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Experimental Investigation on the Properties of Pavement using Waste Plastic in Road Construction

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ABSTRACT

Due to the tremendous increases in population and changes in life style Waste plastic material Management playsan important role and one of the most powerfulconcepts in recent year.Therefore the disposal of waste plastic is a hazardous and become a serious problem globally due to their non-biodegradabilityand burning of these waste plastic bags causes highly environmental pollution.A study was conducted on use of waste Polyethylene Terephthalate in bitumen mixes. Marshall Stability and flow values were used to determine strength and deformation characteristics Strength. A comparison was made between conventional bitumen mixes and Marshall Values of modified mixes. Ideal percentage of waste PET polymer in bitumen mixes was found by varying the % of PET. An investigation was carried out on bituminous mixes modified by addition PET by fix mixing temperature.The PET was added in2 – 12 % (by the weight of optimum bitumen).We can conclude that the stability of PET modified bituminous binders is better compared to that of conventional bituminous binders. Use of waste plastic in bituminous binders contribute protection of environment

Keyword: Polyethylene Terephthalate (PET), Stability, Deformation characteristics.

INTRODUCTION

Research in many countries have concluded that the quality of bitumen and bitumen mixes can be improved by addition of some additives. These are termed as “Bitumen Modifiers”. Bitumen with these additives have higher life of surfacing depending on process of modification and additive types. The time period of next renewal may be extended by 50 per cent in case of surfacing with modified bitumen as compared to normal period indicated for conventional bitumen. (A. U. Ravi Shankaret.al 2013) Due to increase usage of plastic, disposal of it is difficult. Recent studies shows only 2 million tons of plastic waste is recycled out of 10 million tons of plastic waste produced in India. If it is not disposed or recycled correctly it is hazardous to environment. One of the better ways of using waste plastic is by melting them and using them in bituminous road constructions. Many highway firms are investigating performance of plastic infused bituminous roads in high way construction and environmental sustainability

OBJECTIVE OF THE STUDY

The main objective of the study is to evaluate the performance characteristic of the bituminous mix using waste plastic

- The percentage of waste plastic were varying from 0 to 14% of the total bitumen content

- With the increase of waste plastic the stability and flow value of bituminous mix determine

Methodology adopted for the present investigation

The procedure were conducting as per Marshall method (ASTM D-1559) the Optimum binder content were found by preparing Marshall specimens with varying the percentage of Binder Marshall tests for stability and flow values are conducted for three specimens for each sample of conventional bituminous mix, mix with PET waste. Marshall Properties have been determined for mix with varying percentage of PET.

MATERIAL CHARACTERIZATION

Aggregate

Locally available crushed granite is used as coarse aggregate for the study. Crushed stone which is a by-product from stone crushing are collected from the same plant for use as fine aggregate and filler. The physical properties of the Ca and FA tested as per IS: 2386 (Part III, IV)-1963 are presented in Table 3.1.

Sl No	Test on Aggregates	Obtained Value	MORTH Specifications(2001)	Test Methods
1	Crushing Value	28.3%	Max 30%	IS: 2386 (IV)
2	Impact Value	20.8%	Max 24%	IS:2386(IV)
3	Los Angeles Abrasion Value	32%	Max 30%	IS:2386(IV)
4	Flakiness Index	14.3%	Max 40%	IS:2386(I)
5	Elongation Index	13.92%	Max 15%	IS:2386(I)
8	Sp gr of Coarse Aggregates	2.76	2.5-3.0	IS:2386(III)
7	Sp gr of Fine aggregates	2.72	2.5-3.0	IS:2386(III)
8	Water Absorption Test	1.06 %	Max 2%	IS:2386(III)

Table 1: Physical Properties of Aggregates used in present study

Bitumen

Bitumen which is used in the investigation were 80/100(VG-10).The physical properties of Bitumen are described as per IS: 73-1992 and are given in Table

Sl No	Test on Bitumen	Obtained Value	Bitumen Grade	Test method
1	Penetration	82mm	80/100	IS:1203-1978
2	Softening Point	48.65 ^{0}c	80/100	IS:1205-1978
3	Ductility	75 cm	80/100	IS:1208-1979
4	Flash point & Fire point	262^{0}c&299^{0}c	80/100	IS:1209-1981
5	Specific Gravity	1.02	80/100	IS:1202-1980
6	Viscosity	148sec	80/100	IS 1206 (Part 2)

Table 2:Physical Properties of Bitumen used in present study

Selection Of Aggregate Gradation

In the present study bituminous concrete [BC] which is considered as the wearing course or the surface course were consider. The two gradations for bituminous concrete layers for Grade I and grade II as per [MORTH] specification were study nominal aggregate size of 19mm and layer thickness of 50-60mm is selected. Aggregates of size 25mm, 12mm, 6mm and crush stone dust were used and sieve analysis were obtain in order to get the individual gradation of aggregates, of Desired gradation of BC mix which was obtained to met the MORTH requirement

Results and discussion

The used of waste plastic in the investigation can be employed by the two method in the Bituminous mixes. The directly addition of waste plastic into the heated aggregates mixes before the addition of binder and the other is incorporating the waste plastics into the bitumen directly . For the present investigation the waste plastic is added to the heated aggregate

Determination of obc

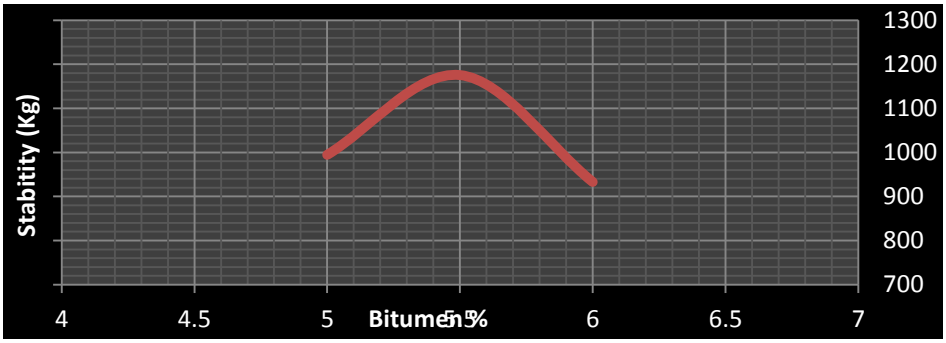


Fig 1:Relation between stability (kg) and bitumen content

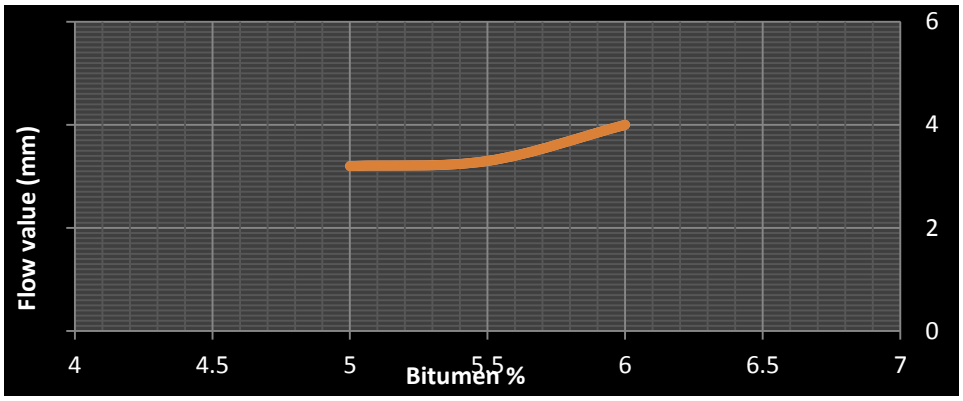


Fig 2:Relation between flow value and bitumen content

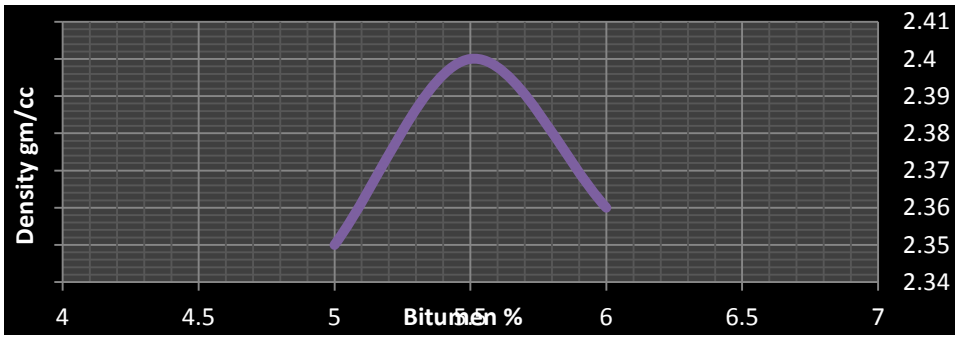


Fig 3:Relation between bulk density and bitumen content

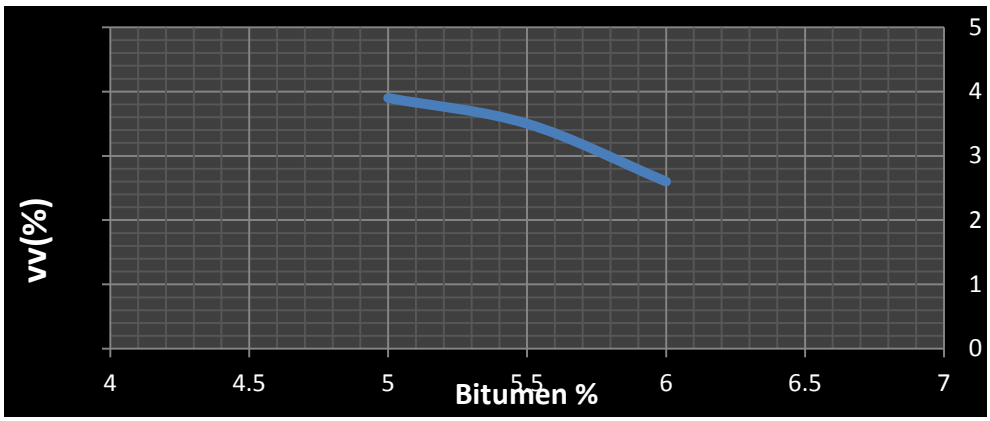
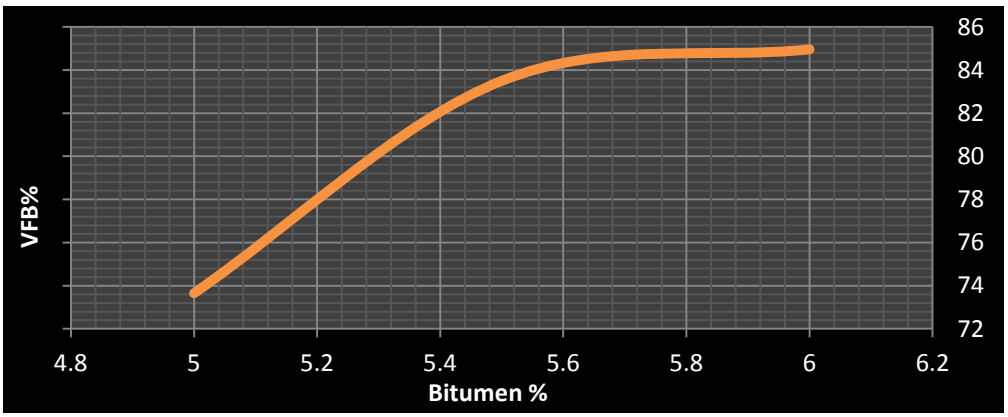


Fig 4: Relation between bulk density and bitumen content



Fid 5:Relation between voids filled with bitumen (VFB) and bitumen content.

The study was carried out to obtain optimum bituminous concrete mix of 80/100grade. The optimum binder content obtained was 5.5% for 80/100 grade of bitumen with the stability value of 1190 Kg. The flow value with the maximum stability is 3.6mm. G_m was found to be maximum of 2.394 gm/cc at 5.5% of bitumen. V_v varies from 2.5% to 4% by different percentage from 5% to 6%, and were found to be 3.5%, with the bitumen content of 5.5%. VFB at 83.89% at 5.5% of binder content.

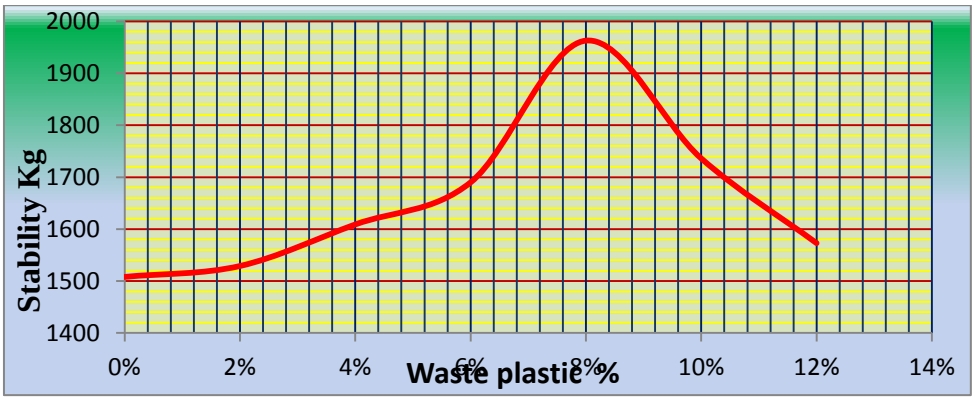


Fig 6:Relation between stability and waste plastic content in percentage

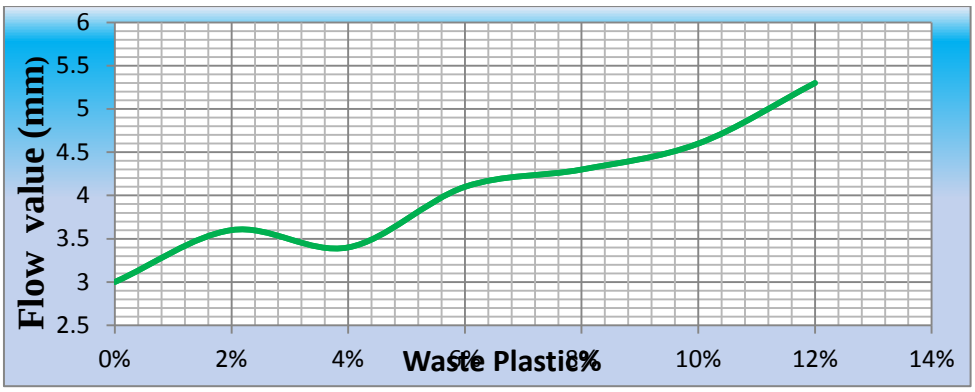


Fig 7: Relation between flow value and waste plastic content

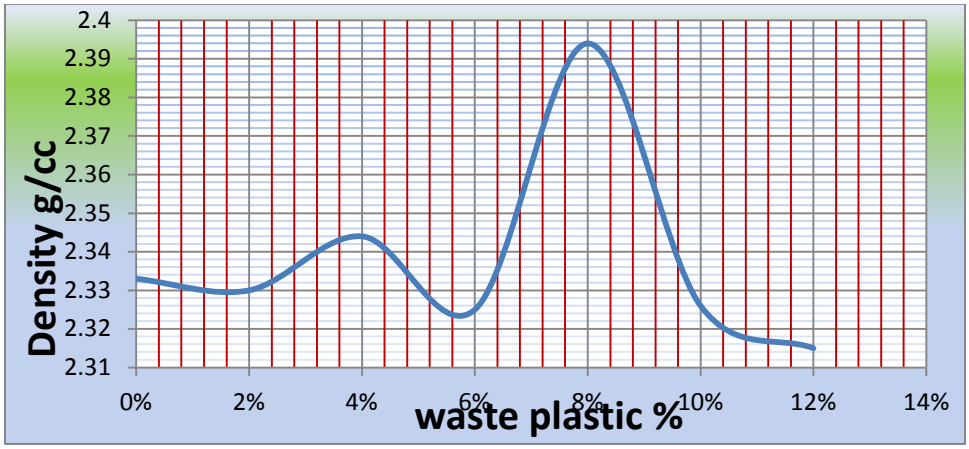


Fig 8:Relation between bulk density and waste plastic content

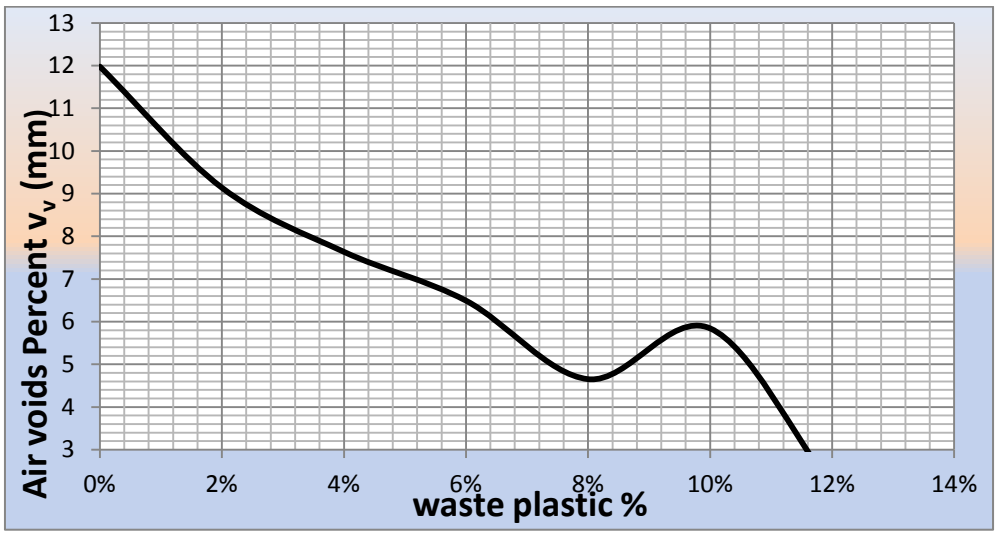


Fig 9:Relation between air voids ratio (Vv) and waste plastic content

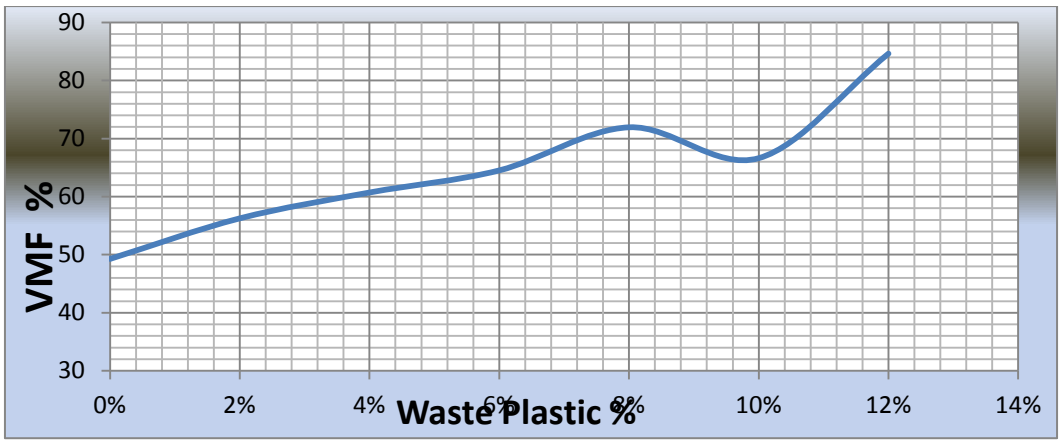


Fig 10:Relation between voids filled with bitumen (VFB) and waste plastic content

CONCLUSION

The experimental was conducted by varying from 0 to 12 percentage of waste plastic with the increase in percentage of waste plastic it is found that the optimum stability was found to be in the range of 1930 to 1950 Kg, with the flow values varying from 4.0 to 4.5 mm and at 8% of waste plastic. The Bulk density $\mathbf{v_b}$ was found to be in the range of maximum of 2.29 to 2.35 gm/cc at 8% waste plastic and there by decrease from to 2.14 gm/cc at 12% waste plastic.

1. The Voids in the total mix Vv was found to be 4.9 to 4.6%. Has shown higher value at 8% of waste plastic. The properties of bitumen such as softening point, viscosity, flash and fire point improved with the addition of 12% to 14% of waste plastic, compared to unmodified bitumen.
2. There is significant decrease in penetration value for modified blend when compared to plastic binder. To bring the limitation to be in the positive approached the shredding instrument should be properly design for the use of waste plastic.
3. The investigation not only utilizes beneficially but also the waste utilization of e non-degradable plastics
4. Which improved the pavement performance which strengthen the mixes, longer life period and finally reduces the noise produce by normal highway .

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