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EFFECTIVE UTILIZATION OF WASTE MATERIAL TO ENHANCE THE PERFORMANCE OF BITUMEN BASED PAVEMENTS

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ABSTRACT- This work includes experimental investigation of the use of waste material in construction of roads. It is our moral responsibility to have concern about some of the frequent problems faced in India regarding roads and environmental safety such as formation of potholes, rutting, decreased durability of the pavements are of major concern in Indian villages as well as in metropolitan cities; this study also states an evergreen solution to it. The use of plastic and related materials is increasing exponentially due to tremendous growth in population, urbanization and changed life style leads to widespread littering of plastic on the landscape. Disposal of waste plastic is a serious problem globally due to their non-biodegradability and hazardous to human health, since these are not disposed scientifically. This study investigates use of plastic waste with bitumen to replace it to a limited extent and also the steel slag of a particular type in the form of aggregates along with conventional stone aggregates, its effects and an economical method for its implementation.

Keywords: Bitumen, Aggregate, Steel Slag, Plastic Waste.

I. INTRODUCTION

India is a under "developed country". The fulfilment of this motive demands rapid industrialization and vast infrastructure as a need of hour. In addition being hugely populated country . As a result of which India generates 150 million tons of waste on daily basis as per the report from International Solid Waste Association (ISWA). This increases demand of municipal waste management. Particularly plastic wastes have many problems in its disposal. Plastics are common man's friend and people are widely dependent on plastics specifically those of use and throw culture like cups, carry bags. But these plastics pose a serious threat to environment and human health when not taken care of; most of them are non-biodegradable in nature. They create problems like global warming, pollution etc. Hence they should be properly managed following the three R's i.e. reduce, reuse and recycle. By many researchers the use of plastic wastes like polyethylene, polypropylene, poly vinyl chloride in construction of pavement is suggested. These plastics have softening a softening point between 110°-140° and have a tendency to improve adhesion, reduce water permeability etc. These plastics are mixed at a temperature of 160° with hot aggregates and bitumen to form a modified mix. This modified mix has unique properties and enhanced quality. As suggested, use of steel slag of a particular type is also a good alternative for conventional stone aggregates, it can be added to a limited extent with these stone aggregates in a bituminous mix to increase the parameters like strength, bearing capacity and tensile reinforcement.

II . LITERATURE REVIEW

In the construction of flexible pavements using asphalt, hot bitumen is coated over the heated stone aggregate and rolled up in which bitumen acts as a binder element. Though when water is stagnated over road during rainy season it penetrates and results in formation of potholes, as defect in the pavement. It leads to the discomfort for the traveler passing by and many other problems like accidents. Remedial measures of filling potholes by concrete or asphalt do not prove to be long lasting. Literature review related to the modified bituminous mix has been done. The specific objective was to know the guidelines regarding the performance of different modifiers used in the bituminous mix. It has been noticed that many researchers, academician and consultant have work on various mixes of bituminous using modifiers.

Theoretically as well as practically the focus is made on the study of properties of BM using modifier. However, very little literature is available related to re-used plastic bottles as modifier. There is no or rather sufficient literature available on use of steel slag (chips) in bituminous pavement. Hence papers mentioning use of steel slag in concrete have been referred for an overview.

S.Rajasekaran, et al., states that the construction of asphalt pavement, hot bitumen is coated over hot stone aggregate mixed, laid and rolled. Bitumen acts as a binder. Use of plastic (virgin as well as waste) to modify the bitumen and also the use of plastic coated aggregates are being studied to improve performance of the pavement. Some of the prop- erties improved are durability, fatigue life , resistance to rutting, softening point, visco elastic property etc. The major obstacle to widespread usage of polymer modified bitumen in paving practice has been their tendency towards gross phase separation under quiescent conditions. (1)

Bhageerathy K. P (2014) stated that the main objective of the study was to investigate the performance of the bituminous mix modified with bio-medical plastic waste and to compare it with the normal mix. Medical plastic waste was collected from IMAGE (Indian Medical Association Goes Eco-friendly), Palakkad, Kerala, India. As part of the study, the properties of Plastic Coated Aggregates (PCA) were determined. The results showed improved properties for PCA when compared to normal aggregates. (2)

Mrs.Vidula Swami, et al., states that, various activities like packing consume almost 50-60%of the total plastics manufactured. There has been tremendous increase in the consumption of plastic raising from 4000 tons/annum (1990) to 4 million tons annum (2009) and it is still expected to rise upto significant level of 12 million tons/annum by 2016.It becomes hard to recover useful substances from plastic waste since rubber compound in tyre because compounds like black carbon, zinc oxide, process oil, and sulphur are present in vulcanized stage. The process of retarding produces tyre crumb as it's by-product . Hence, before applying new rubber the old tread of tyre is buffed to produce crumb. The reclaim process is not environmentally friendly unless expensive scrubbers and effluent treatment plants are installed. (4)

Pratiksha Singh Rajput, et al.,states that the Use of plastic waste in flexible pavements would open up a solution for the disposal issues regarding plastic wastes. They concluded that the Marshall stability value of plastic modified mix was found to be 51 percent more than that for the normal mix which indicates an increase in load carrying capacity. The plastics reduces the porosity, absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy disposal of waste plastics. (5)

Sudha.P (2017) performed the experimental inspection to evaluate the characteristics of concrete using the steel slag as a coarse aggregate. Concrete is most commonly used material than any other material in the world so the use of concrete is necessary at the same time which leads to the scarcity of aggregate is also increased now a day. The industrial waste has been encouraged in construction industries because it reduces the usage of natural resources. Fly ash, silica fume and steel slag where considered as a common industrial waste material. These materials are successfully used in construction industries for the partial and full replacement in concrete. In this study of M20 grades of concrete with W/C ratio 0.45 respectively for the partial replacement of coarse aggregate 20%,40%,60%,80% and 100% by steel slag.(6)

Mr. Mahesh M Barad, et al.,states that the addition of 8.0 % by weight of processed plastic for the preparation of modified bitumen results in a saving of 0.4 % bitumen by weight of the mix or about 9.6 kg bitumen per cubic meter (m3) of BC mix. Modified Bitumen improves the stability or strength, life and other desirable properties of bituminous concrete mix. the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased Softening point and decreased Penetration value with a suitable ductility. When it used for road construction it can withstand higher temperature and load. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy disposal of waste plastics. Mr. Mahesh M Barad concluded that, Polymer Modified Bitumen is used due to its better performance. But in the case of higher percentage of polymer bitumen blend, the blend is a more polymer dispersion in bitumen, which get separated on cooling. This has resulted in reduced rutting, raveling, and there is not pothole formation. The road can withstand heavy traffic and show better durability.(7)

Mr. H. K. Sharma, et al., states that the plastics can stay unchanged for as long as 4500 years on earth with increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. For rigid roads material used is concrete and for flexible roads bitumen is used. In India mostly the flexible pavement roads are available. Bitumen is a useful binder for road construction. Different grades of bitumen like 30/40, 60/70 and 80/ 100 are available on the basis of their penetration values. The steady increase in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature demand improved road characteristics. Mr. H. K. Sharma concluded that, the use of the innovative technology not only strengthened the road but also increased the road life as well as will help to improve the environment and also creating a source of income. It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste. In short we can conclude that, using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road.(8)

V.C. Renge (2012) reviewed that the quantum of plastic waste in municipal solid waste (MSW) is increasing due to

increase in population, urbanization, development activities and changes in life style which leading widespread littering on the landscape. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics for particular road mix. In the present paper developed techniques to use plastic waste for construction of flexible pavements has been reviewed. (9) Ravi Kumar(2016) carried out experimental investigation to evaluate the effects of concrete by replacing the normal coarse aggregate by steel slag on properties of concrete. Concrete is used, more than any other material in the world so the use of concrete is unavoidable at the same time scarcity of aggregate is also increased nowadays. The industrial waste has been encouraged in construction industries because it contributes to reduce the usage of natural resources for many years by product such as fly ash, silica fume and steel slag were considered as waste materials. They have been successfully used in the construction industry for the partial and full substitution in concrete. In this study concrete of M20, M30, M40, M50 grades were considered for aW/C ratio of 0.55, 0.45 ,0.37, 0.32 respectively for the replacement of coarse aggregate 30% 60% and 100% by steel slag. This study revealed that there is improvement in compressive strength 5 to 10% for all the grades of concrete. There is 4 to 8% increase in split tensile strength in all grades of concrete. The Flexural strength of concrete is increase about 2 to 6% for all the grades steel slag can be use up to 60% replacement in all grades of concrete. Full replacement by steel slag decreases the strength considerably.(10)

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