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UTILIZATION OF WASTE PLASTIC IN BITUMINOUS CONCRETE MIX

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ABSTRACT:

Disposal of lot of waste like plastic, poly bags, bottles etc, which are produced in enormous amount and causes ecological hazards after disposal. Disposal of waste is a main problem as they are non-biodegradable, present study attempts to make use of these wastes to improve performance of bituminous. Test results shows that the strength increases up to 16% due to partial substitution of bitumen with plastic waste. The laboratory test results shows that bituminous concrete of the required density and strength can be obtained by using plastic wastes and also with lower material cost eco-friendly green pavement can be prepared.

Keywords: Plastic waste, Optimum binder content, Optimum plastic content,Bitumen.

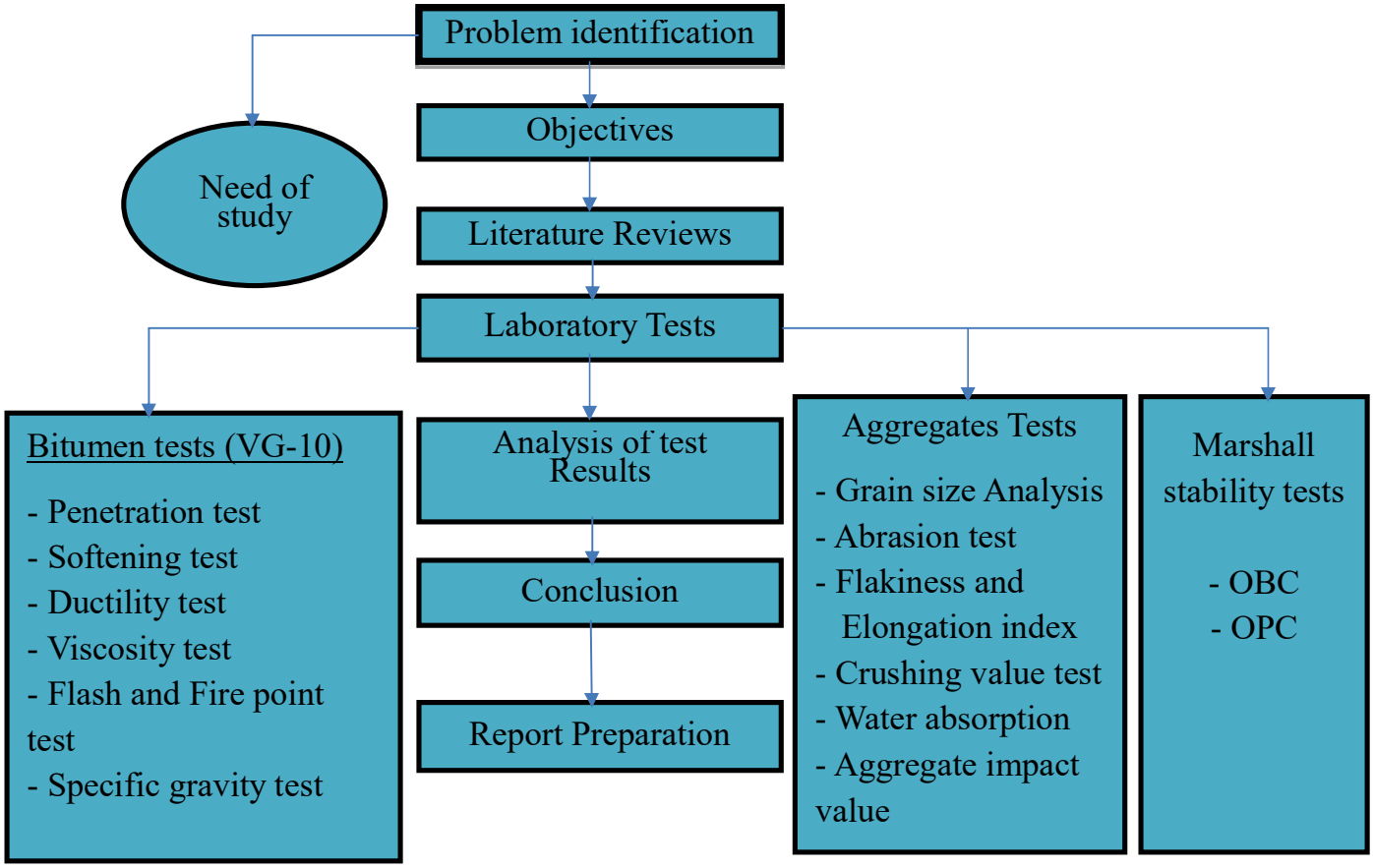
Introduction:

Plastics become a problem for the environment after their use. Disposing of a variety of plastic and rubber waste in an eco-friendly manner is the focus of current research. In view of the current lifestyle, the use of plastic waste cannot be completely prohibited, although plastic waste taking the face of a devil for the present and future generation. Plastic roads perform better than ordinary roads because plastic roads have better wear resistance than ordinary roads and Plastic roads are more durable. In hot and extremely humid climates, durable and environmentally friendly plastic roads are the biggest advantages. It will also help reliving the earth from all kinds of plastic waste.

II. METHODOLOGY

The procured materials for the project work are:

- Coarse aggregates
- Waste plastic
- Asphalt



III.LITERATURE REVIEW

3.1 Evaluation of modified bituminous concrete mix developed using rubber and plastic waste materials.

Shubham Bansal, Anil Kumar Misra, PurnimaBajpai.

Various materials that become waste after their useful life, such as plastic bottles, can be used as a partial replacement in the bituminous concrete mixture, which can help in the increasing demand for bitumen in road construction. Using waste materials such as plastic bottles in the bituminous concrete mix lowers the cost of road construction.

3.2 Utilization of Plastic waste in Bitumen Mixes for Flexible Pavement.

Dr. S. L. Hake, Dr. R. M. Damgir, P. R. Awsarmal.

The optimum bitumen content of pure semi-dense bituminous concrete mixes was found to be 10% higher than that of semi-dense bituminous concrete mixes modified with plastic waste The Marshall stability of pure semi-dense bituminous concrete mixes at optimum bitumen content showed 1.6% less when compared to semi dense bituminous concrete mixes modified with plastic waste.

3.3 Effect of waste polymer modifier on the properties of bituminous concrete mixes.

Sangita, TabrezAlam Khan, Sabina, D.K. Sharma.

The effect of waste polymer modifier on bituminous concrete mixes shows that the waste polymer modifier is thermally stable up to 230°C, so it will not degrade when mixed with hot aggregates.

3.4 Sustainable use of waste plastic modifiers to strengthen the adhesion properties of asphalt mixtures.

SafeerHaider, Imran Hafeez, Jamal, Rafi Ullah.

In modifiers, low density polyethylene improves the performance bituminous mixtures. In the mixing methods, the wet mixing method was better than the dry mixing method. When the modifiers were wet mixed, there is less loss of asphalt binder coating, along with less rut depth, loss of marshall stability, and higher TSR values.

3.5 Use of waste high density polyethylene as bitumen modifier in asphalt concrete mix.

Sinan Hinishoglu, Emine Agar.

It is concluded that the samples prepared with a mixing temperature of 165°C and a mixing time of 30°C for 4% HDPE have the more stability and the less flow, and thus the highest Marshall ratio.

3.6 Experimental investigation on modification of rheological parameters of bitumen by using waste plastic bottles.

SudheerPonnada ,Vamsi Krishna K.

The addition of plastic to the bitumen should reach the optimum level, beyond the optimum value, the rheological properties and stability values decrease, which is not recommended for good pavement design.

3.7 An Experimental Study on Plastic Blended Bituminous Concrete Mix Roads.

T. Sarada , G. Sreeja.

Stripping of the bitumen due to the plastic mixture is reduced. The formation of potholes on the roads are considerably reduced with 6% plastic, but from strength point of view, 8% gives better results.

3.8 An experimental study on the properties of extruded Polystyrene waste polymer modified bitumen for flexible pavements.

S. Abinaya, M. Clement, Dr. S. Shanmugam.

The test results shows that the penetration value of bitumen increases due to use of extruded polystyrene waste polymer.

3.9 Improving the Properties of Asphalt Concrete Using Waste Plastic Bottle as Additive.

RocksanaAkter, Md. Rabiul Islam and Kazi Abu Manjur.

The results indicate that mixing WPB with an asphalt concrete mix performs better than the conventional mix and improves its properties with increasing amounts of WPB.

3.10 Optimum Use of Plastic Waste to Enhance the Marshall Properties and Moisture Resistance of Hot Mix Asphalt.

Assist. Prof.Dr. Hamed M Jassim, Assist. Lect. Omar T Mahmood, Assist. Lect. Sheelan A Ahmed.

Plastic wastes are used to increases bituminous performance. Marshall stability increases due to addition of plastic waste.

3.11 Evaluation of the effect of recycled waste plastic bags on mechanical properties of hot mix asphalt mixtures for road construction.

NakachewAssefa.

The use of plastic waste in bituminous mixes improves the stability of the mix.

3.12 Study the Use of Cement and Plastic bottle Waste as Ingredient Added to the Asphaltic Concrete Wearing Course.

Lilies Widojoko, P. Eliza Purnamasari.

The stability of the mixture is maximum for 4% of plastic. Laboratory tests shows that for plastic content more than 4% stability decreases.

3.13 A Study on use of Plastic Waste in Flexible Pavements.

T. KiranKumar ,J.Vikranth.

The construction cost of flexible pavements reduces due to the utilization of waste plastic. The properties of bitumen and aggregates increases due to the utilization of waste plastic.

3.14 USE OF WASTE PLASTIC IN BITUMINOUS CONCRETE.

AmanKhimta, Sahil Arora.

The strength and the life of road increases due to use of plastic mix. The use of plastic increases the melting point of bitumen.

3.15 REDUCTION IN CONSUMPTION OF BITUMEN BY USE OF PLASTIC-COATED AGGREGATES IN BITUMINOUS MIXES OF FLEXIBLE PAVEMENTS.

Brajesh Mishra, Dr.U.K. Maheshwari, and Dr.M.K. Gupta.

It concluded that use of plastic reduces porosity, moisture absorption and improves binding property of the mix.

IV. RESULTS AND DISCUSSIONS

1.TESTS ON AGGREGATES

Tests that are taken for the examination of the development of asphalt are given in beneath table 1 with correlation of standard satisfactory qualities as per their specific code determined.

Table 1: TESTS ON AGGREGATE

SLNO	TESTS	RESULTS	PERMISSIBLE VALUE	IS CODE
1	AGGREGATES CRUSHING VALUE	26%	30%	IS:2386(PART-IV)
2	IMPACT VALUE	21%	30%	IS:2386(PART-IV)
3	SPECIFIC GRAVITY	2.65	2.5-3	IS:2386(PART-III)
4	WATER ABSORBTION	0.15	2%	IS:2386(PART-III)
5	LOS ANGELES ABRASION TEST	30%	35%	IS:2386(PART-IV)
6	FLAKINESS INDEX	12.69%	-	IS:2386(PART-I)
7	ELONGATED INDEX	5.74%	-	IS:2386(PART-I)

2. TESTS ON BITUMEN

Tests that are taken for the examination of the development of asphalt are given in beneath table 2 with correlation of standard satisfactory qualities as per their specific code determined.

Table 2: TESTS ON BITUMEN

SLNO	TESTS	RESULTS	PERMISSIBLE VALUE	IS CODE
1	RING & BALL TEST (SOFTENING PONIT)	55˚C	56˚C	IS:1205-1978
2	PENETRATION TEST	6.5mm	6.0-7.0mm	IS:1203-1978
3	FLASH & FIRE POINT TEST	320˚C (FLASH) 340˚C (FIRE)	>175˚C	IS:1209-1978
4	VISCOSITY TEST	8 seconds	-	IS:1206-1978
5	SPECIFIC GRAVITY TEST	1.025	0.97-1.02	IS:1202-1978

3. MARSHAL METHOD OF MIX DESIGN

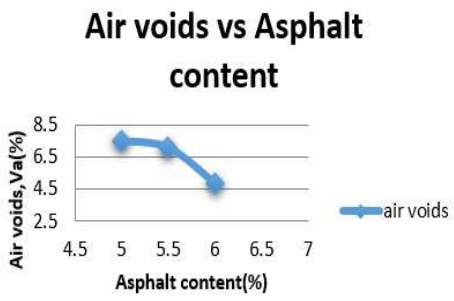
The mix design should aim at an economical blend, with proper gradation of aggregates and adequate proportion of bitumen so as to fulfil the desired properties of mix.

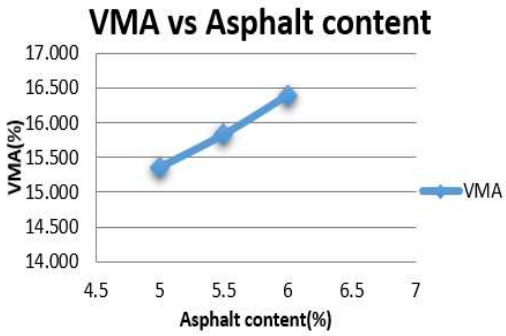
Table 3: AGGREGATE GRADATION FOR BC-GRADE 2

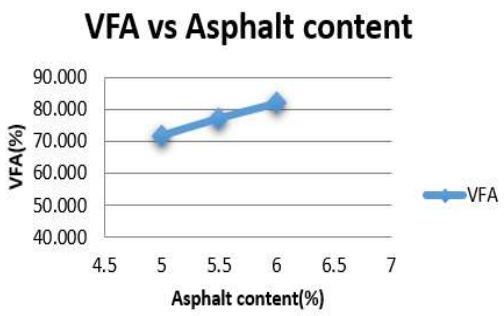
Sieves (mm)	Cumulative Percentage Passing (MORTH 2013)	Gradation Used for The Current Investigation
19	100	100
13.2	90-100	95
9.5	70-88	79
4.75	53-71	62
2.36	42-58	50
1.18	34-48	41
0.60	26-38	32
0.30	18-28	33
0.15	12-20	16
0.075	4-10	7

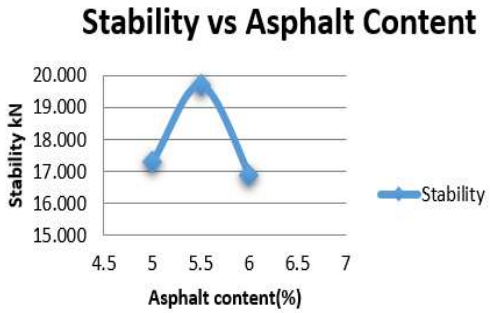
4. DETERMINATION OF OPTIMUM BINDER CONTENT

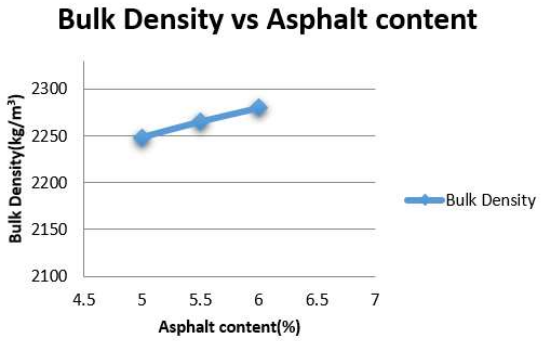
Bitumen By Weight Of Mix (%)	Avg. Marshal Stability (kN)	Flow (mm)	Bulk Density (kg/m3)	VMA (%)	VFA (%)	Air Voids (%)
5	17.030	2.33	2248	15.360	71.742	4.340
5.5	19.685	3.83	2265	15.830	77.151	3.617
6	16.884	3.33	2280	16.390	81.827	2.979

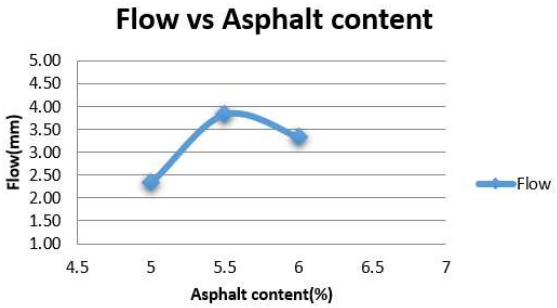












Determining Optimum Binder Content:

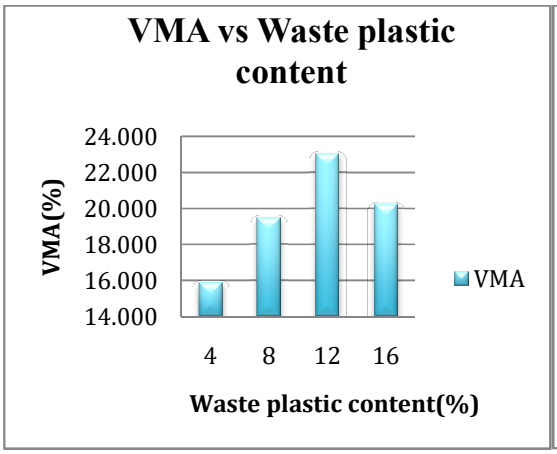
The ideal bitumen content is determined by taking the normal of the accompanying bitumen contents found from the individual charts.

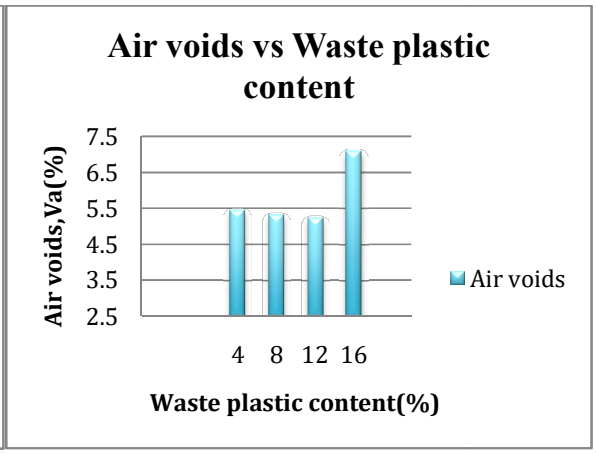
- Bitumen content comparing to most extreme stability.
- Bitumen content comparing to most extreme Bulk density.
- Bitumen content comparing to 4% of air voids.

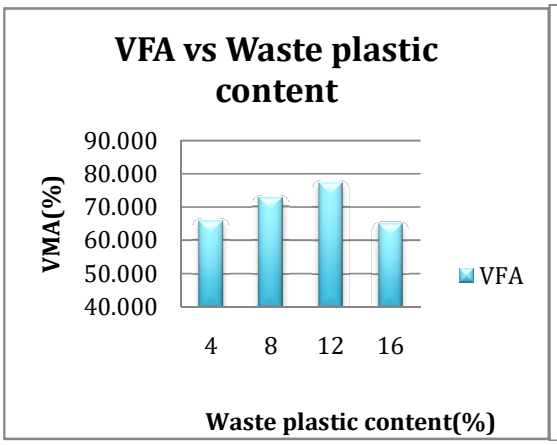
The optimum binder content determined as 5.5%.

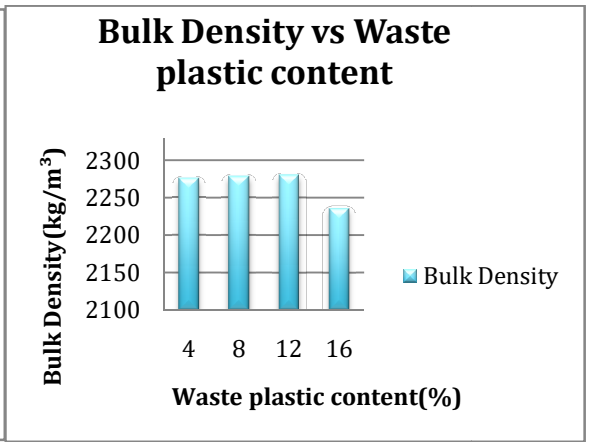
With this ideal bitumen content, the different properties of Plastic modified bituminous blends were tried for various dosage of waste plastic content.

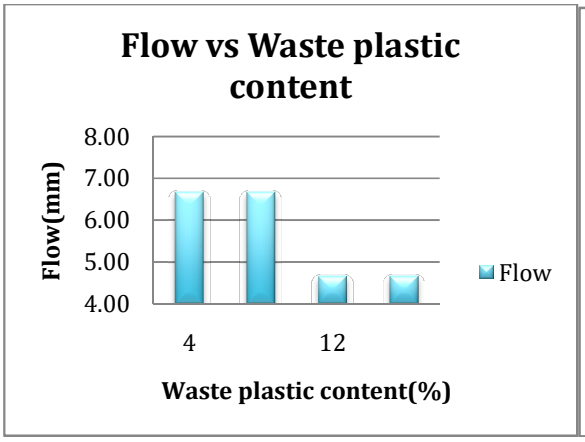
WTC	AV	VMA	VFB	BULK DENSITY	STABILITY	FLOW
4	5.439	15.880	65.749	2275.4	18.550	6.67
8	5.318	19.463	72.674	2278.3	24.904	6.67
12	5.234	23.035	77.276	2280.32	26.003	4.67
16	7.088	20.239	64.978	2235.714	25.509	4.67

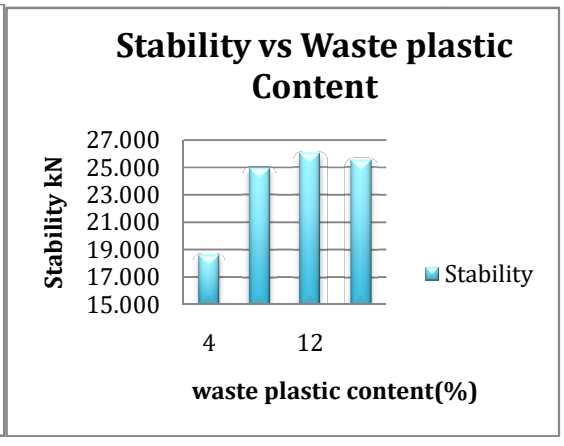

VMA vs Waste plastic content
VMA(%)
24.000
22.000
20.000
18.000
16.000
14.000
4
8
12
16
VMA
Waste plastic content(%)


Air voids vs Waste plastic content
Air voids,Va(%)
7.5
6.5
5.5
4.5
3.5
2.5
4
8
12
16
Air voids
Waste plastic content(%)


VFA vs Waste plastic content
VMA(%)
90.000
80.000
70.000
60.000
50.000
40.000
4
8
12
16
VFA
Waste plastic content(%)


Bulk Density vs Waste plastic content
Bulk Density(kg/m3)
2300
2250
2200
2150
2100
4
8
12
16
Bulk Density
Waste plastic content(%)


Flow vs Waste plastic content
Flow(mm)
8.00
7.00
6.00
5.00
4.00
4
12
Flow
Waste plastic content(%)


Stability vs Waste plastic Content
Stability kN
27.000
25.000
23.000
21.000
19.000
17.000
15.000
4
12
Stability
waste plastic content(%)

CONCLUSION:

- Optimum binder content obtained as 5.5%.
- Considerable increase in marshal stability value obtained at 12% of Plastic.
- Overall, the waste burned through Plastic which is a contamination danger can track down its utilization in street development and subsequently taking care of the issue of contamination partially.

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