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EXPERIMENTAL STUDY ON THE BITUMINOUS MIXES CONTAINING FLY-ASH

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Abstract: This paper presents an overview of laboratory and field demonstration work with beneficial use of fly ash in bituminous mixes. 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. Using laboratory tests specimens, in this study the physical properties of pozzolanic coal fly ash, a bituminous coal waste of Iasi thermal power station, Romania, are investigated to analyze the composition of fly ashes. A good design of Modify bituminous mix is expected to result in a mix which is adequately strong, durable and resistive to fatigue and permanent deformation and at the same time environment friendly and economical. A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions of material combinations and finalizes the best one. The research result shows that the Marshal method of bituminous mix design was carried out for varying percentages of Fly ash to determine the different mix design characteristics.

Keywords: Fly ash, Modify Bitumen, Marshal Stability

1.0 INTRODUCTION

Materials such as fly-ash from thermal power plants and other coal fired industries, blast furnace slag from steel industries, cement kiln dust from cement related industries, phosphogypsum from phosphatatic fertilizer industries, and many other solid wastes have already proved to be useful for road construction in many countries. The waste materials that are commonly known are blast furnace slag, fly ash, silica fume(from Power Plants) recycled aggregates (from Demolition sites), solid waste, plastic waste (Domestic waste) and rubber waste (commercial waste). Partial replacement of Portland cement with waste materials like blast furnace slag, fly ash, silica fume (from Power plants), recycled aggregates (from Demolition sites), solid waste, plastic waste (Domestic waste) and rubber waste (commercial waste) will be a great help in reducing environmental pollution and also in reduction in manufacturing of cement and other material that required for the construction activities. . Fly ash is a mineral by-product of coal combustion in thermal power projects. One of the major challenges of our present society is the protection of environment.

Any construction activity requires several materials such as concrete, steel, brick, stone, glass, clay, mud, wood, and so on. However, the cement concrete remains the main construction material used in construction industries. For its suitability and adaptability with respect to the changing environment, the concrete must be such that it can conserve resources, protect the environment, economize and lead to proper utilization of energy. To achieve this, major emphasis must be laid on the use of wastes and byproducts in cement and concrete used for new constructions. The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. The enormous quantities of demolished concrete are available at various construction sites, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. As the problem of disposing these waste materials became a big environmental problem, the proper utilization of these materials again in construction activities will be a great relief to the society. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials, systematic consumption and use of waste materials to a great extent. Research & Development activities have been taken up even in India for proving its feasibility, economic viability and cost effectiveness for the use of waste materials in all the construction activities.

1.1 SCOPE OF THE STUDY

Although the scope for use of fly ash in concrete, brick making, soil-stabilization treatment and other applications has been well recognized, only a small quantity of the total ash produced in India is currently utilized in such applications. Most of the ash generated from the power plants is disposed off in the vicinity of the plant as a waste material covering several hectares of valuable land. The bulk utilization of ash is possible in two areas, namely, ash dyke construction and filling of low-lying areas. Coal ash has been successfully used as structural fills in many developed countries. However, this particular bulk utilization of ash is yet to be implemented in India.

Since most of the thermal power plants in India are located in areas where natural materials are either scarce or expensive, the availability of flyash is bound to provide an economic alternative to natural soils in the Embankment construction and other application in National Highway Projects.

2.0 LITERATURE ON FLY ASH

P. ESKIOGLOU et al studied the protection of environment by the use of fly ash in road construction. In this assignment, clay soils, natural and crushed sand-gravel were stabilized with different quantities of fly ash, for the creation of durable forest roads. From research, it has been found that stabilization with fly ash, improves the natural and mechanical characteristics of soils (plasticity, compressive strength and particle size distribution). As a result, the improvement of the forest road networks from one side and the economy in natural inert materials and the exploitation of fly ash from the other, the importance of such an intervention in the protection of the forest ecosystem and the natural environment in general are obvious.

Prof. Sameer Mistry et al studied the Fly Ash Bricks Masonry. In this paper Fal-G brick production process, uses of rap-trap bond in Fal-G brick masonry prism test study and economy have been described. The observations, limitation and suggestions in various areas have been described. Fly ash utilization in the country has remained less than 10% during the past 5 years and it might take several years to reach the final goal of cent percent utilization. Every year nearly 70 million tonnes of ash is produced in India, of which NTPC stations alone contribute to the extent of about 22 million tonnes.

M S RANADIVE et al studied the Quality Control of Cationic Emulsion Modified Cold Mix in Flexible Pavement. Several ambitious road construction plans and activities primarily involve bituminous pavements with hot mix technology. Hot mix technology which is a conventional method for road construction, has structurally satisfied the performance requirements over many years. The procedures generally followed by the hot mix 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 120ºC to 165ºC temperature. So, it is desirable to find out a suitable alternative for hot mix technology. In India almost 90 percent road network is occupied by bituminous pavements only. Certain limitations associated with use of hot mix asphalt are like emission of greenhouse gases from it, shut down of plants during rainy season, problems in maintaining the paving temperature when hauling distances are more, etc. Field trials have proved that cold mix can be easily produced by using hot mix plant and can be laid in using similar techniques. Here the main objectives of the experimentation are to evaluate and improve the properties of the cold mixtures. Test results also show that the addition of additive significantly improved the performance of the cold mix. In this paper the performances of cold-mix, cold-lay emulsion mixtures is described with reference to its quality control.

Vaishali Sahu et al reviewed the use of stabilized fly ash as a green material in pavement substructure. The stabilization of fly ash can be achieved by adding either cement, lime or other materials. Stabilization of fly ash with available industrial by-products is also possible and is gaining researchers' attention now a day. Considerable economic as well as environmental benefits can be achieved when bulk amount of fly ash is utilized along with other potential waste materials. Hence a comprehensive study has been done to review the various ways of stabilizing fly ash for higher strength and durability for its extensive use in pavement sector. The paper therefore presents a comprehensive review of available literature on attempts at beneficial reuses of stabilized fly ash (FA) in sub base/base layer of pavement.

Anil studied to use cement stabilized fly ash sub base course in field pavement stretches, and compared the performance with fly ash Sub base. Cyclic plate load tests were conducted on fly ash sub base and cement stabilized fly ash sub base stretches constructed on different sub- grades (i.e., sand and expansive soil) and found that cement stabilized fly ash stretch had shown better performance in load carrying capacity and reduction of heave compared to conventional stretch, laid on expansive soil subgrade.

Kalinski et al found that the compressive strength of cement stabilized fly ash is affected by cement content, water content and compaction effort and by knowing these parameters the compressive strength can be predicted. The highest strength of 5000 kPa was achieved for 28 days tested specimen at 30% cement addition to fly ash.

Lav et al attempted for an aggregate free stabilized mixtures for pavement base. A class F fly ash was stabilized with 2, 4, 8, and 10% of cement by total weight. The MDD increased and OMC decreased upon cement addition to the fly ash. They investigated two types of reaction that takes place when cement is added to fly ash. First is pozzolanic reaction and second is reaction result in various hydration products due to cement stabilization. Solid bindings between fly ash particles are mainly developed by hydration products due to stabilization. They identified formation of ettringite using the fly ash spheres as nucleation sites and Calcium Silicate Hydrate (C–S–H) gel along with Portlandite ($Ca(OH)_2$) maintained a bond between particles and ettringite rods joined together, resulting in an increased strength .They concluded that the mixes with cement content less than 8% may be used as sub base material instead of being used in pavement base.

Adamska investigate the influence of cement additions on the compatibility of a fly ash/bottom ash mix. Waste samples in the natural state and with different percentages of cement additions (2, 5 and 10%) were compacted by both impact compaction methods to obtain compatibility curves. The cement addition influences fly ash compatibility. With increasing cement percentage in the fly ash/cement mix, the maximum dry density increases and optimum water content decreases. Changes of compaction parameters, dry density and water content, after cement addition, are caused by an increase in solid particle density, a moisture content decrease and a change in grain-size distribution of the mix.

S.D.Katara et al studied the Influence of Modify Bituminous Mix with Fly Ash. Fly ash is the main solid waste discharged by coal-fired power plant. In India, the annual emission of fly ash is more than 0.3 billion tons, and it is one of the main industrial waste residue. The use of four wheeler, two wheeler vehicles etc. is increasing day by day. As a result amount of waste tyres also increasing. Waste tyres in India are categorized as solid or hazardous waste. It is estimated that about 60 per cent of waste tyres are disposed via unknown routes in the urban as well as rural areas. This leads to various environmental problems which include air pollution associated with open burning of tyres and aesthetic pollution. Therefore, it is necessary to utilize the wastes effectively with technical development in each field. A good design of Modify bituminous mix is expected to result in a mix which is adequately strong, durable and resistive to fatigue and permanent deformation and at the same time environment friendly and economical. A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions of material combinations and finalizes the best one. The research result shows that the Marshal method of bituminous mix design was carried out for varying percentages of Fly ash to determine the different mix design characteristics.

M. Abukhettala studied the Use of Recycled Materials in Road Construction. Several waste by-products and materials have been investigated, assessed, evaluated for utilizations and practiced in the field. Depending on the attributes of the characteristics of the recycled material, the inclusion varies. Some recycled materials have been proven to possess preferable properties over the other and have performed satisfactorily in the field. However, there are numerous concerns regarding such incorporation based on both laboratory experimental, and field observations which have turned out to be of the essence for further in-depth studies. Reclaimed asphalt pavement, recycled concrete aggregates, plastic wastes, scrap tires, mine wastes, recycled crushed glass, foundry sand, coal combustion products as fly ash, bottom ash, and pond ash, steel slag, oil sand, oil shale sand, lateritic soil, are amidst the long list. It is believed that magnificent preservation of natural and precious resources would be attained from the inclusion of secondary and tertiary materials in road construction. Nonetheless, without rigorous cooperation between the academia and the industry and educating people who are in routinely interact with paving activities, several performance-related issues would not be resolved and would remain in existence. This paper present a literature review report on the most viable recycled materials currently in practice by the industry and it aims towards developing a noble idea on better inclusion of a recycled material in the road industry.

3.0 PREPARATION OF MARSHALL TEST SPECIMENS

The samples for bituminous concrete mixtures were prepared as per ASTM D1559 (1989) at different bitumen contents for each type of filler used. The optimum bitumen content for each type of filler in bituminous concrete mix was done as per the normal procedure. Approximately 1425g of the aggregate consisting of different aggregate fractions, as worked out earlier, was pre-heated to 175-190°C. The bitumen (plain/modified) was heated to 121-138°C and the first trial bitumen content was added to a preheated steel bowl. The mix was thoroughly mixed at mixing temperature about 168°C. The mix was compacted in a preheated Marshall mould by applying 75 blows on each face of the specimen. Specimens were prepared at bitumen content 4 %,5%, 6%, 7% and 8% weight of dry mix modified using Fly ash at 2.5%, 5%, 7.5%, 10 %and 12.5% weight of bitumen respectively. The results for Marshall's stability tests is shown in Figure 1 to 8.

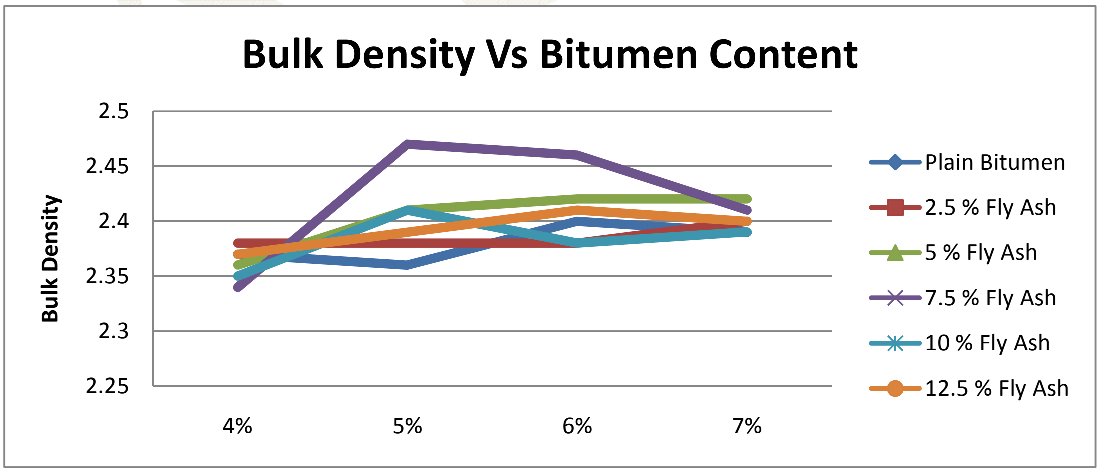

Figure 1: Bulk Density Vs Bitumen Content

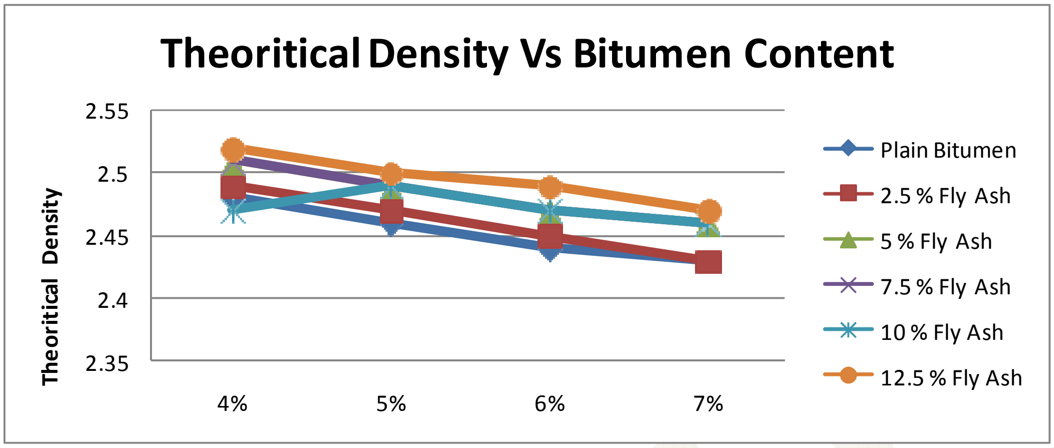

Figure 2: Theoretical Density Vs Bitumen Content

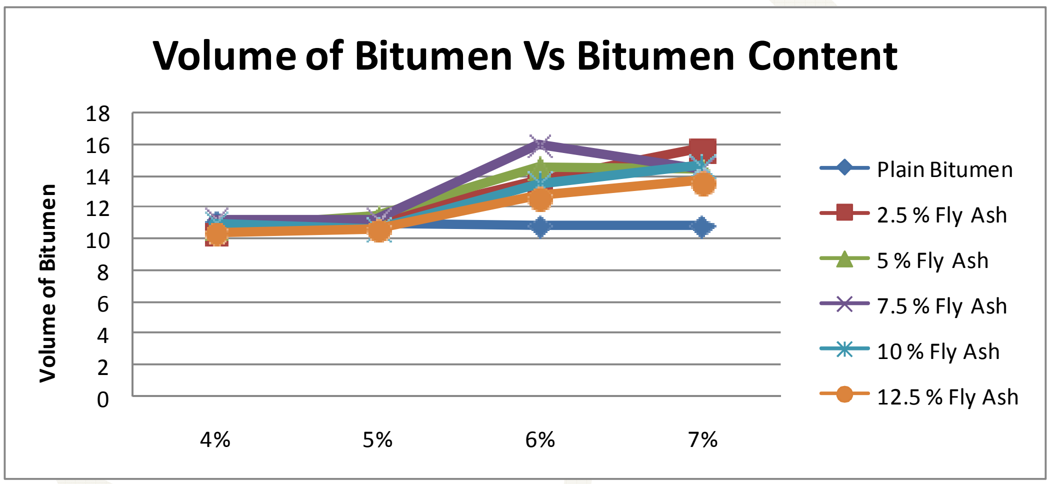

Figure 3: Volume of Bitumen Vs Bitumen Content

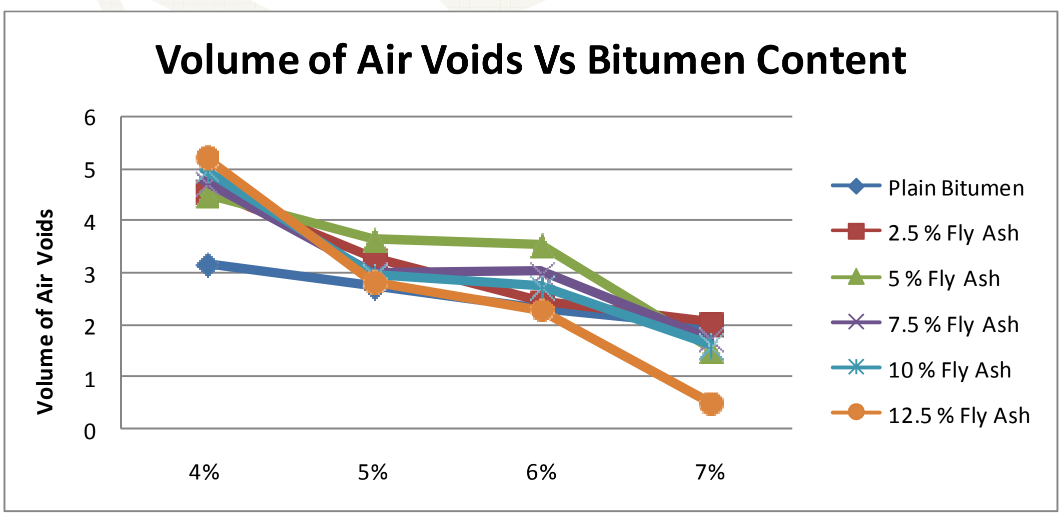

Figure 4: Volume of Air Voids Vs Bitumen Content

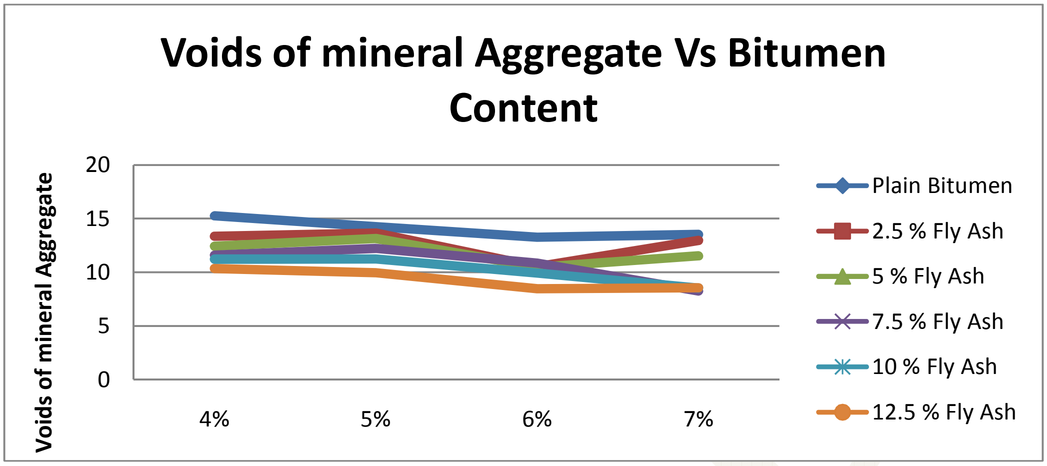

Figure 5: Voids of mineral Aggregate Vs Bitumen Content

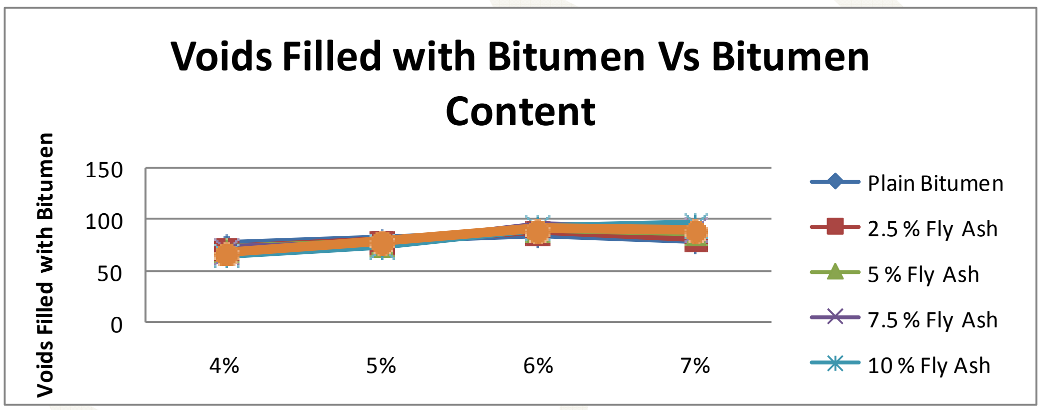

Figure 6: Voids Filled with Bitumen Vs Bitumen Content

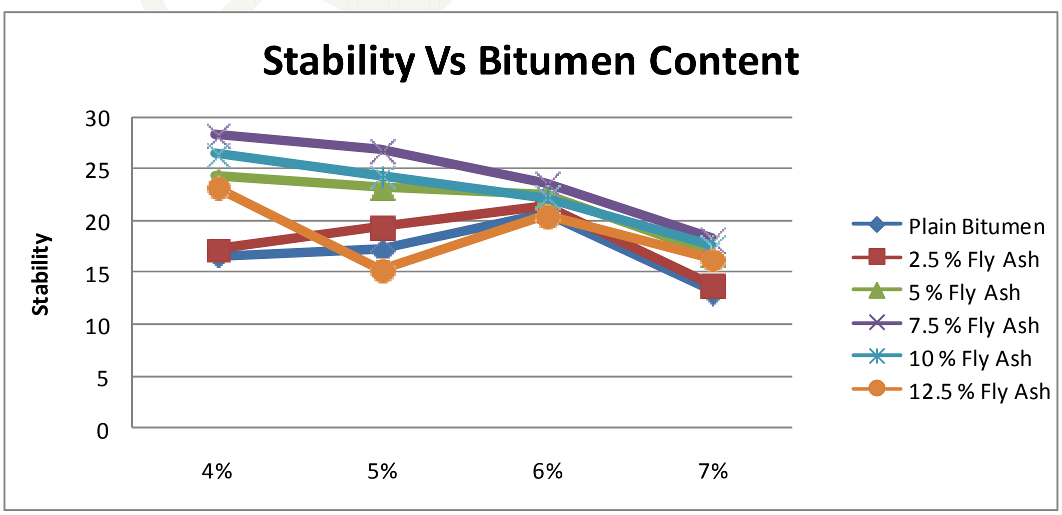

Figure 7: Stability Vs Bitumen Content

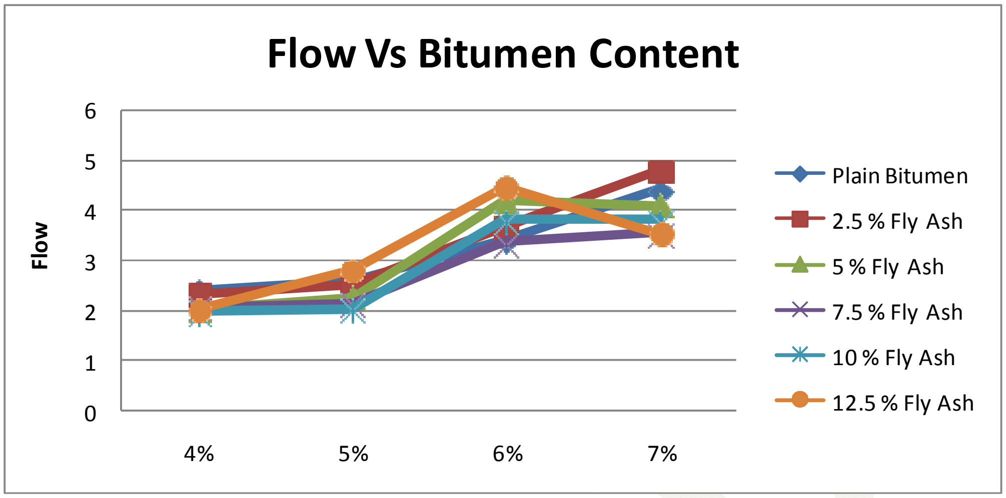

Figure 8: Flow Vs Bitumen Content

CONCLUSION

The present project is an attempt to utilize industrial wastes fly ash in the construction of roads. Based on result of Proctor hammer test and Marshall Stability test the following conclusions are drawn. The conclusions are based on the tests carried out on sample selected for study.

1. The increase of the optimum moisture content contributes to the increase of the stabilized soil's capability.
2. The Marshall Stability value is found maximum of 31.38Kn for 7.5% fly ash at 4% bitumen content which is more than plain bitumen.
3. The bulk density is also found maximum having 2.45 g/cc for 7.5 % addition of fly ash at 5% bitumen content
4. The Theoretical density is also found maximum having 2.45 g/cc for 12.5 % addition of fly ash at 4 % bitumen content.
5. It is also observed that air voids decrease, which is required for better strength and service life of the pavement and the VFB is increased by addition of bitumen.
6. As per MoRTH, Optimum Binder and modifier content is found to be 5.03% and 8% respectively.
7. Modification of Bituminous concrete mix has resulted in maximum stability with less bitumen content, which solves the world oil crisis.
8. These mixes were seen to display higher air voids than required for normal mixes.

It is evident that with further tests fly ash generated as waste materials can be utilized effectively in the making of bitumen concrete mixes for paving purposes.

REFERENCES

1. Tomas U. Ganiron Jr , "Analysis of Fly Ash Cement Concrete for Road Construction", International Journal of Advanced Science and Technology Vol.60, (2013), pp.33-44 http://dx.doi.org/10.14257/ijast.2013.60.04
2. Brajesh Mishra, "A Study on Use of Industrial Wastes in Rural Road Construction, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 11, November 2015"
3. S.D.Katara, "Influence of Modify Bituminous Mix with Fly Ash", International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-2, Issue-4, April 2014
4. Sabina, Khan Tabrez A, Sangita, Sharma D.K., Sharma B.M, Performance Evolution. Of Waste Plastic/ Polymers Modified Bituminous Concrete Mixes, Journal of Scientific and Industrial Research Vol.68, 2009.
5. Yadav Kajal, Sangita and Chandra A, Identification, Characterization and Quantification of Elastomeric/Plastomeric Waste for Sustainable Waste Minimization American Journal of Environmental Sciences 1 (3) pp-202-205, 2005.
6. Aslam Shahan-ur-Rahman "Use of Waste Plastic in Construction of Flexible Pavement", New Building Materials & Construction World, 2009.
7. Vasudevan R., Nigam S.K., Velkennedy R., Ramalinga Chandra Sekar A., Sundarakannan B. Utilization of Waste Polymers for Flexible Pavement and Easy Disposal of Waste Polymers, International Conference on Sustainable Solid Waste Management, 5 - 7, Chennai, India pp-105-111, 2007.
8. S Shankar, Prasad C.S.R.K., Evaluation of Rutting Potential for Crumb Rubber Modified Bitumen in Asphaltic Mixes, Emirates Journal for Engineering Research, 14 (2), pp- 91-95, 2009.
9. Vasudevan, R., Utilization of waste plastics for flexible pavement, Indian High Ways Indian Road Congress, Vol. 34, No.7, 2006.
10. Justo C.E.G., Veeraragavan A "Utilization of Waste Plastic Bags in Bituminous Mix for Improved Performance of Roads", Centre for Transportation Engineering, Bangalore University, Bangalore, India, 2002.
11. Specifications for Roads & Bridges works (fourth revision), 2001.
12. I.S. 3812, Specification for Fly ash as pozzolana and admixture (First Revision) 1983.
13. I.S. 8112-43 Grade ordinary Portland cement specification (First Revision) 1989.
14. IRC: SP 58-2001 Guidelines for Use of Fly-ash In Road Embankment Indian Roads Congress Special Publication.

