Effect on Replacement of Stone Dust Filler with Waste Glass Powder and Wood Ash in Bituminous Mix

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***Abstract*:- Generation of wastes in our daily life continuously from industries, houses and agricultural residue creates severe environmental issues in terms of treatment and disposal in all over the world. Utilization of wastes and residue in construction work is an excellent alternative solution to treatment as well as in reducing disposal problems. In this research, the application of waste glass powder and Wood Ash in bituminous Concrete mix is investigated as replaced filler material in place of natural crushed Stone dust. Bituminous Mix specimens were prepared using crushed stone dust without waste materials as a control material. The waste glass powder and wood ash were partially replaced with 25% and 5%, 50% and 10%, 75% and 15%, 75% and 20% by weight of total mix respectively to test Marshal Stability and to obtain the Optimum bitumen content and Optimum filler content. Results indicated at 75% replacement of waste glass powder and 15% wood ash to the crushed stone dust with 5.50% bitumen content provided 12.0kN Marshall stability value, 4.1 mm Flow value. Hence, the mixture of 75% waste glass powder and 15% wood ash by weight of crushed stone dust filler meets the minimum requirements of MORTH.**

Keywords: Waste Glass Powder, Wood Ash, Marshall Stability, Flow Value.

I. INTRODUCTION

Bituminous mix (commonly called asphalt, blacktop or pavement in North America, and tarmac, bitumen macadam, or rolled asphalt in the United Kingdom and the republic of Ireland) is a composite material commonly used to surface roads, parking lots, airports, and the core of embankment dams. Asphalt mixtures have been used in pavement construction since the beginning of the twentieth century. It consists of mineral aggregate bound together with asphalt, laid in layers, and compacted. The process was refined and enhanced By Belgian-American inventor Edward De Smedt. The terms asphalt (or asphaltic) mix, bituminous asphalt mix, and bituminous mixture are typically used only in engineering and construction documents, which define as any composite material composed of mineral aggregate adhered with a binder. The abbreviation, ac, is sometimes used for asphalt mix but can also denote asphalt content or asphalt cement, referring to the liquid asphalt portion of the composite material. The asphalt is a mixture which consists alumina, lime, silica and asphaltic bitumen. At low temperatures, it is in solid state and at high temperatures it is in liquid state.

The Aim of the study is to Evaluate the effect of Waste glass powder and Wood ash as a filler in Bituminous mix., to Evaluate the Marshall Stability value of Wood ash and Waste glass powder as a filler in Bituminous mix. To Find out the Flow Value of Wood ash and Waste glass powder as a filler in Bituminous Mix. Also to Find out the Optimum Binder content for Bituminous mix with fillers.

II. MATERIALS AND METHODOLOGY

2.1 Materials.

a) Aggregates
b) Bitumen
c) Wood ash
d) Waste glass powder

a) Aggregates

Aggregates are coarse particulate rock-like material consisting of a collection of particles ranging in size from < 0.1 mm to > 50 mm. It includes gravel, crushed rock, sand, recycled concrete, slag, and synthetic aggregate. types of aggregates include coarse aggregate and fine aggregate.
Aggregates were collected locally from various sources with proper grading requirements.

Test on Coarse aggregates and Fine aggregates

(1)Specific Gravity of Fine Aggregates : 2.72
(2) Specific Gravity of Coarse Aggregates : 2.68
(3) Finess modulus of Fine Aggregates : 2.50
(4)Finess modulus of Coarse Aggregates : 2.90

(5)Impact test on Coarse Aggregates: 16.11%.
(6)Crushing test on Coarse Aggregates: 18.70%.
(7)Abrasion test on Coarse Aggregates: 25.35%.

b) Bitumen

Bitumen is a residual material during the process of refining crude oil into liquefied petroleum gas (lpg) and gasoline. Bitumen is produced as a byproduct during the distillation process for heavy crude as such refiner decisions to process heavy versus light crude plays is critical for bitumen price. Bitumen used in this research is 60/70 bitumen which was collected from bituminous mix batching plant which is near to channagiri taluk, Davanagere District.

Test on Bitumen :

1) Specific Gravity test: 1.012
2) Ductility test: 68.53 mm
3) Softening point test: 59.24^{O} C
4) Viscosity test: 114 sec
5) Penetration test: 63 mm

c) Bitumious mix

Bituminous mix is one of the most common types of pavement surface materials used in the world. It is a porous material made at a very high temperature of about 180°c that consists of mixture of asphalt binder (bitumen), aggregate particles, and air voids.

d) Wood Ash

Waste Glass powder (WGP) is a waste material and it becomes granulated by sieving by means of sieves after they are crushed in the breaker and milled. It is used for surface treatment by blasting, reinforcement of synthetic resins, and path lines.
Wood ash (WA) was obtained from local hotels in Davangere where it is used as source of fuel in their cooking.

Test on wood Ash:

c) Finess modulus of wood ash: 1.78

e) Waste glass powder

Waste Glass powder (WGP) is collected from local glass work shops where glass is used to photo frame works.

Test on Waste glass powder :

(1)Finess, modulus of waste glass powder : 2.65

2.2 Experimental Details.

2.2.1 Mix Design, Means, Modes and Methods:

In this experiment the mix design is done as per MORTH code book for bituminous mix. There are 3 methods for MIX DESIGN such as 1) JOB MIX FORMULA METHOD. 2) TRIAL AND ERROR METNHOD. 3) ROTH FUTUCH METHOD .
In these three methods wehave followed JOB MIX FORMULA METHOD according to MORTH. Total 20 moulds are prepared for various % of fillers and various % of bitumen content. The Coarse Aggregates are taken as40% , Fine Aggregates as 35% and Fillers as 25%.

Figure 1: Preparation of Moulds

Table 1: Quantity of Materials

Sl. No.	Samples	Trial 01	Trial 02	Trial 03	Trial 04
1.	Quantity of cake	1	1	1	1
2.	Bitumen %	4.50	5.00	5.50	6.00
3.	Total aggregates %	95.50	95.00	94.50	94.00
4.	Weight of cake in gms	1250	1250	1250	1250
5.	Weight total aggregates in gms	1194	1188	1181	1175
6.	Weight of 10 mm aggregates in gms	476	475	473	470
7.	Weight of crush sand in gms	418	415	413	411
8.	Weight of fillers in gms	299	298	295	294
9.	Weight of bitumen in ml	57	62	69	75

Figure 2: Moulds sample for testing

Figure 3: Specimens @ 60° C

2.3 Testing of Specimens and Results

2.3.1 Marshall Stability Value for Bituminous Mix (in kN)

Table 2: Stability Value for Bituminous Mix

SI. No.	01	02	03	04
Binder Content	4.5	5.0	5.5	6.0
Bituminous mixture with 25% of WGP and 5% of WA	9.40	9.68	9.94	9.62
Bituminous mixture with 50% of WGP and 10% of WA	10.23	10.46	10.99	10.52
Bituminous mixture with 75% of WGP and 15% of WA	11.54	11.69	12.21	11.71
Bituminous mixture with 80% of WGP and 20% of WA	11.13	11.32	11.68	11.54

2.4.2 Flow Value for Bituminous Mix in (mm)

Table 3: Flow Value for Bituminous Mix

SI. No.	01	02	03	04
Binder Content	4.5	5.0	5.5	6.0
Bituminous mixture with 25% of WGP and 5% of WA	1.5	1.9	2.8	2.4
Bituminous mixture with 50% of WGP and 10% of WA	2.6	3.3	3.8	3.5
Bituminous mixture with 75% of WGP and 15% of WA	2.8	3.52	4.1	3.7
Bituminous mixture with 80% of WGP and 20% of WA	2.54	3.2	3.6	3.5

2.4.3 Marshall Stability value Charts for Bituminous Mix (in kN)

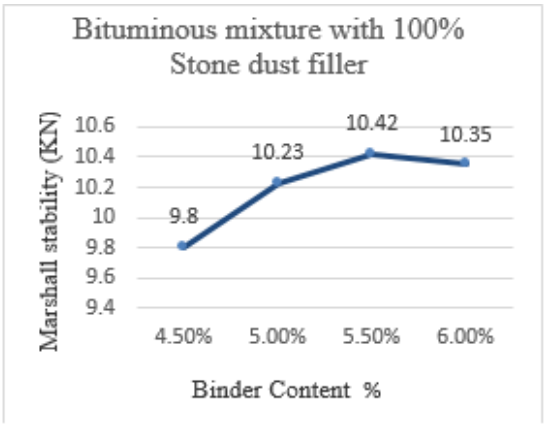

Figure 4: Stability value for 100% filler

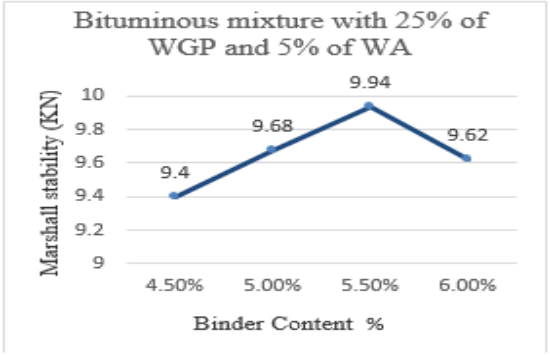

Figure 5: Stability value (25% WGP and 5% WA)

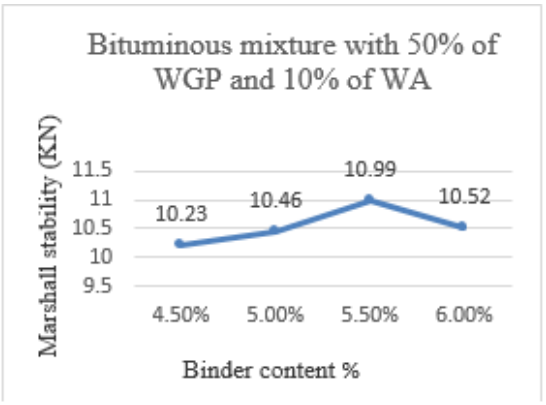

Figure 6: Stability value (50% WGP and 10% WA)

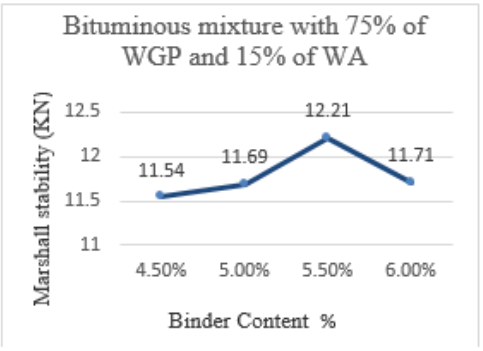

Figure 7: Stability value (75% WGP and 15% WA)

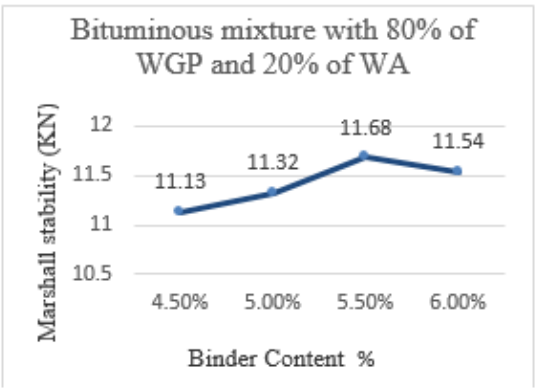

Figure 8: Stability value (80% WGP and 20% WA)

2.4.3 Flow Value Charts for Bituminous Mix (in mm)

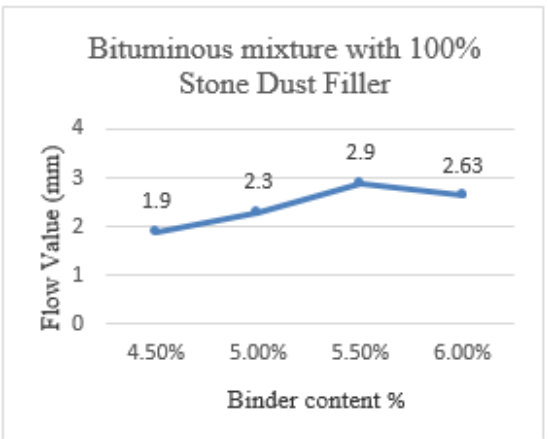

Figure 9: Flow value for 100% filler

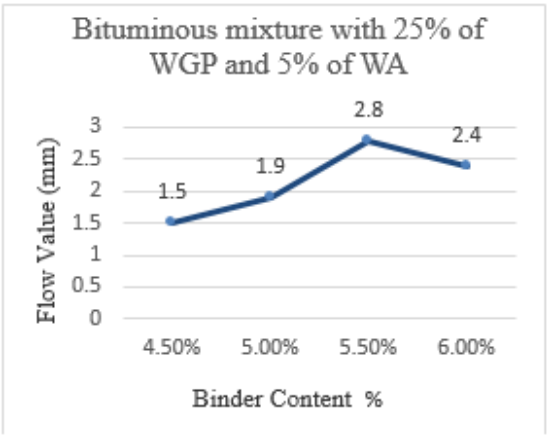

Figure 10: Flow value (25% WGP and 5% WA)

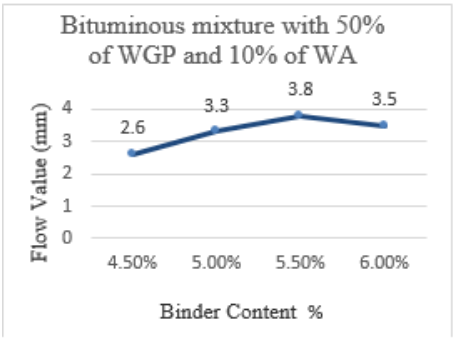

Figure 11: Flow value (50% WGP and 10% WA)

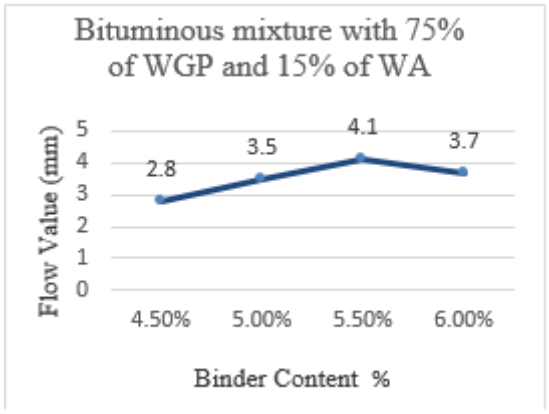

Figure 12: Flow value (75% WGP and 15% WA)

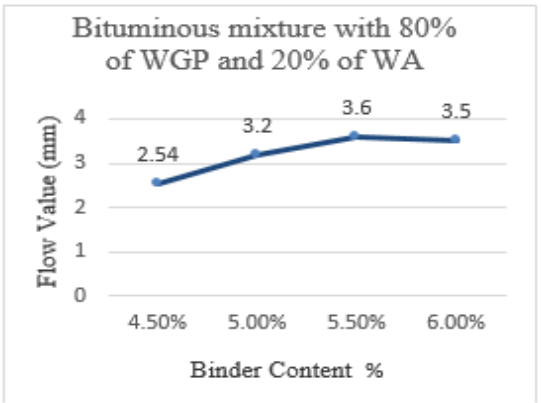

Figure 13: Flow value (80% WGP and 20% WA)

2.4.4 Marshall Stability Chart for bituminous Mixture for various bitumen% (in KN)

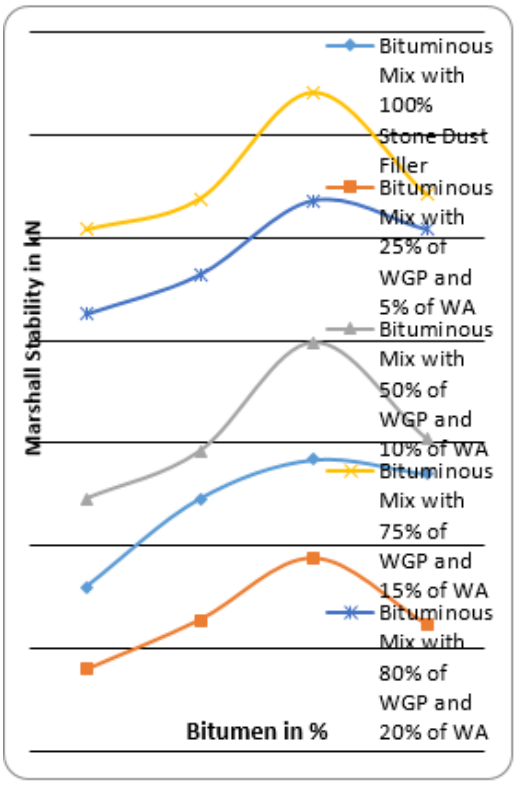

Figure 14: various bitumen% Marshall Stability Curves

2.4.4 Flow Value Chart for bituminous Mixture for various bitumen% (mm)

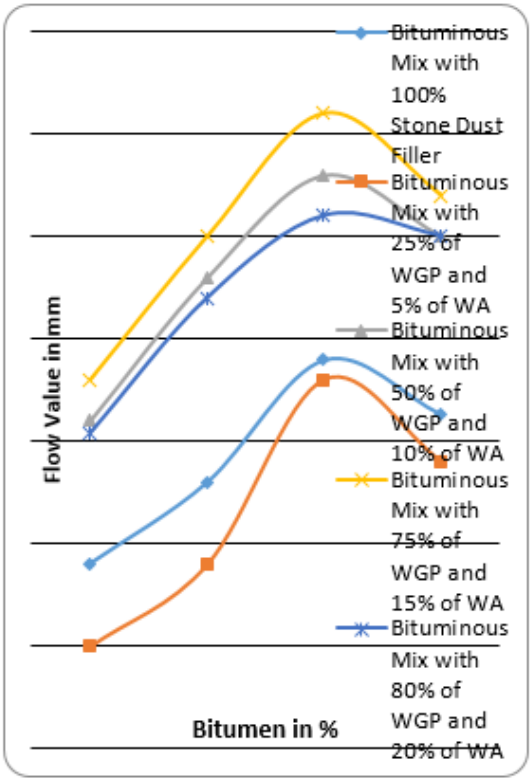

Figure 15: various bitumen% Flow value Curves

IV. ANALYSIS AND DISCUSSION

1. The various tests on Aggregates like Specific Gravity, Sieve Analysis, Impact Test, Crushing test, abrasion test has given satisfactory results which meets the specifications according to MORTH which can be used in respective layer of the pavement.
2. Similarly we have done the tests on bitumen such as Penetration Test, Ductility Test, Viscosity Test, Softening Point Test, and Specific Gravity Test and the results obtained as per specification.
3. The samples prepared by replacing the various percentages of fillers such as waste glass powder and wood ash. There is increase in the stability value upto 75% replacement of glass powder and upon next addition the stability value decreased. Similarly upto 15% of replacement in wood ash, the stability value increased, later stability is decreased.
4. The maximum flow value was 4.1mm for the 75% and 15% combination of WGP and WA was obtained.
5. The optimum binder content in our research was found out be 5.5%.
6. The waste glass powder results in increase in stability value whereas wood ash was responsible for decrease in stability. But the combination of WGP and WA resulted in increase in the strength characteristics.

V. CONCLUSION

1. The waste glass powder results in increase in stability value whereas wood ash was responsible for decrease in stability. But the combination of WGP and WA resulted in increase in the strength characteristics.
2. The optimum binder content for bituminous mix has reached at 5.5%.
3. The maximum Marshall stability value of bituminous mix is 12.11 k N.
4. The maximum flow value of bituminous mix is 4.1 mm.

VI. REFERENCES

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