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Expermential Investagation and Analysis of Bitumen Modifaction Using Fly Ash

Mohammad Ather Ul Jahangeer[1], Er. Pannu Ovais Manzoor[2], Er. Sajad Ahmad Mir[3]

[1]M Tech, Transportation Engineering, [3]Assistant Professor, Department of Civil Engineering,
[1,3]Mewar University, Chittorgarh, Rajastan, India
[2]M Tech, Structural Design, Jammu Kashmir, India

ABSTRACT

The increase of crude oil prices in recent years resulted in an increase in bitumen prices as crude oil is origin for bitumen, asphalt & in other hand the fly ash from the power generating plants causes severe disposal problems. The main purpose of this project is to study the possibility of using fly ash as mineral filler in Bituminous paving mixes. Fly ash, a coal combustion product once treated as waste and disposed in landfills, is used today in substructure and road works. The research of fly ash properties may solve the problems of treatment and intelligent use of this residual material. This Marshall stability test is employed to determine the properties like stability, flow value,% air voids, voids in mineral aggregate (VMA), voids filled with bitumen(VFB) for a Dense Bituminous Macadam (DBM) mix. The experimental work is carried out by using specifications from MORTH (Ministry of road transports & highways, specifications for road & bridge works,5th revision).By replacing the stone dust with fly ash at the levels 4%, 6% and 18% the results are compared. The variation of properties, optimum bitumen and fly ash contents are evaluated. It is observed that the mixes with fly ash as filler not differ much in properties when compared with control mix and satisfy desired criteria specified by a much higher margin. Hence, it has been recommended to utilize fly ash wherever available, not only reducing the cost of execution, but also partly solve the fly ash utilization and disposal problems.

KEYWORDS: *Bitumen, Fly Ash, Dense Bituminous Macadam, Marshall Stability Test*

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I. INTRODUCTION

With the changing life style among different classes of the society, road network has become one of the essential backbones for the movement from place to place as it provides a good access for the commuters to travel to their desired place. Road network has been adopted long ago by the people when other modes of transport were not even invented. From last 50 years road transportation has expanded for providing services to both passengers and goods. This is considered as one of the vital means of transportation. For providing services to passengers and goods majority of roods constructed consists of flexible pavement network majority of the roads constructed consists of flexible pavement. Flexible pavement generally comprises of four layers as: (1) Soil sub grade (2) Sub base course (3) Base course (4) Surface course.

There are usually three component of flexible pavement. bitumen, aggregate and air void. Bitumen is commonly used as binding material in case of flexible pavement. Bitumen is a viscoelastic material that is extracted from petroleum, with the help of frictional distillation .bitumen is usually soluble in carbon disulphide. In its solid state it is its known as asphalt and in its liquid state is known as mineral tar. In recent years there is high increase of highway utilization due to the rapid increase of traffic on the road throughout the world which has lead to heavy load implications on the pavement by the movement of the traffic. However unmodified bitumen and usually practiced high grade classic asphalt concrete has failed to satisfy the increasing demand and level of performance expected. This insufficiency leads to excessive rutting, thermal cracking and hence result in shorter life of pavement. To irradiate such problems it has led the attention of many researchers and agencies concerned to it to look for various efforts that can be made for improving the properties of the bitumen to deal with the problems related to pavement distresses. One of the methods which have recently received more attention is modification of the bitumen with other materials commonly termed as admixtures. Some admixtures have been known to work as modifiers of bitumen if thoroughly mixed with it, resulting in an increase of binder properties. These admixtures are directly added to the bitumen mixture as a bitumen modifier or it can be added into the aggregate containing the mixture.

II. LITERATURE REVIEW

The Ghulamsakhi Azizi and Amit Goel (2018) studied Use of Waste Plastic, Waste Rubber and Fly Ash in Bituminous Mixes To explore the use of waste plastic, waste rubber and fly ash as a road construction material. The reduction of bitumen content in the mix by addition of waste plastic and waste rubber is the can help Te focus area which make the

mix more economical The statistical analyses like correlation and regression have been done to find the relationship between variables especially the affecting of independent parameters to depended parameters. (Waste plastic was affected to the stability, bitumen was affected to flow value). The results show that a mix of 5% each of waste plastic and waste rubber (by weight of bitumen) and 4.5% of bitumen in the total mix was found as an optimum percentage by weight of total mix, with 1% fly ash as a filler material to control the flow value.

Fayaz and Gupta (2018) the research paper entitled "use OF fly ash in bituminous mixes FOR flexible pavements: a review" presents the previous researches done on the usage of fly ash in bituminous mixes for flexible pavements. This research reports the investigations carried on bituminous mixes with fly ash as mineral filler. Fly ash which is an industrial waste is generated by thermal power plants all over the country and poses health and environmental concerns if not disposed properly. In this research the properties of bituminous mixes with fly ash as mineral filler at varying proportions of bitumen content will be investigated.

Mishra and Gupta (2017) the research paper entitled "Use of Fly Ash Plastic Waste composite in Bituminous Concrete Mixes of Flexible Pavement" presents the usage of fly ash with plastic waste in combination in the Bituminous Concrete mixes of flexible pavement.

Rajat Kajal and Rajesh Chauhan (2018) presents use of e-waste and fly ash as a filler replacement in the bituminous concrete pavement. Studied that the impact of e-waste as a coarse aggregates and fly ash as a filler in the bituminous concrete pavement. Due to increase in the demand of raw materials there is depletion of raw materials nowadays which make depletion of resources for the future generation. There is lot of alternative like e-waste and fly ash which recklessly increasing day by day and effect badly to environment. From the previous researches it is observed that there is unequivocal increment in marshal stability and flow rate with the increase in percentage of e-waste with and fly ash in the bituminous design mix. The fly ash is not helping in increasing the strength but it helps to attain the stability nearly equal to nominal mix. It is an attempt to use the waste products like e-waste and fly ash which harm the environment and difficult to decompose and reuse. In this research i am going to use e-waste as coarse aggregates in replacement with different percentage and fly ash as a complete filler.

III. MATERIALS USED

The various materials used are as follows:

1. Cement:

Ambuja 43 grade ordinary Portland cement was used in this study. It was fresh and free from any lumps. Cement is a fine, grey powder. It is a fine powder produced by grinding Portland cement clinker (more than 90%), a limited amount of calcium sulphate (which controls the set time) and up to 5% minor constituent it is mixed with water and materials such as coarse aggregates and fine aggregates to make concrete.

Figure 1: Sample of Cement

2. Fly ash:

Fly ash is a heterogeneous by-product material produced in the combustion process of coal used in power stations. It is a fine grey coloured powder having spherical glassy particles that rise with the flue gases. A dark grey to black colour is typically attributed to an elevated un-burned content. Fly ash used in the study was obtained from Guru Nanak Dev Thermal Power Plant, Bathinda. Fineness modulus of fly ash was 100 μ -90 μ.

Figure 2: Sample of Fly Ash

3. Binder:

Bitumen is non-crystalline hydro carbon in solid or liquid state possessing properties of adhesion; it is obtained by artificial of natural distillation of crude petroleum. Rather than in water it is soluble in carbon di sulphide. Properties of bitumen not only depend on its source from which it is extracted but also on preparation methods. In North America it is nick named as asphaltic cement or asphalt. Naturally occurring bitumen is called with the name of rock asphalt or natural asphalt. Bitumen is used as a binder in SMA and DBM mix. The various characteristics of bitumen that affects the bituminous mix behavior are susceptibility to temperature, viscos-elasticity and aging. The behavior of bitumen depends on temperature and also on the time of loading. It is stiffer at low temperature and under a short loading period. Bitumen

must be treated like a visco-elastic material as it shows both viscous and also the elastic properties at normal pavement temperatures. Even though at low temperature it behaves as if it was an elastic material and at high temperature its behavior is like a viscous fluid. For preparation of SMA and DBM mix samples we used VG30 grade bitumen.

Figure 3: Sample of Binder

4. Coarse aggregates:

Materials which are large to be retained on 4.75 mm IS sieve and contain only that much of fine material as is permitted by the specifications are termed as coarse aggregates. The graded coarse aggregate is described by its nominal size i.e. 40 mm, 20 mm, 16 mm and 10 mm.

Figure 4: Sample of Coarse Aggregates

5. Fine aggregates:

It is aggregate most of which passes through a 4.75 mm IS sieve. Sand is generally considered to have a lower size limit of about 0.07 mm. Material between 0.06 mm and 0.002 mm is classified as slit, and still smaller particles are called clay. According to size the fine aggregate may be described as coarse, medium and fine sand. Depending upon the particle size distribution IS: 383-1970 has divided the fine aggregate into four grading zones. The grading zones become finer from grading zone I to grading zone IV. The sand confirming to zone II is used in this study.

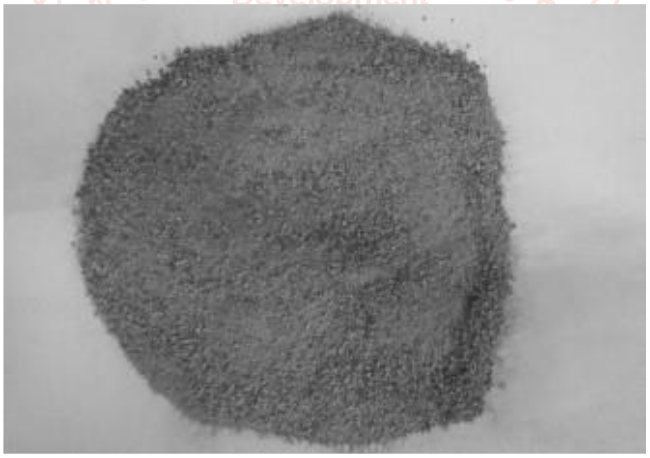

Figure 5: Sample of Fine Aggregates

IV. RESULTS AND ANALYSIS

The results where submersed in table 1 and the relation is shown in the figures below:

Table 1: Mix Design Parameter

S. No.:	Marshall properties	Test result BC mix without fly ash	Test result BC mix with 4% fly ash	Test result BC mix with 6% fly ash	Test result BC mix with 8% fly ash
1	Optimum Bitumen Content (%)	4.73	4.70	4.92	5.17
2	Marshall Stability, (Kn)	15.04	23.73	27.08	28.69
3	Flow, (mm)	2.54	1.65	1.72	1.85
4	Airvoids (Vv)%	3.50	4.32	2.506	5.37
5	VMA,	15.00	15.28	16.01	16.92
6	VFB, %	17.46	71.92	70.19	68.94

Relationship

The comparison between the values obtained during testing of different samples with varying percentage of fly ash (4%, 6% and 8%) is shown in figures. The relation derived between the different values obtained during the investigation was obtained and relationships were made with respect to bitumen content.

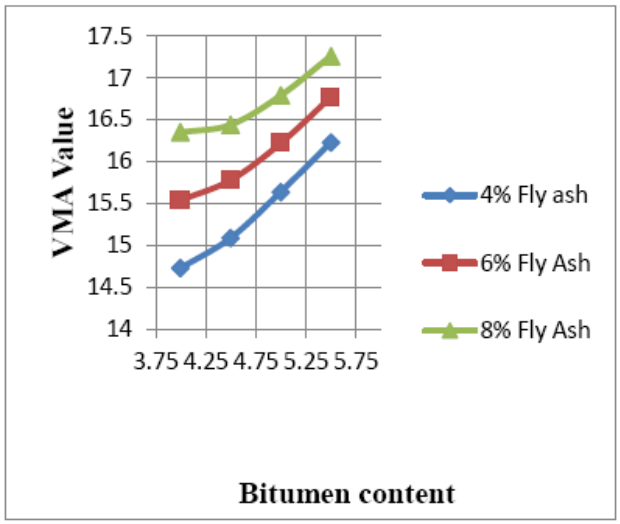

Figure 6: Bitumen content Vs. VMA Value of bitumen samples with fly ash

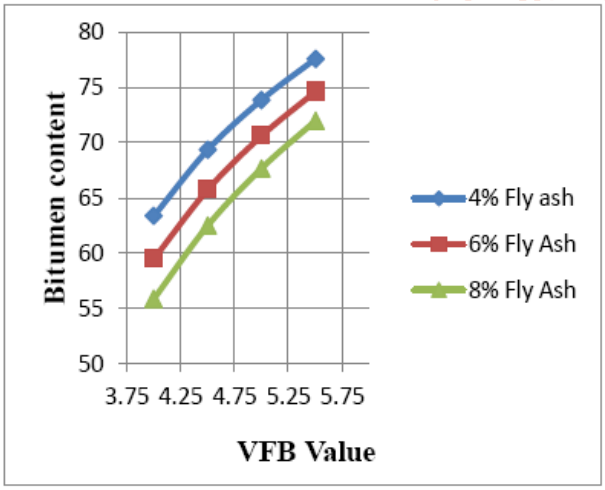

Figure 7: Bitumen content Vs. VFB Value of bitumen samples with fly ash

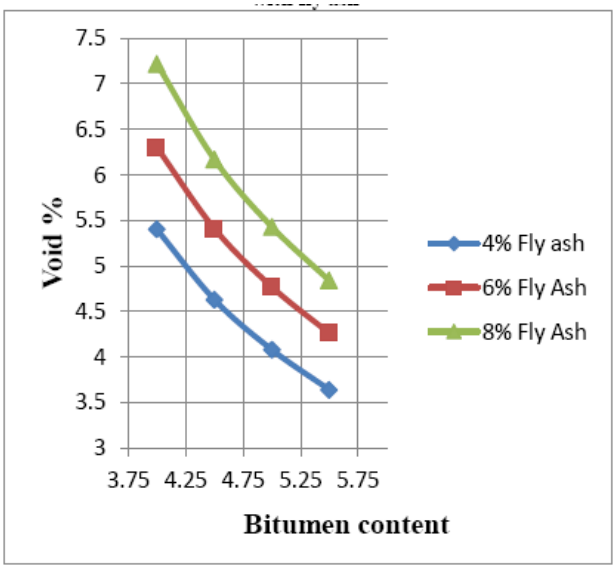

Figure 8: Bitumen content Vs. Void % of bitumen samples with

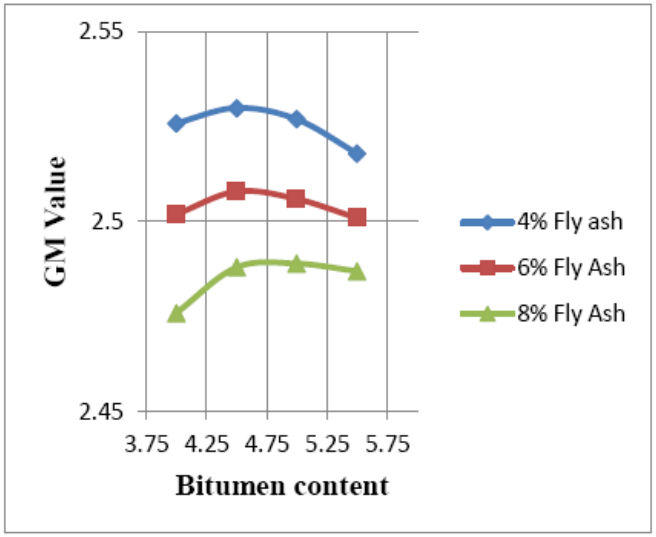

Figure 9: Bitumen content Vs. GM Value of bitumen samples with fly ash

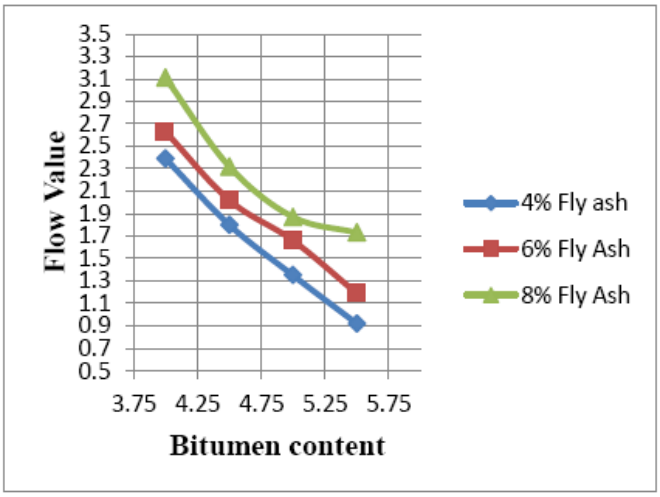

Figure 10: Bitumen content Vs. Flow Value of bitumen samples with fly ash

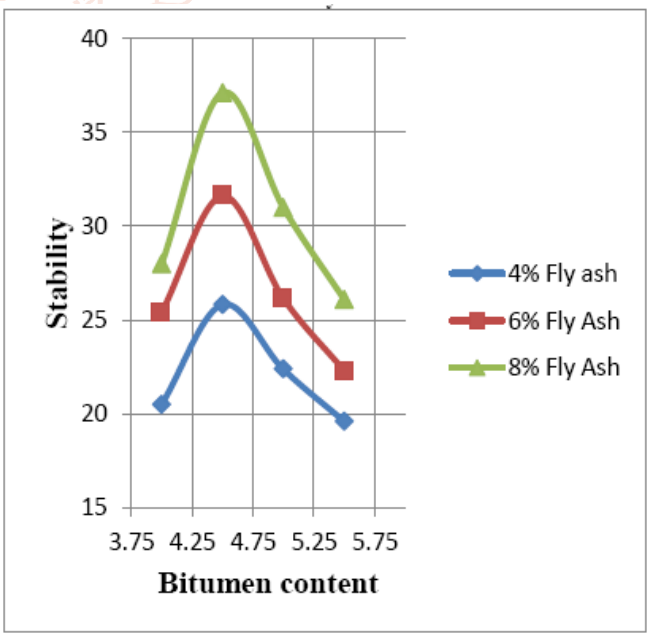

Figure 11: Bitumen content Vs. stability of bitumen samples with fly ashfly ash

CONCLUSION

1. The optimum bitumen content for virgin bitumen mix prepared was 4.75 and the bitumen mix with fly ash 4%, 6% and 8% are found to 4.70, 4.92 and 5.17 respectively.
2. The stability for virgin bitumen mix prepared was found 10.24, 14.10, 16.33 and 13.15 and the bitumen mix with fly ash 4% was found 20.48, 25.80, 22.36, and 19.58 and the bitumen mix with fly ash 6% was found 25.39, 31.58, 26.13 and 22.28 and the bitumen mix with fly ash 8% was found 27.96, 37.08,30.97 and 26.07 respectively.
3. The VFB for virgin bitumen mix prepared was found 65.73, 71.49, 75.85 and 79.36 and the bitumen mix with fly ash 4% was found 63.34, 69.32, 73.85 and 77.57 and the bitumen mix with fly ash 6% was found 59.46, 65.72, 70.59 and 74.60 and the bitumen mix with fly ash 8% was found 55.84, 62.47, 67.66 and 71.96 respectively.
4. The VMA for virgin bitumen mix prepared was found 14.30, 14.73, 15.32 and 15.99 and the bitumen mix with fly ash 4% was found 14.73, 15.09, 15.64 and 16.23 and the bitumen mix with fly ash 6% was found 15.54, 15.78, 16.22 and 16.77 and the bitumen mix with fly ash 8% was found 16.35, 16.44, 16.79 and 17.26 respectively.
5. The Flow for virgin bitumen mix prepared was found 2.39, 2.48, 2.64 and 3.06 and the bitumen mix with fly ash 4% was found 2.39, 1.80, 1.35 and 0.92 and the bitumen mix with fly ash 6% was found 2.63, 2.02, 1.66 and 1.19 and the bitumen mix with fly ash 8% was found 3.11, 2.32, 1.87 and 1.73 respectively.
6. The increase in the Bitumen content results in increase in the Flow value for all virgin bitumen mix prepared with or without combination of fly ash.
7. Total percentage air voids is found to be decrease as the bitumen content increases for all bitumen mix prepared with or without combination of fly ash.

FUTURE SCOPE

A. In future performance bitumen mix prepared combination of fly ash of with various other grades of bitumen can also be tested and seen whether it can be use
B. Other waste materials such as rock dust, slag dust etc. can be used to prepare bitumen samples of SMA and DBM.
C. Wheel tracking test can give us idea about the rut resistance of the specimen.
D. Many properties of bitumen's such as Marshall Properties, static tensile strength, tensile strength ratio, retained stability have been studied in this investigation by using various additives. However, some of the properties such as fatigue properties, resistance to rutting, dynamic indirect tensile strength characteristics and dynamic creep behavior needed to be investigated.
E. Various other types of aggregate grading, Filler, Binder, Emulsion and Additive can be considered for further studies

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