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THE EFFECT OF USING FLY ASH AS AN ALTERNATIVE FILLER IN HOT MIX ASPHALT

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Abstract: In this study, the effect of using fly ash (FA) in tar mixtures instead of mango filler was investigated. For these purposes, samples were prepared using 2% hydrated lime (HL) in the control mixture as well as 2% to 8% different bitumen content (3.5% to 6.5% growth at 3.5%). In filler modified alloys. The optimum bitumen content (OBC) for all composites is determined by the Marshall Mix design. Experimental results indicated a higher stability value for alloys with 4% FA compared to conventional alloys and standard specification. Therefore, especially in areas where fly ash is dumped, it can be used as mineral filler in asphalt concrete alloys instead of HL.

***Keywords* - Filler, Fly ash, Marshall Properties, Modified mix, Optimum bitumen content, Hydrated lime**

I. INTRODUCTION

High quality paving materials are essential for the construction and maintenance of highway pavements in India. On the other hand, the demand for good quality material for the app to keep up with the rapid growth in continuous heavy axle traffic. The development and use of modified asphalt alloys can meet the needs of communities. Asphalt modification can be realized mainly by polymer modification; however, this method is expensive because of the cost of raw polymers, skilled people and specialized equipment. In other ways, asphalt composite can be replaced by ordinary filler (i.e. stone dust, lime or cement); A fine material that goes through a 75μ sieve [1] along with other suitable materials. Nowadays, due to environmental and economic concern, researchers have extensively investigated the use of recycled waste in place of a common fill [2], [3]. In addition recycling supports global sustainability. Fly ash, a mineral byproduct of coal combustion, is a threat to the environment and human health, as is usually the case in thermal power plants on land. In India, Volume of fly ash produced each year (about 170 million tonnes) has become a national interest in efficient recycling of this waste. Although fly ash has been used for years in concrete research, asphalt pavement has very limited application. The present study was undertaken to observe the effect of fly ash and their content on the war characteristics of dense bituminous macadam (DBM). Based on the experimental results, the feasibility of fly ash as a complement to the optimum ratio is compared to that of the control mixture.

II. MATERIALS AND METHOD

- Materials

- Aggregate: This study used coarse and fine aggregates, respectively. Continuous aggregation of the DBM GR-2 determined by the MORT & H specifications was selected.
- Bitumen: VG30 Grade Paying Bitumen Collected from Haldia Petrochemicals, India has been used to prepare the HMA blend after it was certified by ISA: 73: 2002 [3].
- Filler: Traditionally used hydrated lime (HL) is sourced locally and fly ash (FA) obtained from the Kolaghat thermal power plant in West Bengal is used as fillers. Chemical and physical properties were determined and are shown in Table 1. The physical form and SEM image of fly ash are shown in fig.1

Table 1

Chemical and physical properties of hydrated lime and fly ash

Fillers	Chemical compositions								Physical properties	
	SiO_2	CaO	Al_2O_3	Fe_2O_3	MgO	K_2O	SO_3	LOI*	SSA** (m^2/kg)	Specific gravity
HL	3.2	72.4	0.4	0.3	0.4	0.1	1.2	21.7	431.3	2.15
FA	49.6	12.3	25.3	4.8	1.4	2.4	0.9	3.05	309.4	2.32

* LOI – loss on ignition, ** specific surface area (SSA)

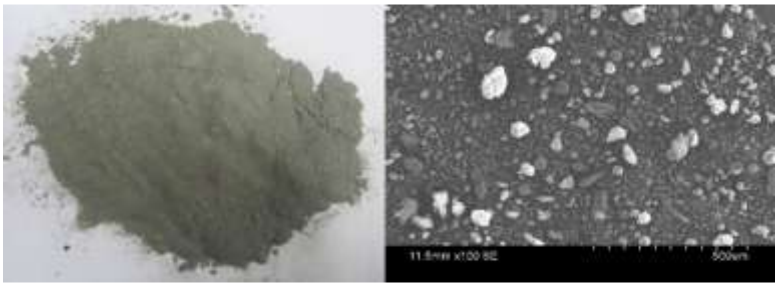
Fig.1

- Method:

- Design of DBM alloys: In this study, the Marshall mix design method was used to create the HMA mix. According to ASTM: D6926 [5], standard combat designs were made by applying 75 warps to each face, with a total of seven different bitumen contents (i.e., mixtures containing 2% HL) in 3.5% and 6.5% in 0.5% increments for the control mixture. 2%, 4%, 6% and 8% supplementing FA.
- Marshall Stability, Flow and Marshall Quotient Testing: The main goal of Marshall Mix Design is to determine the optimal bitumen content (OBC) for different mixing ratios. For these reasons, it is necessary to conduct martial stability and flow tests on each sample under a 50 ° C / 50 ° C loading rate based on ASTM: D6927 [6]. Marshall Cotein, this is a kind of counterfeit austerity. Can be calculated as the ratio of stability to flow.

III. RESULTS AND DISCUSSIONS

As mentioned previously, the Marshall Mix design method was used to determine the optimal bitumen content (OBC) of the relative filler ratios of the alloys compared to the control mixture. The OBC was calculated as the data shown in Fig. 2 and selected in 4% of the air ducts. Other combat properties, such as bitumen (VFB) filled voids, mineral aggregates (VMA), stability, flow, and martial quotient (MQ), have been tested to be within the specified range of MORTH at that Bitumen content.

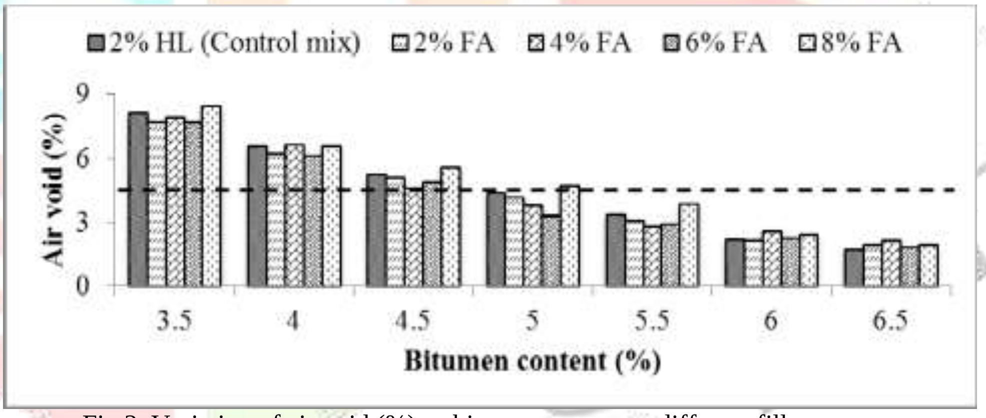

Fig.2. Variation of air void (%) vs bitumen content at different filler content

Table 2 shows the warping characteristics of the respective mixture for obtaining OBC values in the modified mixture with FA as well as with the filler material studied for the control mixture. As shown in Table 2, the OBC of the control mixture was 5.21%. FA inclusion was 5.07%, 4.9%, 4.8% and 5.4% with OBC values of 2%, 4%, 6% and 8%, respectively. Decreases with an increase in OBC values Up to 6% of filler content. However, further increases in filler content may increase the value of OBC relative to the control mixture. In addition, Table 2 gives the martial stability (MS) values of the control mixture of 13.56 kN. The MS of 2, 4, 6 and 8% mixtures of FA was 13.98, 15.44, 19.48 and 17.52 kN, respectively. The flow values of all composites belonging to OBC are in the range of 2 mm - 4 mm (Table 2). In addition, the increase in MQ values is noticeable as the filler content increases, and after a filler ratio of 4%, the same value exceeds the maximum allowable 5 specified value (Fig.3). Since the origin of all materials, the total height, and the composition of all the compounds, the change in all the properties obtained can only be attributed to the filler type and their content.

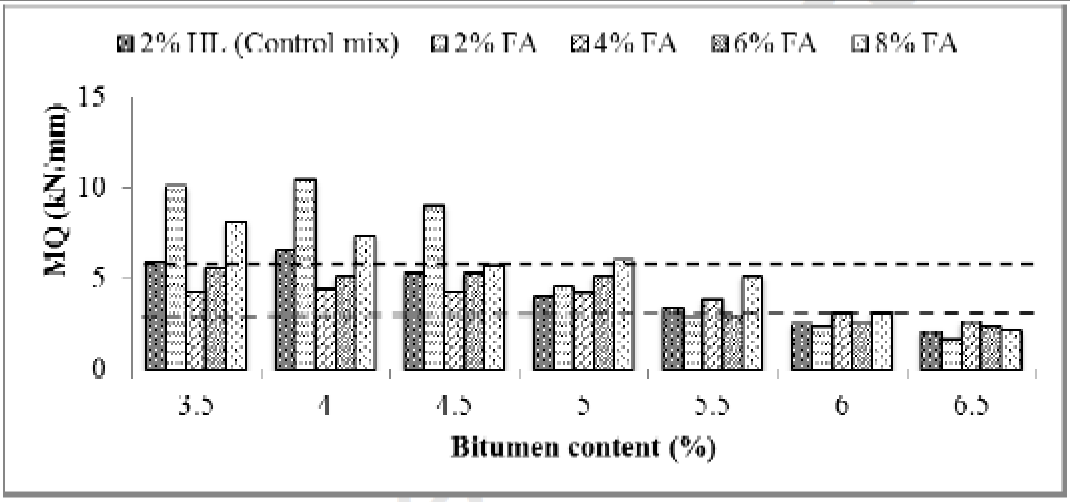

Fig.3. Variation of MQ values vs. bitumen content at different filler content

Table 2

Marshall Properties of the mixes corresponding to OBC at various filler content

Filler type	Percentage Filler	OBC (%)	VMA (%)	VFB (%)	Stability (kN)	Flow (mm)	MQ (kN/mm)
HL	2	5.21	16.08	74.57	16.08	3.82	3.53
FA	2	5.07	15.58	73.58	13.98	3.09	4.54
	4	4.9	15.11	74.33	15.44	3.77	4.11
	6	4.8	14.78	73.62	19.48	3.35	5.23
	8	5.4	16.16	74.87	17.52	3.79	5.34

- Conclusion

The potential utilization of fly ash collected in hot mix asphalt from a local thermal power plant was investigated by Marshall Mix Design. The following conclusions can be drawn from the analysis of laboratory test data. According to the obtained martial parameters, the inclusion of FA in up to 4% of the DBM alloy provides a significant economy of bitumen in the resulting mixture, replacing traditional mineral filler such as HL.

Experimental results indicate that filler modification by the FA provides better strength with less deformation than conventional mixing. As a result, it can be used instead of the usual filler to support global stability, especially in areas where fly ash is commonly thrown.

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