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UTILIZATION OF FLY ASH AND GLASS POWDER AS A FILLER MATERIAL IN FLEXIBLE PAVEMENTS

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ABSTRACT

Aggregates bound with bitumen are conventionally used all over the world in construction and maintenance of DBM of a flexible pavement. The DBM normally comprises of bituminous mixture comprising of coarse aggregate, fine aggregate and filler heated to suitable temperature, mixed thoroughly with heated bitumen at required viscosity and then compacted. One of the major concerns of mix design of bituminous mix is the type and amount of filler used which may affect the performance of the mix. A number of studies has been made on use of different type of fillers in various types of paving mixes which are presented briefly below. Although the filler particles are small in size, it is well documented that filler exerts a significant effect on the characteristic and performance of asphalt concrete mixture. Good packing of the course aggregates, fine aggregates and filler provides a strong backbone for the mixture. Optimum filler concentration result in stronger pavement attributable to better asphalt cohesively and better internal stability. However, an excessive amount of filler may weaken the mixture by increasing the amount of asphalt needed to coat the aggregates. In general type of filler, type of stabilizer, amount of stabilizer affect not only optimum bitumen content (OBC) of paving mixes but also affect the property like Marshall Stability, tensile strength, retain stability of mixes

Keywords: Fly Ash, Aggregate, Hot Mix.

I. INTRODUCTION

Several ambitious road construction plans and activities primarily involve bituminous pavements with hot mix technology. Hot mix technology which is a very conventional method for road construction, has structurally satisfied the performance requirements over many years. The procedures generally followed by the hot mix

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technology are heating of binder and aggregate, mixing, tack coating, laying of mix followed by the compaction process everything done at high temperature in a range of 120^0C to 165^0C temperature.

Though the emulsion based cold mixes overcome hot mix problems, they have attracted little attention and considered inferior to hot mix as structural layers due to their less satisfactory performance. Thanaya et al. (2009) reported some major problems with cold mixes such as high air-void content in the compacted mixes, weak early life strength due to pre-wetting water, long time required to achieve fully cured samples for maximum performance. In addition to this the pre-wetting water in cold mix which is considered as an important part of the process, becomes a problem since inhibiting compaction. The Ministry of Road Transport and Highways specification introduced the cold mix design procedure which simply followed the Asphalt Institute Manual Series-14 (1997). While MS-14 did not specify any required air void range, MORTH provided the adequate air void range as 3 to 5 at 50 blows of compaction level. But Thanaya (2007) showed that achieving 5 to 10 air void was difficult even at 75 blows of compaction level. Also Pundhir reported a range of 7 to 8 air voids achieved for the cold mix and he also observed the field performance of cold mix in a satisfactory level. Hence, 3 to 5 air void range provided by MORTH seems to be an ideal one, but its feasibility should be proved.

II COLLECTION OF RAW MATERIALS & AGGREGATE

We collected the aggregate from Hot Mix Plant, Ajwani Infra.Pvt.Ltd,Ravet, as per requirement for dense graded bituminous mixture as per grading of aggregates as per MORTH coarse aggregate consist of stone chips up to 4.75 mm IS sieve collected from a local source.

Fine aggregate comprises of stone dust with fraction passing 4.75 mm and retained on

0.075mm IS sieve.

Stone dust less than 0.075mm IS sieve.

BITUMEN

Bitumen is also collected from Hot Mix Plant, Ajwani Infra.Pvt.Ltd, Ravet, of grade VG 30.

III TEST ON MATERIALS

AGGREGATE

Following are the test performed on aggregates.

Table 1: Test Results on aggregate

Sr No	Type of test	Value
1	Aggregate Impact Test	7.68%
2	Aggregate Crushing Value Test	20.45%
3	Shape Test	12.74%
4	Specific gravity and water	2.8 &1.26%

	absorption Test	
5	Los angeles abrasion test	15.22%

BITUMEN

Following are the test performed on bitumen.

Table 1: Test Results on bitumen

Sr No	Type of test	Value
1	Penetration Value Test	10.233mm
2	Ductility Test	65.5cm
3	Specific gravity	1.028
4	Softening Point Test	48.25^0C
5	Flash and Fire point Test	235^0C & 279^0C

IV SPECIMEN PREPARATION

Prepare at least three specimens for each combination of aggregate and bitumen content. Dry the aggregate to constant weight at 105ºC to 110ºC. Separate the aggregate by dry sieving into the desired size fractions. Composition of aggregate and bitumen per cone is given in mix design as per IRC SP53 for DBM.

1) Determine the temperature to which the bitumen must be heated to produce viscosities of 85 ± 10 sec.

2) Weigh about 1200 g of each size fraction for each test specimen to produce a batch that will result in a compacted specimen of height 63.5 ± 1.27 mm.

3) Place the material either in oven on or a hot plate, to a temperature of approximately above the mixing temperature as established. Charge a mixing bowl with heated aggregate and dry mix thoroughly. From a crater in a dry blended aggregate.

4) Weigh the require amount of bitumen heated to a require temperature and pour on to the mixture. At the time of mixing, the temperature of aggregate and bituminous material shall be within the limits of mixing temperature established.

5) Charge a mixing blow with heated aggregate and dry mix thoroughly. Clean the specimen assembly and face of the compaction hammer. Heat them to a temperature between 93.3 ºC to 148.9ºC.

6) Keep a filter paper on the top of the base plate and place the entire batch into the mould. Spade the mixture thoroughly and vigorously with a heated spatula 15 times around the perimeter and 10 times over the interior.

7) Remove the collar. Smoothen the surface of the mix with the trowel to a slightly rounded shape. Temperature of the mixture immediately prior to compaction shall be within the limits of the compacting temperature established.

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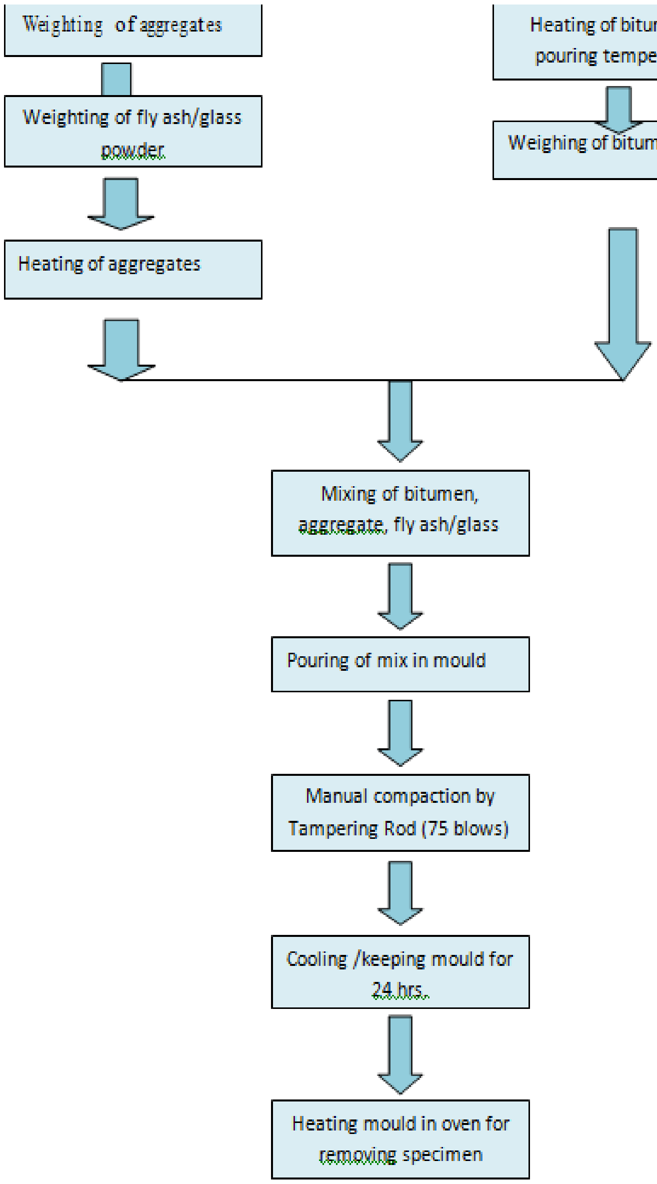
8) Replace the collar. Remove the top of the specimen mould holder by unscrewing the knurled screw. Mount the heated assembly over the compaction pedestal to which the specimen holder is fixed.

9) Replace the top flanged plate on the collar and tighten with the knurled screw. Place the rammer on the mix. Raise the hammer to the full height (457 mm) and allow it to fall freely. The stop at the top is screwed on to the stem and fix to it with a pin.

10) The stem act as a guide. The stop has been adjusted to give the hammer a free fall of 457 mm. Apply 75 blows careful to hold the axis of rammer perpendicular to the base of the mould assembly. Remove the base plate and collar, reverse and reassemble the mould. Apply 75 blows with the rammer to the face of the reversed specimen.

11) The mould is kept as it is for next 24 hrs in room temperature 27°c.

12) After 24 hrs the mould is kept in oven and heated for a easy removal of specimen.



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VI TEST PROCEDURE

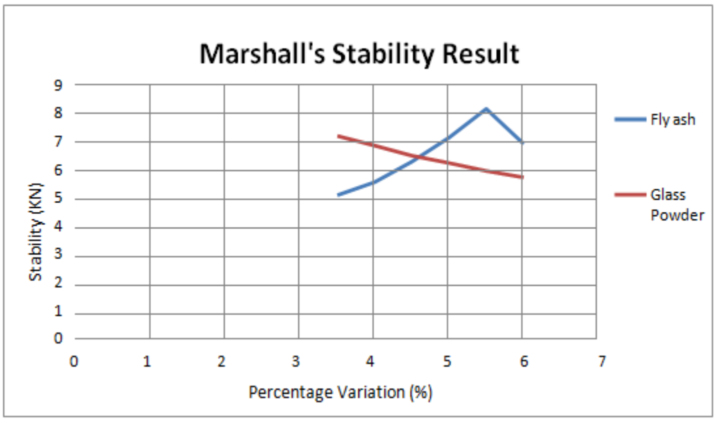
Arrange the wire basket apparatus for calculation of density void analysis. Take the dry weight of sample in air, then the specimen is placed in water to get the weight in water, finally the weight of saturated specimen is weigh. Keep the specimen for 30-40 minutes in a water bath at 60 ± 1ºC for bitumen specimens. After removing the specimen from water bath measure the thickness of specimen. Clean the guide rods and jaws of breaking head assembly. See that the dial gauge for flow measurement is securely fixed, specimen from the bath. Keep the specimen on the bottom jaws. Replace the top jaw. Mount the whole assembly on the base of the loading unit. If the clearance between the proving ring and the breaking head is much, bring it down by electrical operation taking care that it does not touch the breaking head. Then bring the proving ring in contact with breaking head for noting down the reading of the dial gauge for flow measurement. Either set the proving ring dial gauge on zero or note down the reading. Switch machine to 'Forward' to start applying the load observing the dial indicator carefully. Make a note of the reading including the number of revolutions it has already made when the needle is just on the point of reversing the direction of motion. Note and record the indicate flow on the dial gauge. From the calibration chart, record the maximum load. The elapsed time for the test from the removal of the test specimen from the water bath to the maximum load determination shall not exceed one minutes

VII RESULT AND DISCUSSION

Marshall test on bituminous paving mix is carried out to determine Marshall stability, flow, unit weight and other properties of the sample. In this chapter, changes in the Marshall stability flow, unit weight and other properties of the sample (by using fly ash and waste glass powder as filler material at various dosage rate) are compared with the conventional sample (0% content of fly ash and glass powder) has been determined and hoe effectively utilization of fly ash and glass powder can be done

By using this data, different properties of mix has been plotted graphically.

MARSHALL STABILITY



Graph of Marshall stability Result

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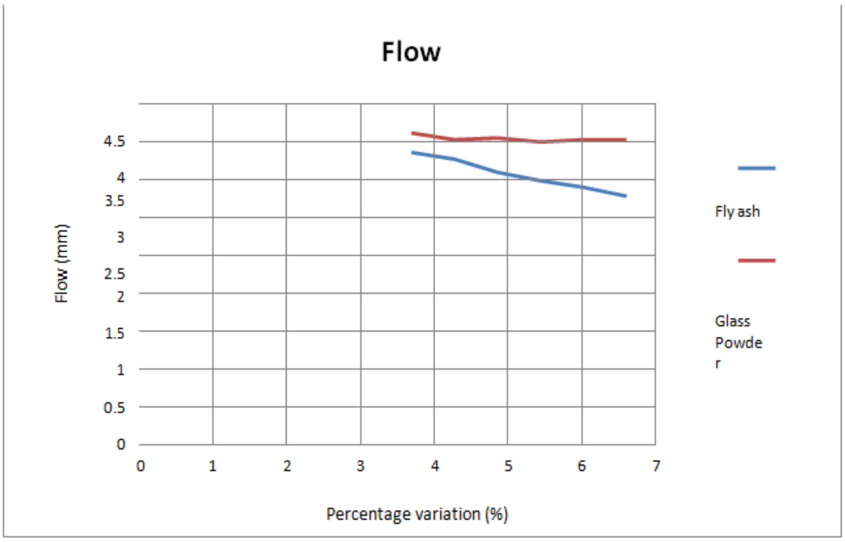
Interpretation:

Addition of fly ash at dosage rate of 5.5% by the total weight of aggregate (1200 g) gives the maximum Marshall Stability. With increase in the dosage rate of glass powder, there is decrease in the marshell stability.

FLOW VALUE

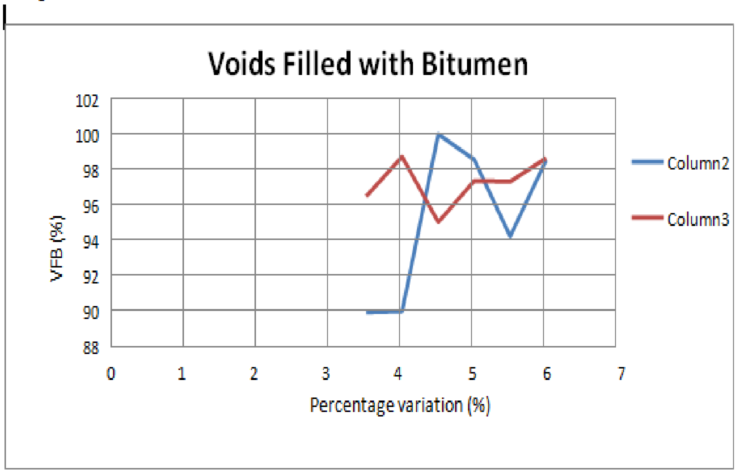


Graph of Flow values

Interpretation:

With increase in the dosage rate of fly ash and glass powder, there is decrease in the flow value of paving mix

VOIDS FILLED WITH BITUMEN:



Graph of voids filled with bitumen

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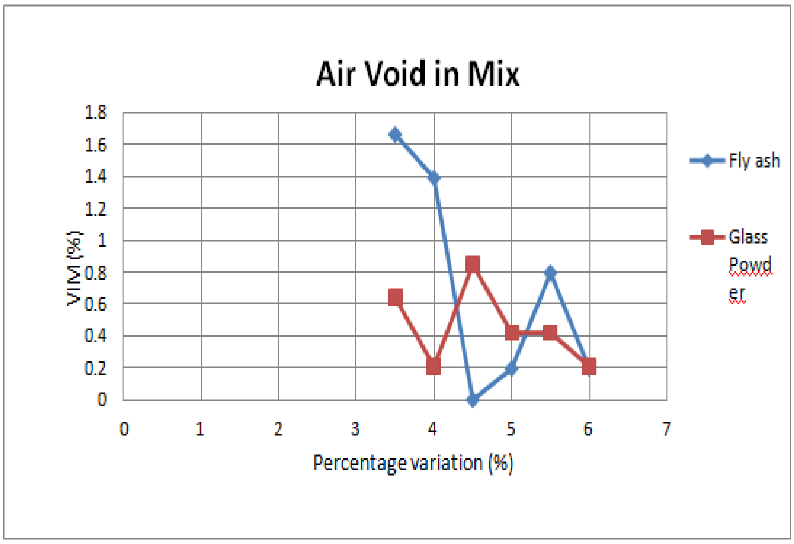
Interpretation:

With increase in dosage rate of fly ash, Voids Filled with Bitumen (V.F.B) increases upto 4.5% and then it decreases and varies. With increase in dosage of glass powder, V.F.B varies.

AIR VOIDS IN MIX:

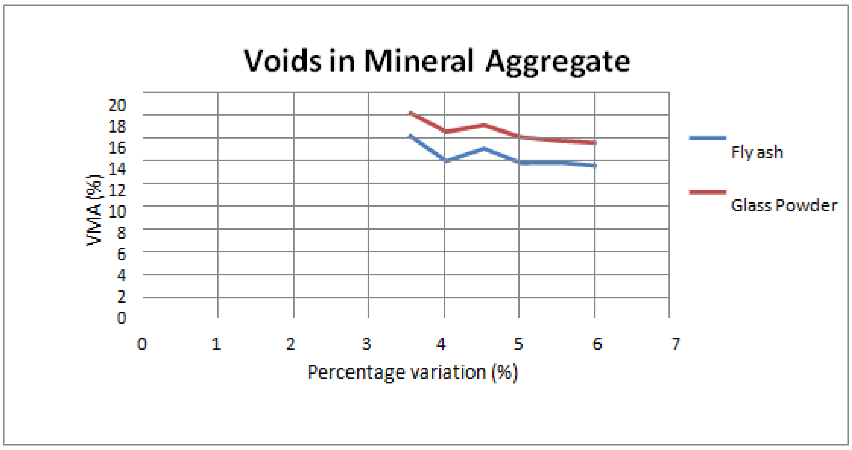


Graph of air void in mix

Interpretation:

With increases in dosage rate of fly ash, air voids decreases and falling down to zero at 4.5% and rising unto 5.5% again falls on 6.0%. With increases in dosage rate of glass powder, air voids varies.

VOIDS IN MINERAL AGGREGATE:



Graph of voids in mineral

Interpretation:

With increases in dosage of fly ash and glass powder, VMA varies then decreases.

MORTH LIMITS:

Sr. No.	Particulars	Limit
1	Voids in mineral aggregate (VMA %)	Min. 13%
2	Air voids (VIM %)	3 – 6%
3	Voids filled with bitumen (VFB %)	65 – 75%
4	Marshall's stability (KN)	Min. 9KN
5	Flow value (Marshall's apparatus) (mm)	2 – 4mm

VIII CONCLUSION

FLY ASH

Marshall Stability of specimen (with fly ash as filler materials) is optimum at 5.5% whereas Flow value decreases with increase in percentage of fly ash.As increase in percentage of fly ash, the cost will decrease as fly ash is free and abundantly available. With the rapid economy growth and continuously increased consumption of electricity from thermal plant, fly ash is abundantly available so it's an effective way to utilize fly ash.

GLASS POWDER

Marshall Stability of specimen (with glass powder as a filler material) is decreasing with increase in percentage of glass powder and flow value also decreases with increase in percentage of glass powder. Glass material is non-metallic and in-organic, it can neither be incinerated nor be decomposed by crushing, it can be used as filler material in bituminous concrete paving.

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