IMPROVEMENT OF PAVEMENT TECHNIQUES USING SHREDDED PLASTICS

[1]Vishwas K, [2]Madhumitha Shetty, [3]Sushma Toraskar, [4]Aravind K V, [5]Mr Ullas S L

[1,2,3,4]UG Students, [5]Assistant Professor,

Department of Civil Engineering,
SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, UDUPI

***Abstract:*. The plastic waste has been increasing day by day due to increase in population, urbanization, industrialization, change in life style, and socio-economic condition. It is need of the hour to use plastic waste for construction of flexible pavement to minimize the bitumen consumption, protect the environment, manage the plastic waste and improve the properties of aggregates. It exhibit improved soundness, specific gravity, impact value and extra resistance to water than that of plain aggregates**

***Index Terms:* Aggregates, improved properties, non-biodegradable plastic waste.**

I. INTRODUCTION

Quality of bitumen is by modifying the rheological properties of bitumen by blending with organic synthetic polymers like rubber and plastic. The surface layer of pavement is made of bituminous combination with aggregate and filler material. The material for the base coarse is typically base course of water bound macadam, wet mix macadam, or crushed run macadam aggregates or unbound granular layers. The aggregate base could also be bound layer mixed with bitumen, Portland cement, or another binding material. The sub-base is mostly a local aggregate material. Also, the top of the sub grade is sometimes stabilized with either cement or lime. Modified bitumen has lower susceptibility to daily and seasonal temperature variations, better age resistance, better adhesion between aggregates and binder, higher fatigue life of mixes, overall improved performance in extreme climatic conditions and heavy traffic condition. Excellent pavement life, driving comfort and low maintenance. The life of periodical maintenance and overlays gets enhanced by about 1.5 times. Minimize the damage of pavement due to increase in service traffic density, axle loading. In construction of flexible pavement, bitumen plays the role of binding the aggregate together by coating over the aggregate. It also helps to improve the strength of the road. But its resistance towards is poor. Anti-stripping agents are being used. A common method to improve the quality of bitumen is by modifying the rheological properties of bitumen by blending with organic synthetic polymers like rubber and plastic.

II. OBJECTIVES

1. Effective utilization of a non- biodegradable material like plastic in road construction.
2. To study the Marshall properties of modified semi dense bituminous concrete mixes in comparison with neat Semi dense bituminous concrete mixes.
3. To arrive at optimum plastic content for semi dense bituminous concrete mixes.

III. LITERATURE REVIEW

Verma S.S(2008),-concluded that plastics will increase the melting point of the bitumen. This technology not only strengthened the road construction but also increased the road life.

Dr.R.Vasudevan and S.Rajasekaran(2007) -stated that the polymer bitumen blend is binder compared to plain bitumen. Blend has increased softening point and decreased penetration value with a suitable ductility.

Prof. C.E.G Justo states that addition of 8% percent by weight of processed plastic is desirable in saving 0.4% bitumen by weight of mix

Table 1 Test Results for Aggregate

Property method	Test method	Results method	Morth specification
Aggregate impact value,%	IS:2386(IV)	29.37	30% MAX
Aggregate crushing value,%	IS:2386	27	30%MAX

Table 2 Test Results for Bitumen

Property method	Test methods	Test results
Penetration Test(mm)	IS:1203-1978	18.33
Ductility Test(cm)	IS:1208-1978	4.1
Softening point °c	IS:1205-1978	93.25

IV. METHODOLOGY

1) Collection of shredded plastic from kakunje polypacks Baikampady.
2) Shredded plastic of size passing 4.75 mm sieve retained on 2.36mm sieve are collected.
3) The bitumen of 80/100 paving grade is mixed with starting from 2, 4, 6,8and 10% of polyethylene shredded plastic by weight of bitumen.
4) Sample moulds of 4, 4.5,5 and 5.5 percentage of bitumen by weight of aggregate are prepared for each increase of percentage plastic content.
5) Among which 12 moulds are prepared without adding plastic and 60 moulds by adding plastic.
6) Mould is prepared by giving 75 blows on each side.
7) Mould is then kept for 24hrs.
8) De moulded specimen is kept in water bath for 30 minutes at 30°c.The specimen is then tested for Marshall stability.

Fig. 1 Prepared Test Specimen

MARSHALL STABILITY TEST CALCULATION

[1] Theoretical specific gravity (G_t):

$$G_t = \frac{W_1 + W_2 + W_3 + W_b}{(W_1/G_1) + (W_2/G_2) + (W_3/G_3) + (W_b/G_b)}$$

[2] The bulk specific gravity (G_m):

$$Gm = W_m/(W_m - W_w)$$

[3] Air voids (Vv):

$$V_V = (G_T - G_M)*100/G_T$$

[4] Percent volume of bitumen (V_b):

$$V_b = \frac{(W_b/G_b)}{(W_1+W_2+W_3+(W_b/G_m))}$$

[5] Voids in mineral aggregate (VMA):

$$VFB = (V_b \times 100)/VMA$$

[6] Voids filled with bitumen VFB:

$$VFB = (V_b \times 100)/VMA$$

V. GRAPH AND CALCULATIONS:

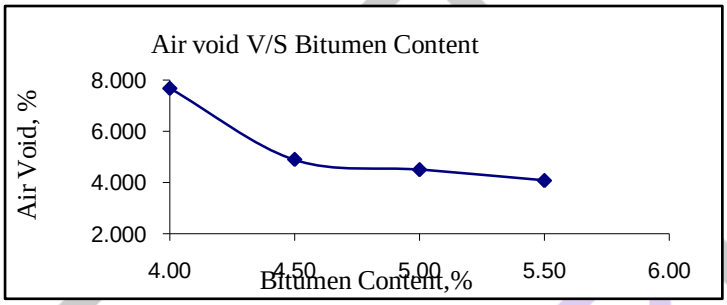
Marshall Properties for determining the optimum Binder Content for Bituminous mix

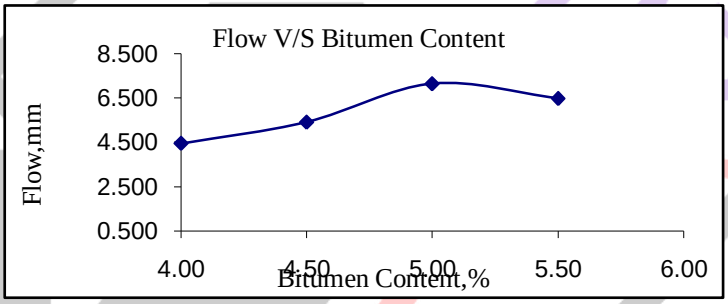
[1] W1 (percentage weight of coarse aggregate)= 54

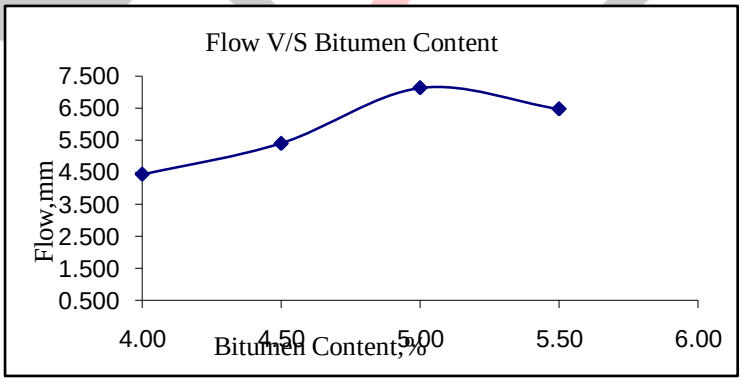
[2] W2 (percentage weight of fine aggregate)= 43
[3] W3 (percentage weight of fines)= 1
[4] W4 (percentage weight of cement)= 2
[5] G1(apparent specific gravity of coarse aggregates)= 2.65
[6] G2 (apparent specific gravity of fine aggregates)= 2.71
[7] G3 (apparent specific gravity of fines)= 2.77
[8] G3 (apparent specific gravity of cement)= 3.01
[9] G4 (apparent specific gravity of bitumen)= 0.995

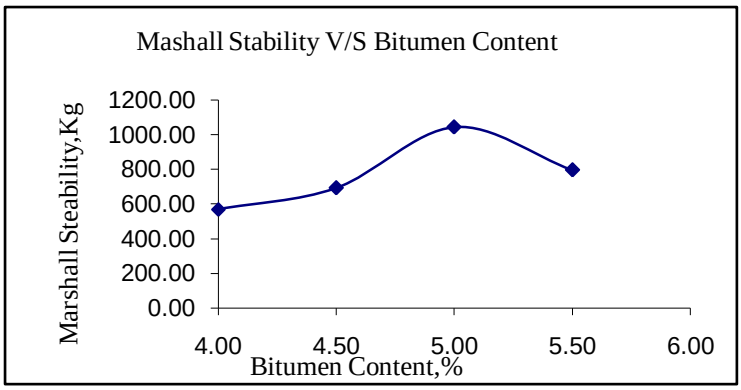
Table 3 Binder Content for Bituminous mix with 0% plastic

SL.NO	Bitumen content,%	Bulk Density,gm/cc	V_v	V_b	VMA	VFB	Marshall Stability,Kg	Flow, mm
1	4.00	2.381	5.205	11.225	16.430	68.323	**560**	4.43
2	4.50	2.384	4.429	12.303	16.732	73.530	597	5.4
3	5.00	2.380	3.897	13.340	17.237	77.396	736	7.13
4	5.50	2.376	3.406	140359	17.766	80.833	627	6.47









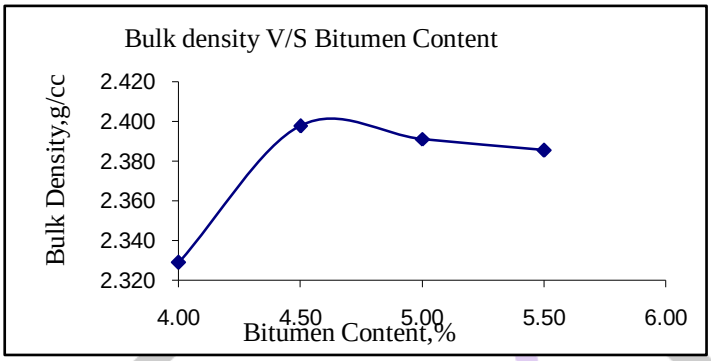
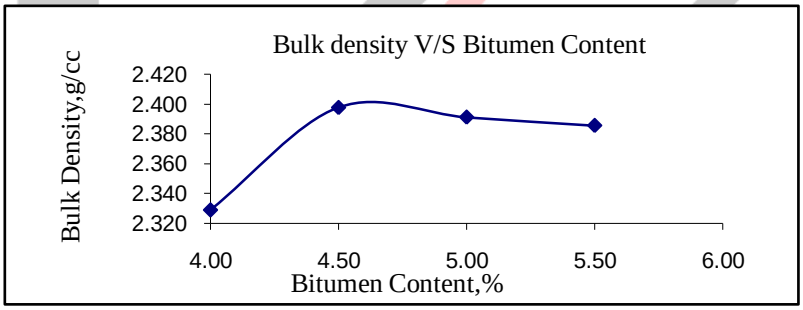
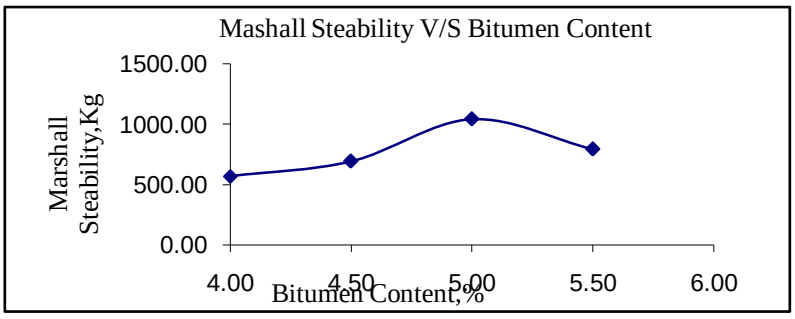
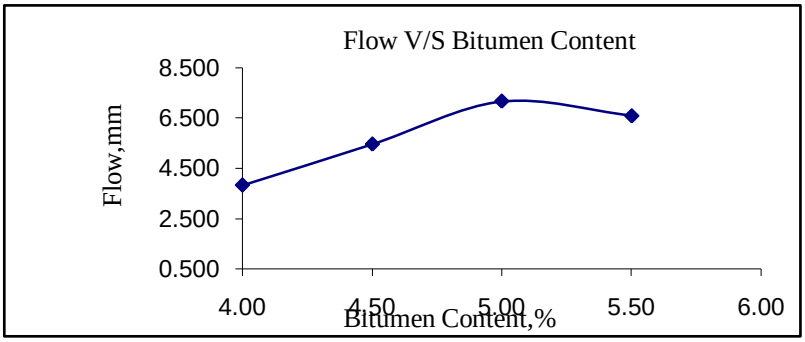


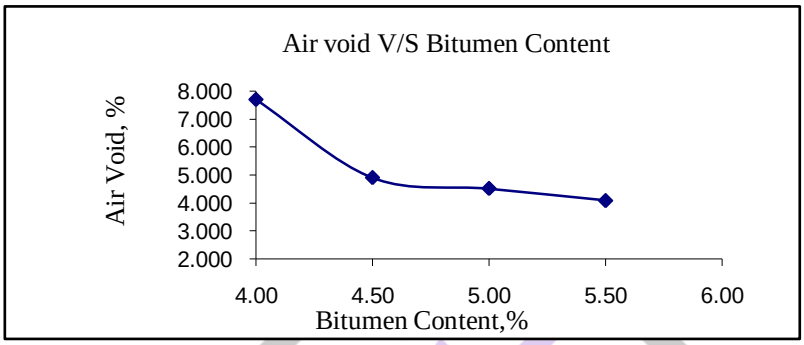
Table 4 Binder Content for Bituminous mix with 8% plastic.

Sl.No	Bitumen content,%	Bulk density,gm/cc	Vv	V_b	VMA	VFB	Marshall stability,kg	Flow, mm
1	4.00	2.380	5.257	11.021	16.476	68.099	619	3.84
2	4.50	2.380	4.569	12.285	16.854	72.893	692	5.47
3	5.00	2.375	4.097	13.312	17.410	76.470	1053	7.71
4	5.50	2.368	3.759	14.307	18.066	79.233	795	6.60









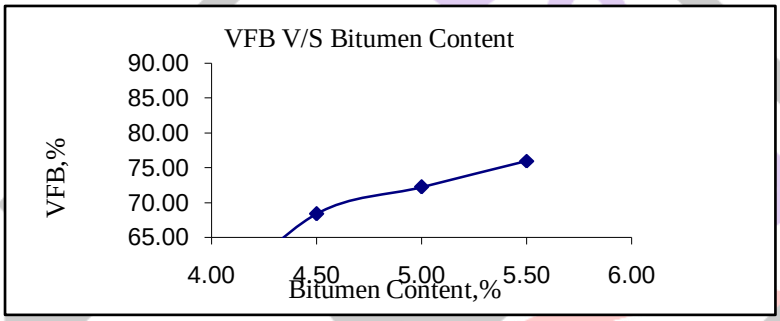
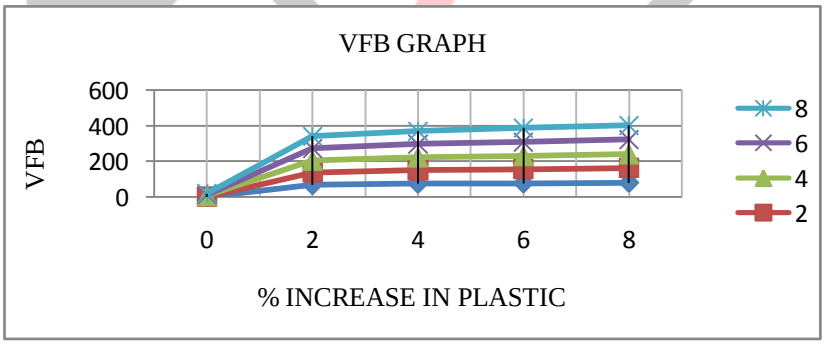
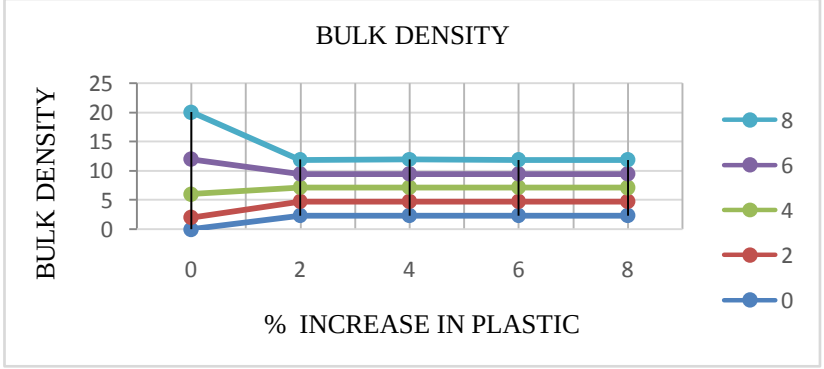
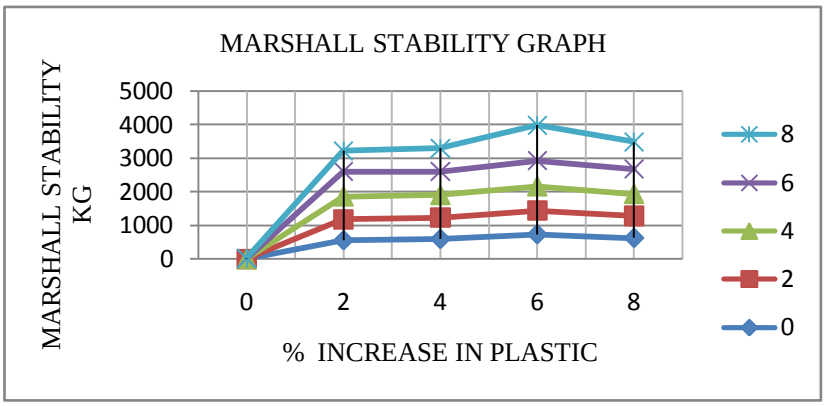
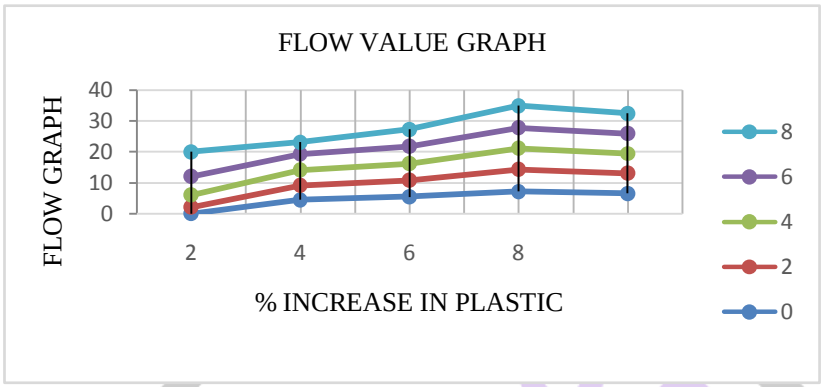


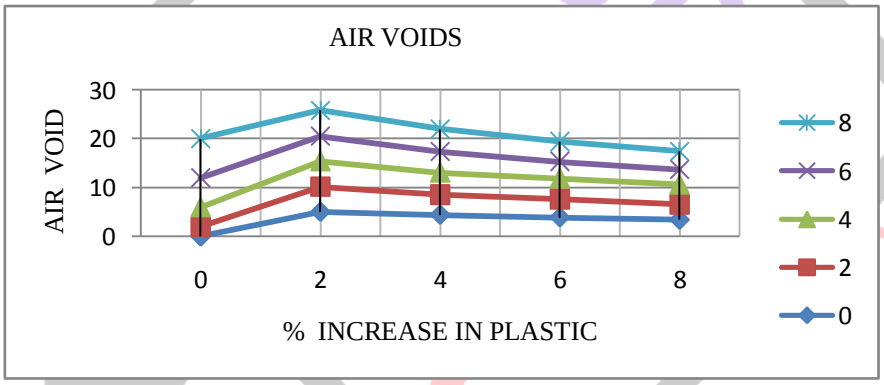
Table 5 COMPARISION GRAPH OF 2,4,6,8 PERCENTAGES OF PLASTICS











VI. CONCLUSION

[1] In the present study, the importance was to add the shredded waste plastic to bituminous mix and to evaluate the various mix properties like Marshall Stability, flow, bulk density, voids in the mix and VFB.

[2] Indirect tensile strength was investigated for OBC and 8% plastic coated on aggregates which had yielded the highest marshal stability.

[3] The addition of waste plastic modifies the properties of bitumen.

[4] The modified bitumen shows good result when compared to standard results.

[5] The optimum content of waste plastic to be used is between the range of 5% to 10%.

[6] The problems like bleeding are reduce in hot temperature region. Plastic has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic.

[7] The waste plastics thus can be put to use and it ultimately improves the quality and performance of road.

VII. ACKNOWLEDGEMENT

The authors would like to thank Dr. B Radheshyam, Professor and Head, Department of Civil Engineering, and Mr. Anand V.R, Assistant Professor, Department of Civil Engineering, for helping us to take permission from concerned authorities and also our project guide Mr Ullas S l. The authors are grateful to all the members of Maintenance Department of SMVITM, Bantakal for providing us with the necessary information.

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