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Toner Modified Bitumen-A better method of disposal of spent Toner

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Abstract:- Use of waste toner from copiers and printers as a binder modifier in road construction is presented in this paper. Various properties of bituminous mixes using ordinary bitumen and toner modified bitumen were studied. Since the properties are improved, this can be considered as a better solution for the disposal of waste toner.

Keywords:- Toner, bitumen, penetration value, softening point, optimum bitumen content, mix design.

I. INTRODUCTION

Waste toner from copiers and printers is a serious solid waste, difficult to dispose. It is usually dumped in to landfills since there is no other way of utilising this material. As a fine powder, toner can remain suspended in the air for some period, and is considered to have health effects compared to dust. This work deals with the use of toner modified bitumen for road constructions. The various properties of ordinary bitumen and toner modified bitumen are compared. Marshall stability value, flow value and other parameters of bituminous mixes(ordinary and toner modified) were also compared.

II. LITERATURE REVIEW

A cooperative research project, 7-3933, undertaken by the Texas Department of Transportation and The University of Texas at Austin[3], investigated the feasibility and potential benefits of utilising waste toner in hot mix asphalt. It is concluded that the properties of asphalt are improved a lot when modified with toner. Galliford (2004) explained the ill effects of toner. "Use of waste in Asphalt concrete" published by Centre for Transportation Research[4] described the mix designs with toner modified bitumen. Ayers,M.E.etal.[5] explained the incorporation of waste Toner in asphalt concrete highways.

III. MATERIALS AND PROPERTIES

The materials used for the preparation of mix are

A. **Aggregates.**

Aggregate was obtained from a local quarry and the physical properties were tested in the laboratory and are given in Table 1. To get the required gradation, three grades (A,B,C) of aggregates were used. Cement was used as a filler material.

Table 1. Properties of Aggregates

Sl.No	Property	Test result	Remarks
1	Aggregate crushing value	30%	satisfactoy
2	Impact value	28%	
3	Specific gravity	2.73	
4	Los Angeles Abrasion value	42%	
5	Flakiness Index	13.48%	
6	Elongation index	8.87%	
7	Water absorption	0.4%	
8	Soundness	10%	
9	Stripping value	0%	

B. Bitumen.

80/100 bitumen was obtained from Cochin refineries Ltd. The physical properties of this bitumen are shown in Table 2.

C. Toner.
Spent toner obtained from photocopiers.

D. Filler.
Ordinary Portland cement was used as the filler material.

Table.2 Properties Of Ordinary Bitumen

Sl.No	Property	Test result	Remarks
1	Softening point of bitumen	41^0C	satisfactory
2	Ductility Value	82cm	
3	Specific gravity of bitumen	1.0	
4	Penetration Value	65	
5	Viscosity of bitumen	72sec	

E. Marshall method of mix design

The mix design should aim at an economical blend, with proper gradation of aggregates and adequate proportion of bitumen so as to fulfil the desired properties of mix.

1) Proportioning of aggregates.

It is done by Rutherfoth method and different proportions are shown below:

Aggregate A- 15%
Aggregate B- 32%
Aggregate C- 51%
Cement- 2% (filler)

The final gradation of the mix with the requirement of MOST (Ministry Of Surface Transport) is shown in Table 4

Table 4. Resulting Grading

Sieve opening(mm)	%Finer	MOST specifications	Remarks
26.5	100	100	satisfactory
19	97	90-100	satisfactory
9.5	71	56-80	satisfactory
4.75	41	35-65	satisfactory
2.36	24	23-49	satisfactory
0.3	5	5-19	satisfactory
0.075	3	2-8	satisfactory

Toner was added to bitumen at different percentages by weight of bitumen and the properties were studied and are shown in Table 5

Table5. Properties of Toner modified Bitumen

Toner (%)	Penetration(mm)	Softening point$^{(0}$C)	Sp.Gravity	Viscosity(sec)
0	93	40	1.0204	93
8	45.6	48.5	1.0249	104
10	33.33	52.2	1.0296	110
12	27.67	52.5	1.0347	119
14	18	53.25	1.0365	128
16	12.33	68.40	1.0489	135

1) Preparation of Test Specimen

The standard specimens were prepared with ordinary bitumen and toner modified bitumen at different percentages of

Toner. Three specimens of each were prepared and tested.

2) Properties of Compacted specimens.

The various properties tested are specific gravity, percentage air voids (V_V), percentage Voids in Mineral Aggregate(VMA), percentage Voids Filled with Bitumen(VFB) and bulk density. The variations of these properties with different %bitumen are shown in Fig 1 to 5.The test results for different specimens are shown in Table 5.

Table 5 Marshall Properties of Specimens with Ordinary Bitumen

Bitumen by weight of mix (%)	Specific gravity		Voids %		
	Bulk average	Theo. max.	VMA	VFB	Vv
4.5	2.34	2.4	14.598	67.590	4.731
5	2.344	2.375	14.587	72.790	3.969
5.5	2.357	2.408	14.850	78.380	3.210
6	2.348	2.405	14.956	78.670	2.901

IV. TEST RESULTS AND ANALYSIS

Marshall Stability value and flow value of specimens with ordinary bitumen is shown in Table 6.

Table 6 Marshall Test Results (Ordinary Bitumen)

Bitumen by wt. Of mix	Marshall stability value(kN)	Flow value (mm)
4.5	7.46	2.54
5	8.64	2.589
5.5	6.015	2.593
6	5.136	2.612

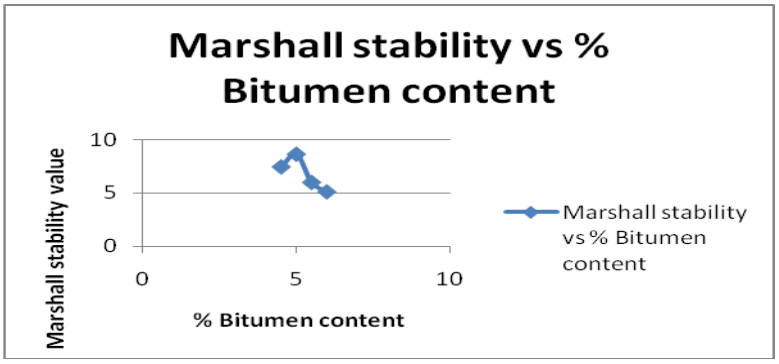

Fig 1. Marshall Stability vs% Bitumen

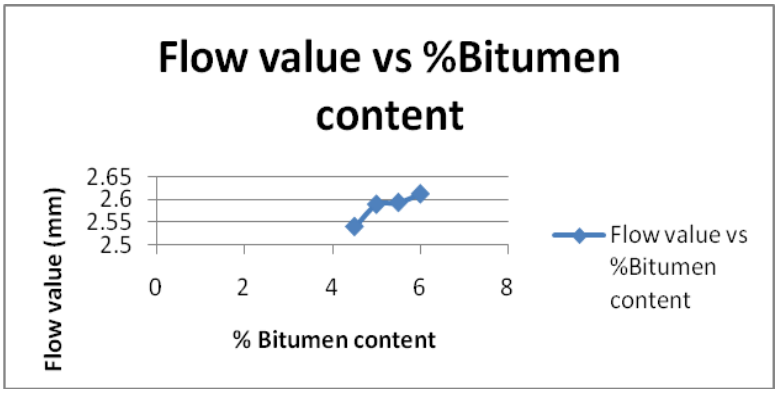

Fig 2. Variation of Flow value with % Bitumen content

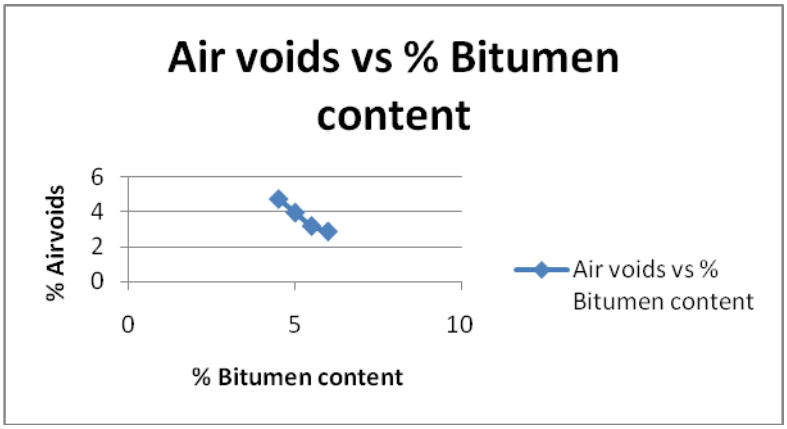

Fig.3 variation of %Vv with % bitumen content

Fig 3. Air voids vs Bitumen content

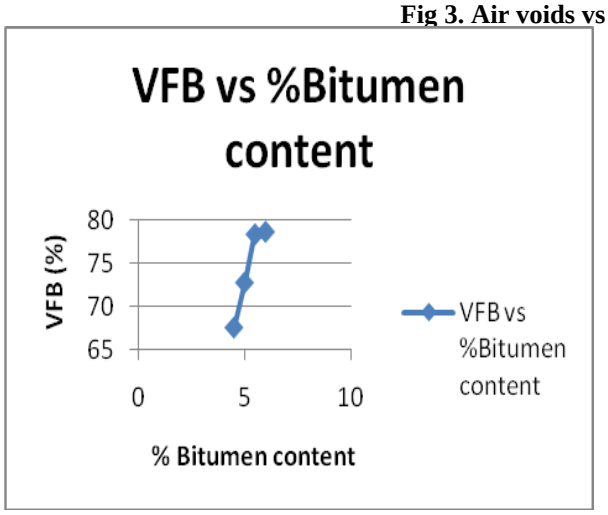

Fig 4.VFB vs % Bitumen content

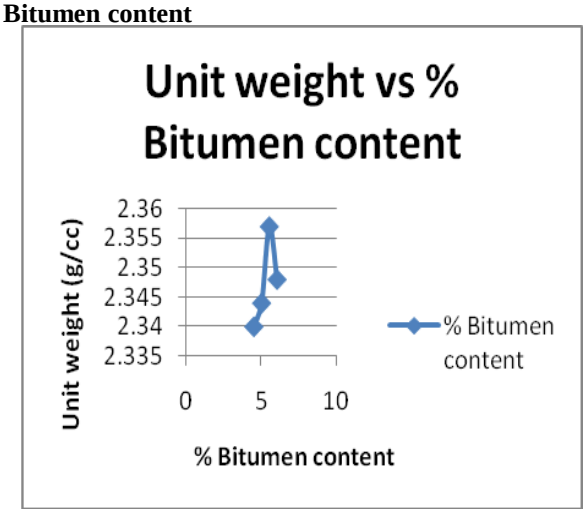

Fig 5.Unitweight vs Bitumen content

The optimum bitumen content is calculated by taking the average of the following bitumen contents found from the respective graphs.

- Bitumen content corresponding to maximum stability
- Bitumen content corresponding to maximum unit weight
- Bitumen content corresponding to the median of designed limits of percentage voids (Vv) in the total mix.

The value of optimum bitumen content is 5.2%

With this optimum bitumen content the various properties of toner modified bituminous mixes were tested for different percentages of toner content and is shown in Table 7.

Table7. Marshall Properties Of Toner Modified Bituminous Mix.

Particulars	**Toner %**				
	8	10	12	14	16
Unit weight	2.292	2.317	2.351	2.309	2.235
%Air voids	9.875	9.603	7.840	6.560	4.056
VMA(%)	19.23	17.331	8.967	10.609	13.447
Marshall	9.625	12.670	10.00	7.44	5.59
Flow	2.250	2.133	2.167	2.20	2.50

The variation in these properties is shown in Fig. 6 to Fig. 10

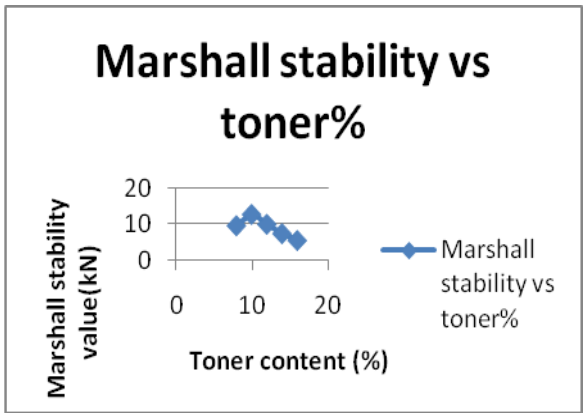

Fig 6. Marshall stability value vs % Toner content

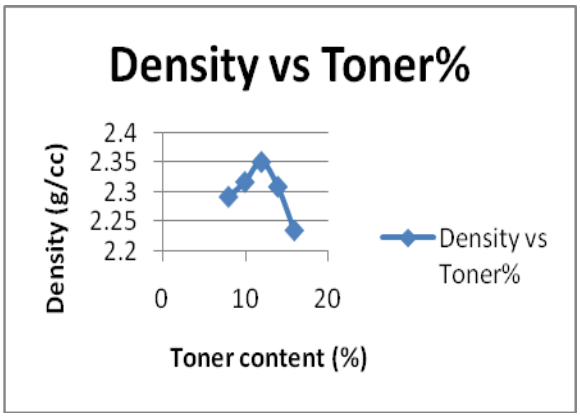

Fig 7.Density vs % tonercontent

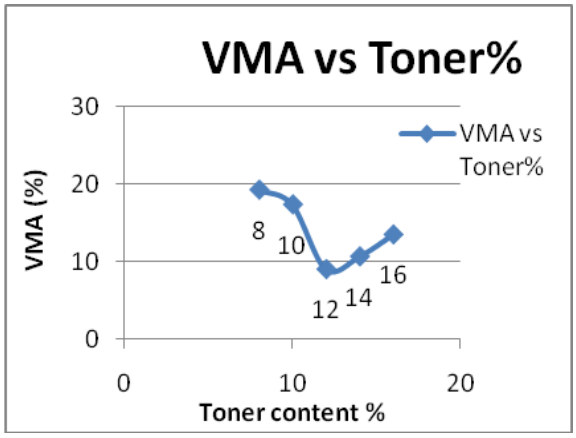

FIG 8.VMA VS TONER CONTENT (%)

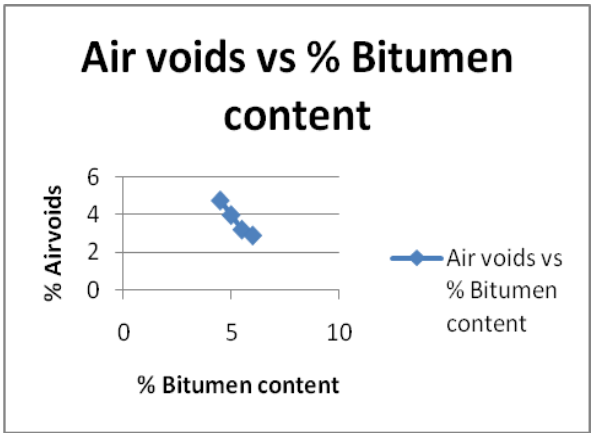

FIG 9. AIR VOIDS VS TONER CONTENT (%)

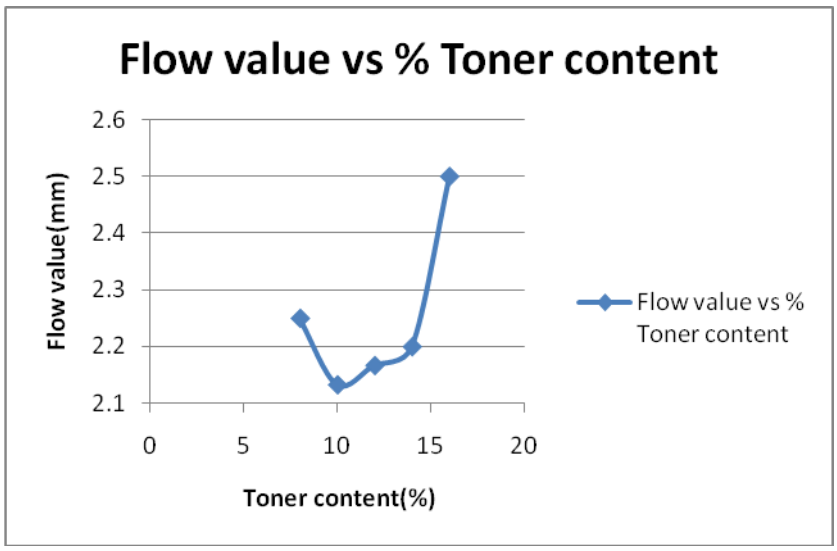

Fig 10 .Flow value vs % Toner content

V. CONCLUSION

With a view to improve the pavement characteristics of the flexible pavement using Toner midified Bitumen, the following conclusions are made.

- The properties of Bitumen which mainly because rutting action are improved using Toner modified Bitumen.
- Considerable increase in Marshall Stability value at 10% Toner.
- The various properties are improved using Toner modified Bitumen.

- Above all the waste spent Toner which is a pollution menace can find its use in road construction and thereby solving the problem of pollution to a certain extent.

REFERENCES

[1]. IRC SP:16-2004,Guide lines for surface evenness of highway pavements.
[2]. IRC SP: 53-2002, Guide lines on use of polymer and rubber modified bitumen in road construction
[3]. Yildrim,Y., The Modified Asphalt Demonstratiproject (2007), http:///www.utexas.edu/research/ctr/pdf_report/5_3933_01_2.pdf
[4]. Korkmaz, Arnagan, Prozzi, Jorge,Y.,Yetkin(19980, Toner midified Asphalt, Transportation Research Board,ISSN:0361-
[5]. 1981,Volume1638/1998,pp120-128
[6]. Ayers, M.E., and R.Tripathi. Incorporation of Xerox Waste Toner Material in Asphalt cement concrete, Research reportDHT-36, Texas Department Of Transpotation,1994.