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REVIEW PAPER ON USE OF WASTE POLYTHENE IN BITUMINOUS CONCRETE MIXES FOR HIGHWAYS

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Abstract: Worldwide, sustainability is the immediate demand of the hour and towards this end use of waste material in road construction is being more and more encouraged so as to taper environmental impact. In the highway infrastructure, a number of originate materials and technologies have been invented to pin down their suitability for the design, construction and maintenance of these pavements. Polythene is one of them. Also considering the environmental factor, due to more and more use of polythenes in day to day business, the pollution to the environment is enormous .The use of polythene materials such as carry bags, food covers, etc. is constantly increasing day by day. Since the polythenes are non-biodegradable, the need of the current hour is to use the waste polythene in such a way that is beneficial for the world The main aim of this study is to focus on using the available waste poylthene present in abundant which can be used economically and conveniently. The use of these waste materials in road construction proves eco-friendly, economical and use of polythene will also givestrength in the sub-base course of the pavement.

Keywords waste polythenes, bituminous concrete

1. INTRODUCTION

Bituminous binders mostly used by paving industry have a vast civil engineering applications. There are different layers of pavement. The main constituents of bituminous concrete (BC) mix are aggregate and bitumen. Generally, all the hard surfaced pavements are categorized into two groups, i.e. Flexible Pavement and Rigid Pavement.

Flexible Pavement

If the upper layer of a road surface or of a pavement is bitumen material then it is called "flexible" since the total pavement structure can bend or deflect due to heavy traffic loads. Flexible pavements in on the whole have low flexural strength and are rather flexible in their structural action under heavy loads. These types of pavement layers reflect the deformation of lower layers on-to the surface of the layer.

Rigid Pavement

If the surface course of a pavement is of concrete mix other than bitumen then it is called "rigid" since the total pavement structure can't bend or deflect due to traffic loads. These types of pavements are notably stiffer than the flexible pavements due to the high modulus of elasticity of the PCC material. Importantly, we can use RCC in the rigid pavements, to decrease or eliminate the joints.

2. POLYMER MODIFICATION OF BC

Bituminous binders are mostly used in flexibleroad paving and their viscoelastic properties aredependent on their chemical composition. Now-a-days, the steady increment in high trafficintensity in terms of commercial vehicles, and the significant variation in daily and seasonaltemperature put us in a situation to think about some alternative ways for the improvement ofthe pavement qualityand characteristics by applying some necessary modifications which shall satisfy both the strength as well as economical aspects. Bitumen can also be modified by adding different types of additives to achieve the present requirement. One of these additives is the polymers.

The steady increase of wheel loads, tyre pressure, change in climatic conditions &daily wear and tear severely affect the performance of bituminous mix pavements. Hence any improvement in the property of the pavement is highly essential considering the present scenario.

3. ROLE OF POLYMER IN PAVEMENT

Modification of BC, with the synthetic polymer binder can be treated as a resolution to overcome the problems,

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arising because of the rapid increase in wheel loads and change in climatic conditions. Polymer modification can be considered as one of the solution to, reduce the rutting, improvise the fatigue life & thermal cracking in the pavement. Asphalt, when blended or mixed with the polymer, forms a multiphase system containing abundant asphaltenes which are not absorbed by the polymer. This increases the viscosity of the mixture by the formation of a more internal complex structure.

4. STATUS OF ONGOING RESEARCHES

4.1 Evolution of mix design concepts

Roberts et al. 2002 During 1900 in order to prevent rapid removal of the fine particles such as dust from Water Bound Macadam, the technique, of using bitumen in pavements, was first used on rural roads, which was caused due to fast growth of automobiles At initial stages, heavy oils were used as dust palliative.

FransisHveem 1942 project engineer of California Department of Highways developed the Hveemstabilometer in 1927. He does not have any previous experience to recognise, the required mix from its colour,so he decided to measure various mixture parameters. He decided to use surface area calculation concept in order to find the optimum quantity (which was already in use, at that time for the cement concrete mix design), to estimate the quantity of bitumen actually required.

Bruce Marshalljust before the World War-II developed the Marshall testing machine. It was adopted in the US Army Corpes of Engineers in 1930's and subsequently modified in 1940's and 50's.

4.2 Polymer modification

Bahia and Anderson 1984 studied the visco-elastic nature of binders and identified that, the complex modulus & phase angles of the binders, is necessary to be measured, at temperatures and loading rates which different resemble climatic and loading conditions.

Shukla and Jain 1984 described that the effect of wax in bitumen can be lowered by the addition of EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The bleeding at high temperature Susceptibility to high temperatures and brittleness at low temperature of the mixture can be effectively reduced by addition of 4 percent EVA or 6 percent SBS or 8% resin in waxy bitumen .The results from the studies conducted by the Shell Research and Technology Centre in Amsterdam indicated that the rutting rate is greatly reduced as a result of SBS modification of the binder.

Button and Little 1998 on the basis of stress controlled fatigue testing at 20 and 00C, reported that SBS polymer exhibited superior fatigue properties as compared to straight AC-5 bitumen.

Shuler et al. 1987 found that styrene-butadyne-styrene (SBS) modified binder have increased tensile strength as compared to unmodified asphalt mix at minus 21, 25

Collins et al.1991 observed that SBS unmodified asphalt asphmixes have shorter lives than modified asphmixes. The resistance to low temperature cracking can be increasedby addition of SBS polymer to unmodified bitumen .

Denning and Carswell1981 reported that asphalt concrete becomes more resistant to permanent deformation By using polyethylene modified binders at heavy temperature .

Palit et al.2002 found that crumb rubber modified mix have improved stripping characteristics as compared to unmodified asphalt mix.

Sibal et al.2000 evaluated flexural fatigue life of asphalt concrete modified by 3% crumb rubber as part of aggregates .

Goodrich 1998 reported that the polymer modified mixes have significant increase in fatigue life and creep properties as compared to unmodified asphalt The Indian Roads Congress Specifications Special Publication: 53 (2002) reported that the time period of next renewal may be extended by 50% in case of surfacing with modified bitumen as compared to unmodified bitumen.

Firoozifar et al. 2010 investigated the unique methods to increase the low temperature susceptibility and storage stability and of polythene modified bitumen. For increasing stability of polythene modified bitumen They used Aromatic oil, B-oil Kerosene, Oleic Acid, etc. and a fluorescent microscope to observe the homogeneity of the samples

Aslam and Rahman 2009 after studying both dry and wet mix concluded that for flexible pavements dry process is more economical and beneficial for construction .

Vargas et al. 2013 figure out the chemically-implant polyethylene as asphalt modifiers. while the penetration degree decreased in blends prepared with implant polyethylene and the phase distributions of micrographs from fluorescence

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microscopy show that non implant polyethylene polymers were not readily miscible with asphalt. with implanted polyethylene He indicate that most of asphalt blends exhibit improved performance at higher temperature such as enhancing rutting resistance, superior time–temperature and flow activation energy dependent response as compared to the reference polyethylene blends after carried out results of rheological tests in their study.

Rahman and Wahab2013 as partial replacement of fine aggregate in modified asphalt used recycled polyethylene terephthalate (PET) in their investigation. it shows that this recycled PET could lower the construction cost of road In term of economic value, because this recycled material is cheaper than bitumen and easy to obtain, which also improves the level of performance and the service life of the road. It can be concluded from their study that the application of recycled PET modified asphalt gives more advantages compared to the conventional asphalt mixture especially in term of permanent deformation.

5. RECENT APPLICATIONS

In Bangalore A 25 km plastic modified bituminous concrete road was laid. This plastic road showed superior smoothness, uniform behaviour and less rutting as compared to a plastics-free road which was laid at same time, which began developing "crocodile cracks" very soon after. In 2003 The process has also been approved, by the CRRI (Central Road Research Institute Delhi).

Justo et al.2002 used processed plastic bags as an additive in asphalt concrete mixes at the Centre for Transportation Engineering of Bangalore University The properties of the ordinary bitumen were compared to that of modified bitumen. It was pointed that ductility values and penetration values of modified bitumen was decreasing with the increase in proportion of the plastic additive, up to 12 % by weight.

Mohammad T. Awwad et al. 2007 in order to investigate the potential prospects to enhance asphalt mixture properties polyethylene as one sort of polymers is used. The objectives also include finding the best quality of polyethylene to be used and its proportion. Two types of polyethylene High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE) were used to coat the aggregate. The results indicated that in order to attain better engineering property grinded HDPE polyethylene modifier provides should be used. The recommended amount of the modifier is 12% by the weight of bitumen content.

6. CONCLUSION:-

After going through number of researches I conclude that waste polythene can be used for a beneficial purpose since waste polythene is a concern if not used in a proper way there fore it is necessary that different types of waste plastics should be collected and used in bituminous mix .

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