Review on Comparison between the Performances of Plant Produced Plastic Modified Asphalt with Laboratory Prepared Mix for DBM and BC Layers

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Abstract -*Hot mix plants are used for the production of standardized bituminous concrete expeditiously with high quality. To achieve these purposes, two different types of plants are used all over. These are batch-mix & continuous-mix plant (Drum-Mix). As the name suggests, in continuous type; continuous flow of aggregate takes place whereas in batch type there is production of one batch at one time. Waste plastic material that is available in abundance can be used as a modifier in various bituminous mixes. As we use plastic as a modifier, it gets coated over the aggregate which increases the stability and also improve the soundness. The main idea of this study is to evaluate the performance of plastic modified mix prepared in hot mix and making comparisons between the mixes prepared in the laboratory. In this study a modified sample of DBM & BC will be taken from Batch mix and Drum mix plants where Waste Plastic (percentage by weight of Bitumen) is use as a modifier. Marshall Stability test will be carried out over bituminous mixes namely DBM and BC to scrutinize the Specific gravity, Stability, flow value, Marshall Quotient.*

***Keywords*— Plastic Waste, Marshall Stability Method, Batch Mix Plant, Drum Mix Plant**

I. INTRODUCTION

Transportation is a key infrastructure of any country. Transportation majorly contributes to the industrial, economic, social and cultural development. In India which has the second longest road network in the world; spanning a total length of 58.9 lakh kilometres and these road network transports 64.5% of all goods and 90% of India's total passenger traffic uses road network to travel. Flexible pavements are prepared using bituminous mixes that are produced in hot mix plant .Hot Mix Plant contains preparing of material and hot mixing of prepared aggregates, Bitumen and filler. The quality of mix produced at Hot Mix Plant depends on the quality of applied materials and also on the manufacturing process. Superior quality of mix can be achieved by mechanization and computerisation of processes.

II. TYPES OF PLANTS

In general two types of plants are currently in use in India and abroad for mass production of bituminous mixes. These are:

- Continuous-mix (Drum-mix) plant
- Batch-mix plants

In a continuous-mix plant (Drum-Mix) there is continuous flow of aggregate for the production of mix. The mixing time is less than 1 minute. In hilly terrain generally drum mix plants are more suitable for the production as these require less space.

In Batch mix there is production of one batch at one time. This plant is generally preferred for the National highways, State highways and Express ways because of proper batching of aggregates there is uniformity in the mix. A batch mix plant is much more expensive than the drum mix plant.

III. FUNCTION OF HOT MIX PLANT

The primary function of Hot Mix Plant is to blend together aggregates and binder to produce a hot mixed homogeneous asphalt paving mixture with high quality. The aggregate blend may be a combination of coarse and fine aggregates with or without mineral filler. The binder is usually VG-grade bitumen or modified binder such as CRMB, PMB etc. Various additives, solid, or powdered materials, can also be integrated into the mixture.

IV. USE OF PLASTIC

Plastic is the most widely used material in the present times. As plastic is non-biodegradable martial it become great problem for our environment. Hence, it can be used as a modifier for the bituminous mix. As we use plastic as a modifier it gets coated over the aggregate and increases the stability of the mix. Generally, a waste plastic which are uses in shredded form of 2.36 mm to 600 microns size. According to IRC: SP: 98: 2013, the quantity of waste plastic will be 6% to 8% (by weight of bitumen) depending on rainfall areas. A

proper mixing time for a plastic modified mix will ranging from 10 seconds to 50 seconds. Waste plastic can also be added in hot bituminous mix.

V.NEED AND SCOPE OF STUDY

Many research studies have been done throughout the world in use of shredded plastic of varying percentage in the bituminous mixes. These studies are generally carried out in the laboratories. This study is little ahead of them in a way that here is utilization of shredded plastic in the hot mix plant which helps in better implementation of waste plastic in pavement construction at site.

VI.OBJECTIVES OF STUDY

The main objectives of proposed work are:

1. To prepare a bituminous mix in Batch Mix Plant and Drum Mix Plant for DBM & BC with Waste Plastic (percentage by weight of bitumen) as a modifier.
2. To determine the actual binder content, stability, flow and density of mixes prepared in hot mix plants.
3. To prepare a control mix and similar sample in the laboratory.
4. To develop comparison of stability, flow, percentage air voids and density of bituminous mix prepared in hot mix plant with that produced in the laboratory.

VII. RESEARCH AND VARIOUS STUDIES

Yonar F, Iyinam S, Iyinam A. F. & Ergun M. [1] Department of Civil Engineering, University of Istanbul, Turkey performed case study for Turkey on various Asphalt Plants in terms of their performance. They chose asphalt plants (Batch mix and Drum mix plant) for their case study and compared these two plants with respect to performance of production, product quality, quality control, efficiency and effect on environment. They also discussed theoretical and actual capacities of production, total costs, production and various losses from different problems. Due to large components in batch type plants their maintenance and installation costs are very high. In term of capacity they find that batch mix plants produce 320 tons/hour, however continuous type plants may achieve up to 455 tons/hour, as there is continuous process of preparation. Finally, they concluded that maximum capacity is not the solution for higher quality but which may be achieved by optimizing the capacity of plant.

Mohammad T. Awwad and Lina Shbeeb[2]Faculty of Engineering Technology Amman describe using polyethylene in Hot Asphalt Mixtures (HAM). They used two different types of polythene in their study, Low Density Polyethylene (LDPE) & High Density Polyethylene (HDPE) and also introduced polymers to mixture in grinded and non-grinded states. The outcome of this study was that modified asphalt has a higher VMA percentage and stability compared to the non-modified bituminous concrete which also influences the rutting resistance. There is little difference in air void contents of the modified mixture to that of the non-modified mixture. 4% of Air void is enough to provide better rutting susceptibility and to avoid bleeding from the mix. Overall, use of waste polyethylene in asphalt concrete reduces deformation and fatigue resistance and increase adhesion property.

Rattan Nishant, Ajay k Duggal[3] done a Comparison on Drum Mix and Batch Mix Plant. They concluded that batch mix plant is better than the drum mix plant as there is proper batching of material that take place in the batch mix plant as compared to the drum mix plant. Whereas in case drum mix there is less wastage than batch mix but the productivity of batch mix is much better than drum mix. According to the type of terrain and location use of HMP also varies, in hilly terrain drum mix plants are generally preferred whereas is plain terrain batch mix plant are in used.

Soni Kapil, Punjabi K. K[4] has studied the use of plastic waste in asphalt concrete. This modified bitumen shows better density, stability, flow and resistance to water. Their study also indicated that waste plastic added in blend gets laminated over the dry aggregate & reduce moisture absorption, porosity of mix and also improve binding property of blended material. The modified mix having 4.5% waste plastic will show goods results as in comparison with other mix. Up to 4.5% of polythene increases the Marshall Stability value first and then start decreasing. Thus according to the study high percentage of polythene is not recommended in the mix and thus rutting action can be improved using plastic coating over the dry aggregates. It also shows that there is increase in Marshall Stability value and also decrease in optimum bitumen content.

Sangita, Sharma D. K. and Sharma B. M [5] described the comparison in performance of BC mix properties having plastic polymer in varying rates from 8% and 15% bitumen by weight respectively. The results indicated that waste plastic polymer has thermal stability up to 200°C. Waste plastic when coat over the aggregate it will improves the various important parameters like strength, flow value, stability, rutting and flexibility.

Petkevicius, Kazys[6] determined that in Lithuania bad quality of asphalt concrete mix was the major cause of deteriorate of flexible pavements .The bad quality of bituminous concrete is majorly depend on the production errors of asphalt Plant (AP) and dissatisfactory mass ratio of aggregate, bitumen and filler. Different authors give different optimum values of dry coarse aggregate, fine aggregate, bitumen and filler(stone dust) and systematised the varying causes of deviations. On the behalf of mathematical statistical methods, quality assurance approach has been

developed. It will help to avoid the main deviations of different basic element proportions, happen in the production process and raise the uniformity of final product.

Thakur Shivani and Ajay K Duggal[7] studied on reutilization of plastic waste in bitumen mixes. They concluded that on the addition of PET and waste plastic bag in paving mix shows good results which influence various properties of mix such as VFB, VMA, stability and air voids. They concluded that on addition of 6% PET on mix there will be 35% increase in stability and similarly on addition of 7% WPB stability will be increases by 28% as compare to the control mix; DBM

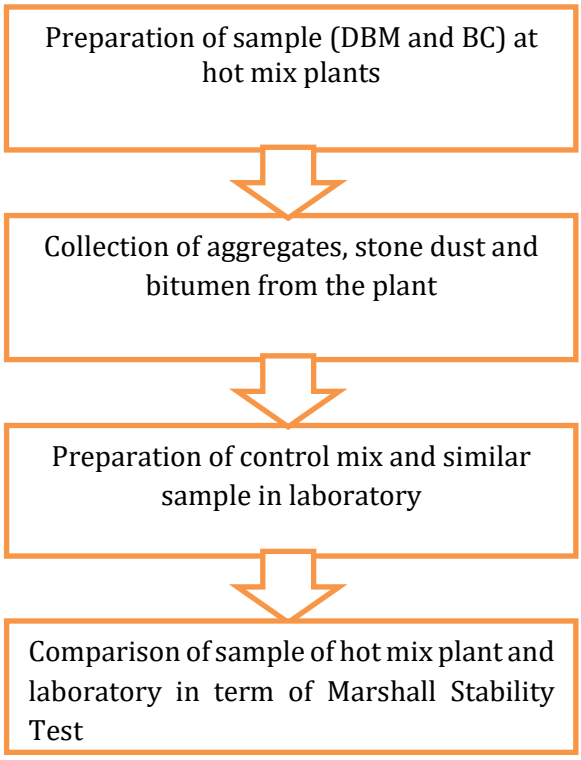
M.S. Ranadive and Honne Gowda S.[8] studied on the stability of bituminous pavements using waste plastic bags and fly ash. Instead of mineral filler they used fly ash produced as by-product from national thermal power plants and waste plastic collected from solid waste in DBM layer. Deformation and strength characteristics have been determined by Marshall Flow and stability values respectively. Marshall Stability test conducted on asphalt mix having 5% of fly ash have 1560 kg of maximum stability value, 2.3-flow value, 4.2% - Percentage air voids, 13.4% - VMA & 68.2% - VFB. Higher value of stability 1700 kg, flow is 2.4, air voids 3.9%, VMA 13.1% & VFB 70.0% were obtained on conducting Marshall Stability Test on bituminous concrete with 5% of fly ash & 2% plastic waste & these values are within the limits of specifications given by MORTH.

Vasudevan(2004) [9] utilized polythene Bags for integrated development of Rural and Arterial road network for socio-economic Growth. He studied both wet and dry mixing process by adding polymer with respect to the weight of bitumen used. Author reported that polymer bitumen blend is a better binder compared to plain bitumen resulting higher Marshall Stability and decreasing the possibilities of potholes formation.

Rahman and Wahab (2013) [10] in their investigation they used polyethylene terephthalate (PET) and waste plastic as partial replacement of fine aggregate in modified asphalt mix. In term of economic, it shows that this recycled PET could also reduce cost of road construction as it is cheaper than bitumen and easily available, which also improves the performance and the serviceability of the road. It can be concluded from their study that the application of recycled PET modified asphalt gives more benefits as compared to the conventional asphalt mixt especially in term of deformation.

VIII.REASEARCH METHODOLGY

In this research work the step by step method to perform the analysis is given:



IX.CONCLUSIONS

(i) Batch mix plant is better than the drum mix plant as there is proper batching of material takes place.
(ii) Maximum capacity is not the solution for higher quality product but which may be achieved by the optimizing the capacity of the plant.
(iii) Mixes with high performance and durability can be obtained with optimum dosage of shredded plastic.
(iv) Addition of plastic improves the general performance of roads over a long period of time.
(v) Waste plastic reduces temperature susceptibility, increases viscosity, imparts elasticity and improves other rheological properties of bitumen.
(vi) The modified mixture has a higher Marshall Stability and VMA percentage as compared to the non-modified mixtures. Hence more stable and durable mix for the pavements can be obtained by polymer modifications.
(vii) Generally research work on modified bitumen is performed in laboratories under controlled conditions but not much research is carried out in Hot Mix Plants.

VI. REFRENCES

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