test is designed to evaluate the toughness of stone.

The results of Impact test with various percentage of plastic in aggregates are shown in Table 1 and Figure 3.

The repeated movement of the vehicle with iron wheeled or rubber tire will produce some wear and tear over the surface of the pavement. This wear and tear percentage of an aggregate is determined with the help of “Loss Angeles Abrasion Study”.

Table 1. Observations for aggregate impact test.

Stone aggregate	% of plastic	Aggregate impact vale
Without plastic coating	0	10.79 %
With plastic coating	5	10.59 %
	10	10.03 %
	15	9.93 %

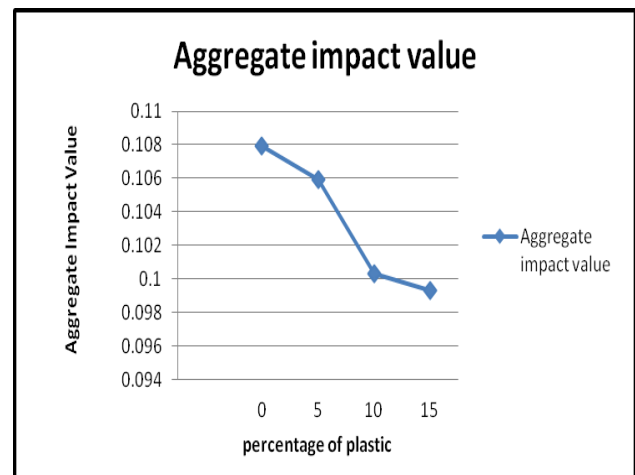


Fig 3. Variation in aggregate Impact Value of Aggregate with increase in percentage of plastic.

3. Loss Angeles Abrasion Test:

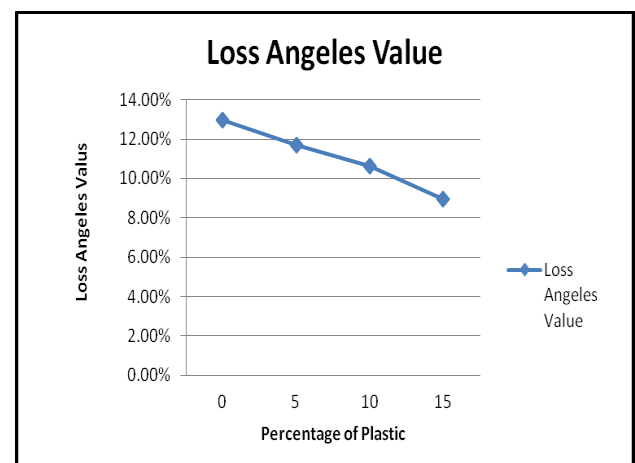


Fig 4. Variation in Los Angeles Value of Aggregate with increase in percentage of plastic.

The results of Loss Angeles Abrasion Test with various percentage waste plastic in aggregates are given in Table 2 and Figure 6.

Table 2. Observation for the Loss Angeles Abrasion test.

Stone aggregate	% of plastic	Loss Angeles Value
Without plastic coating	0	12.99%
With plastic coating	5	11.70%
	10	10.65%
	15	8.94%

Table 3. Observations for tests on bitumen.

% of bitumen	% of polymer	Softening point
100	0	50
95	5	52
90	10	60
85	15	62

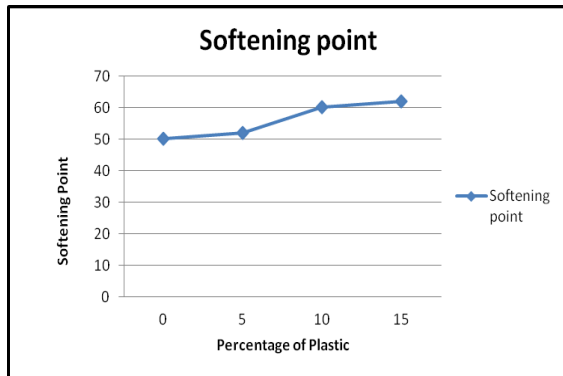


Fig 5. Variations in Softening Point of Bitumen with Increase in percentage of plastic.

4. Penetration Test (IS: 1203-1978)

Table 4. Observation for the penetration test.

% of bitumen	% of polymer	Penetration value in mm
100	0	70
95	5	68
90	10	67
85	15	64

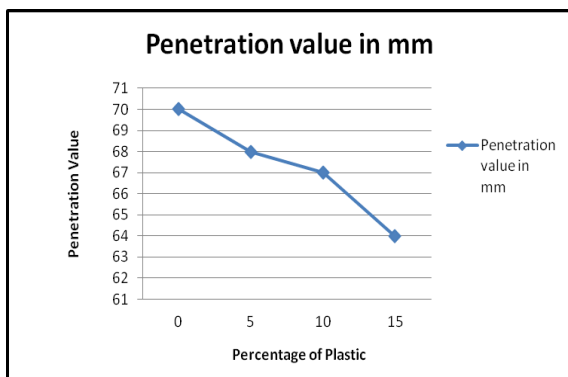


Fig6. Variations in Penetration Value of Bitumen with Increase in percentage of plastic.

5. Ductility Test (IS: 1208-1978):

Table 5. Observation for the ductility test.

% of bitumen	% of polymer	Ductility value
100	0	83
95	5	68
90	10	57
85	15	52

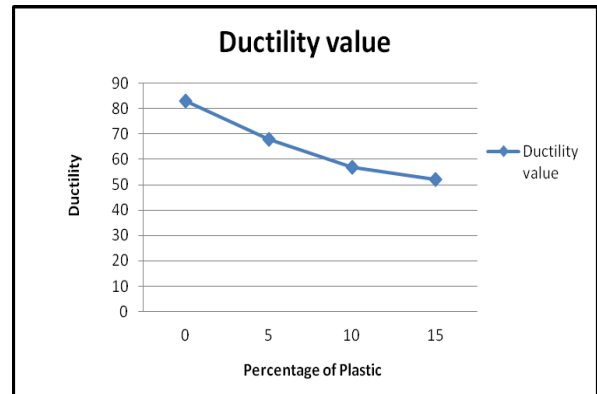


Fig 7. Variation in Ductility of Bitumen with increase in percentage of plastic.

6. Marshal Stability Test:

In marshal stability test, the deformation of specimen of bituminous mixture is measured when the same load is applied. This test procedure is used in designing and evaluating bituminous paving mixes. The marshal stability of mix is defined as a maximum load carried by a compacted specimen.

The following results of Marshal Stability test are shown in Table 6 and Figure 10

Table 6. Observation for the Marshal Stability.

Sr. No	Plastic Added (%)	Stability (kg)
1	0	1010
2	5	1680
3	10	1957
4	15	1181.23

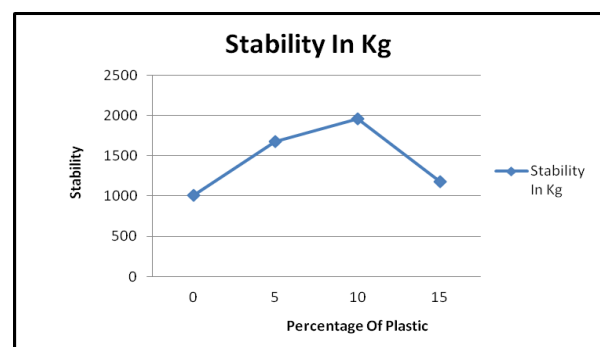


Fig 8. Variation in Stability of Bitumen with increase in percentage of plastic.

V. CONCLUSION

It shows that with the increase of waste plastic in bitumen increases the properties of aggregate and bitumen. Use of waste plastic in flexible pavements shows good result when compared with conventional flexible pavements.

The optimum use of plastic can be done up to 10%, based on Marshal Stability test. This has added more value in minimizing the disposal of plastic waste as an eco-friendly technique. Coating of polymer on the surface of the aggregate has resulted in many advantages, which ultimately helps to improve the quality of flexible pavement.

REFERENCES

- [1] "Chavan A." (2013). "Use Of Plastic Waste In Flexible Pavements" International Journal Of Application Or Innovation In Engineering And Management ISSN 2319- 4847, Volume 2, Issue 4, April 2013
- [2] "Devi R., M, Stephen L., Mini.I.M," (2013) "Reduction of Optimum Bitumen Content In Bituminous Mixes Using Plastic Coated Aggregates". International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 3, March 2013
- [3] "Gawande.A.,Zamare.G.,Renge.V.C.,Tayde.S.,Bhars akale .G (2012) "An Overview On Waste Plastic Utilization In Asphaltting Of Roads" International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 3, March 2013.
- [4] IS: 2386 (Part 3) and (Part 4)-1963.
- [5] IS: 1203 – 1978. Joseph Mercy, et.al. (2013) "Study on Use of Plastic Waste in Road Construction" International Journal of Innovative Research in Science, Engineering and Technology. Vol. 2, Issue 3, March 2013.
- [6] Kumar, S and Gaikwad, SA "Municipal Solid Waste Management in Indian Urban Centres: an approach for betterment", in Gupta K.R.(Ed): Urban Development Debates in the New Millennium, Atlantic Publishers and Distributors, New Delhi, pp. 100- 111,(2004).
- [7] "Mercy Joseph P., Solly George,Jessy Paul "(2013) "Study on Use WastePlastic in Road Construction". Internatio nal Journal of Innovative in Science, Engineering and Technology". ISSN: 2319-8753 vol-2, issue 3.
- [8] "Mohammad Awwad" (2007) "The Use of Polyethylene in Hot AsphaltMixtures", "AmericanJournal of Applied Sciences" 4(6) pp-390-396, 2007.
- [9] "Prasad Shiva, (2012) "Study on Marshall Stability Properties Of BC Mix Used In Road Construction By Adding Waste Plastic Bottles", IOSR Journal of Mechanical and Civil Engineering PP 12-23.
- [10] "R Vasudevan.," (2007) 1 "Utilization of Waste Polymers for Flexible pavement and easy disposal of waste Polymers", International Conferenceon Sustainable Solid Waste Management, 5-7, Chennai, India pp-105- 111, 2007.