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SEMISYNTHETIC POLYMER SHREDDED FLEXIBLE PAVEMENT CONSTRUCTION

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Abstract: - The rapid increase in the use of plastic materials in the years led to the accumulation of extreme amounts of plastic waste. Total decomposition of domestic waste which are mainly categories as organic waste and inorganic waste. E-waste and plastic waste also contribute to total waste stream due to utilization of electronic items. These wastes can cause a potential hazard to human health and environment if any of the aspects of solid waste management is not managed properly. Thermoplastic such as PET, PE, PP, PS and PVC as well as materials that derived from these are the type of plastic most used and consequently create environmental problems. These includes the use of waste plastic in construction of asphalt road. By recycling waste plastic, it is possible to protect the environmental from contamination.

Using waste plastic in asphalt road construction as an aggregate binder is one of the recent plastic waste approach. This will help to avoid the environmental pollution from open-air burning and landfill of plastic waste. In this research paper, the applicability of the waste plastic as a binder, together with bitumen has investigated. The purpose of the research is to utilize the shredded plastic waste in road construction. It is our main objective to promote the concept of proper utilization of plastic waste and to spread the concept of best from waste. To raise the waste product value above zero.

Keywords: - *: Plastic waste, waste management, polymer modified bitumen, plastic coated aggregate*

I INTRODUCTION

Solid waste management is the strong area of today's current issue. Of the various waste materials municipal solid waste, plastic waste and are of great concern. The need of today is to find proper use of the disposed plastics waste. On the other side, the road traffic is increasing. The traffic intensity is increasing. To meet sustainability. Load bearing capacities of the road has to be increased. Plastics, become a problem to the environment after its use who is a versatile packing material. Most used materials are bags, cups, films and foams, made up of PE, PP .They are mostly littered after their use. The littered plastics, non-biodegradable material get mixed with domestic waste and make the disposal of municipal solid waste difficult. The municipal solid waste is either combust or used for land filling. Both are not correct techniques to dispose the waste, it will create both land and air pollution. Moreover, municipal solid waste, if any Incineration of PVC waste gives rise to toxic gases like dioxin. Plastic is mixed with the bitumen. The melting point of the bitumen is increased because of plastic blending in it and the road can retain its flexibility resulting in its long life during winters. Use of shredded plastic waste acts as a strong "binding agent" making the asphalt last long. The bitumen is able to withstand high temperature due to mixing plastic with it. Disposal of plastic wastes in an eco-friendly way. The technique has innovated to use the waste plastics for the construction of asphalt pavement this the process helps in waste disposal in an eco-friendly manner. This process can also promote value addition to the waste plastic.

II OVERVIEW ON PLASTIC WASTE

Synthetic or semi-synthetic materials that use polymers as a main ingredient is called as plastic. Plastic content includes materials composed of various elements such as carbon, hydrogen, oxygen, nitrogen, chlorine and sulphur. Plastics typically have high molecular weight, meaning each molecule can have thousands of atoms bound together.

Most of the plastic contain organic polymers. The vast majority of these polymers are formed from chains atoms, with or without the attachment of oxygen, nitrogen or sulphur atoms. These chains comprise many repeating units which is formed from monomers and each polymer chain consists of several thousand repeating units.

By changeable percentage of plastic waste was added by taking weight of bitumen into the heated aggregate. Varying with the waste plastic content was tested for determining bulk density and stability by marshal specimen. Studies were carried out

from waste plastic content on bituminous mixes by using 60/70 bitumen grade having Marshall Stability value of 1300 kg at 5% of bitumen content by weight of the mix. Studies were carried out on mixes by using binder which is obtained with addition of waste plastics with bitumen grade conventional 80/100.

It was found to be 5.0% by weight of the mix, to the bitumen plastic is added by weight of proceed to be 8% for design criteria binder content fulfil the Marshall Mix. The binder was found to be as 1750 kg at this stage for mix of MSV average which can give the result about increase in stability mix of BC can contain 4.6% bitumen plus 8% plastic by weight of bitumen, i.e, process plastic by weight of the mix is 0.4%.

Under soaking condition of water the mix prepared with the modified bitumen, after soaking in water test were conducted at 60 Co for 24 hours. With binder by using 8% of the plastic the average MSW of the BC mix was found with bitumen of the mix to increase unto about 2.6 times of mix. Different types of plastic can be used in the road construction process are as follows:

1. Polyethylene (PE)
    a. High-density polyethylene (HDPE)
    b. Low- density polyethylene (LDPE)
    c. Polyethylene terephthalate (PET)
2. Polypropylene (PP)

III CHANGES IN PROPERTIES OF PLASTIC COATED AGGREGATE

The difference in changes of properties of plastic coated aggregate over the normal aggregate are as follows;

A. Moisture absorption and voids

Coating of plastics over aggregate improved its quality with respect to voids, moisture absorption and soundness. The moisture absorption in plain aggregates is 4% while in plastic coated aggregates it is only 2%. Plastic coating on aggregate decreases the porosity and helps to improve the quality of the aggregate with respect to its performance in the flexible pavement.

B. Soundness test on plastic coated aggregates

Soundness test is intended to study the resistance of aggregate to weathering action and changes in its volume after comes in contact with water. The plastic coated aggregate does not shows any changes in volume or weight loss after soundness test. Thus there is the improvement in the quality of aggregates.

C. Aggregate Impact value

Impact test shows the brittleness of aggregates after facing a sudden impact. The film which is formed is helps in preventing the cracking on load. The toughness of the aggregate stones is increased by resisting sudden shock of traffic. The impact value of plain aggregate is found to be 15 to 20 while in plastic coated aggregate it is 8 to 10. Hence, the impact value of the plastic coated aggregate is lower when compared with the plain aggregate.

D. Abrasion test on plastic coated aggregates

The coating of polymers over aggregate gives better adhesion over the surface particles. Abrasion over the surface of aggregate is reduced as the roughness of aggregate is reduced. Abrasion value should be 30% for the pavements. The abrasion value of plain aggregates is 37% while for plastic coated aggregate it is found to be 26%.The resistance of aggregates increase with the increase in coating thickness of the plastics coat. The reason behind that, coating of polymers over aggregate gives better adhesion over the surface particles.

E. Aggregates crushing value

Crushing test is used to measure the crushing strength of the road aggregates. The plain aggregates having crushing value 27% and The plastic coated aggregates crushing value is found to be 18% i.e. Thus due addition of plastic, the voids get filled and crushing strength of aggregate is increased.

IV PLASTIC ROAD CONSTRUCTION PROCESS

There are two well-known process of plastic road construction. Dry process utilizes plastic coated aggregate and Wet process utilizes polymer modified bitumen.

A. Dry method:

This method is utilizing for flexible pavement, hot stone combination having temperature 170°c is combined with hot bitumen having temperature 160°c and this mixture is used for road laying. As per IS coding on the basis of strength & wet absorption capability the bitumen mixture is chosen. The is chosen on the premise of its binding property, penetration and elastic property. The aggregate, once coated with plastics improved its quality with reference to voids, wet absorption and soundness. The coating of plastic decreases the porosity and helps to boost the standard of the aggregate and its performance within the flexible pavement. It's to be noted here that stones with < 2% a pair of porosity is allowed by the specification.

B. Wet method:

Waste plastic is ground and created into powder; 6 to 8 % plastic is mixed with the bitumen. Plastic will increase the temperature of the bitumen and makes the road retain its flexibility throughout w. inters leading to its long life. Use of sliced plastic waste acts as a strong “binding agent” for tar creating the asphalt last long. By intermixture plastic with bitumen the power of the bitumen to resist hot temperature will increase. The plastic waste is melted and mixed with bitumen in a specific quantitative relation. Normally, mixing takes place when temperature reaches 45.5°C however once plastic is

mixed, it remains stable even at 55°C. The vigorous tests at the laboratory level tested that the bituminous concrete mixes ready by using the treated bitumen binder consummated all the required Marshall Mix criterion for surface course of road pavement. There was a considerable increase in Marshall Stability value of the combination, of the order of two to three time's higher value as compared with the untreated or standard bitumen. Another necessary observation was that the bituminous mixes ready using the treated binder may face up to adverse soaking condition beneath for long period.

V ADVANTAGES & DISADVANTAGES OF PLASTIC ROADS

A. Advantages:

- Plastic roads have prefabricated lightweight construction.
- Plastic roads requires less maintenance time and faster construction.
- It has a longer lifespan and higher quality.
- Plastic roads prevents water stagnation and from rain water it gives a better protection for the construction of plastic roads.
- Than regular asphalt roads plastic roads give better bonding of mixture components and increased binding.
- By increased Marshall Stability value the construction of plastic roads makes the road stronger.
- Plastic roads leads to less rutting and raveling which have the reduction in pores of the aggregates.
- There is no need of stripping and potholes while construction of plastic roads.
- There is no effect of radiation of UV in plastic roads.
- Plastic roads increases the overall strength by 100%.
- In plastic roads increases the property of withstanding load. For increased road transports now a day's need this features helps in satisfying.
- 1 ton of bitumen is saved and 1 ton of plastic is used for plastic roads construction of 1km x 3.75m.

B. Disadvantages:

- While cleaning the plastic roads it creates difficulty, as in the plastic wastes there is present of toxics which starts trigger leaching which in used in plastic road construction.
- From the surrounding, noxious HCL gas will release from the mixture of asphalt and plastic during the road laying process.
- As over the surface of plastic road the plastic will form a sticky layer, after laying of plastic road it was found that the first rain will result in trigger leaching.
- It cannot be inert once the plastic roads components has been laid.

VI AN OVERVIEW OF PLASTIC ROADS CONSTRUCTION IN INDIA

Uptill now country has almost 33,700 km of plastic roadways it means that 1 million of plastic bags can be used for 1 km road. In December 2019 by using waste plastic India has built 21,000 miles of roads. Plastic road technology was adopted in cities in India were in Chennai, Pune, Jamshedpur, Madhya Pradesh, Surat and In Meghalaya.

- In recent years**, Chennai** has used nearly 1,600 tonnes of plastic waste materials to constructs 1,035.23 kilometers length of plastic roads, and including of N.S.C Bose road, Ethiraj Silai Street, Halls road, and Sardar Patel Street. Plastic roads may be a new concept since 2011 of in many parts of India .Chennai has been experimenting with plastic roads.
- The another places in Pune where plastic roads are constructed which include Katraj Dairy, Dattawadi Kaka Halwai Lane, Magarpatta City HCMTR Road, Kavde Mala Road, Koregaon Park Lane NO.3 and Yeravada Sadal Baba Darga Road located in Chandrama Chowk.
  In 2016 To construct a plastic road at Navi Peth near Valkunth Crematorium by using this technology on waste plastic **Pune municipal corporation** has constructed a 150 meter long stretch of Bhaghat lane.
- **In Jamshedpur**[Jamshedpur Utility and Service Company] **[JUSCO]** which is a Tata steel company, By using the plastic in road construction it constructed a 12 to 15 km road in the steel city and also in Tata Steel Works. In Ranchl which is nearly a 1km stetch, In Dhurwa and Morabaldl 500 km stretch, In Chas and Jamtara 3 km pf plastic roads and In Giridlh it is stretch upto 500m.
- **In Madhya Pradesh** near Indore, around 35 km of plastic roads has constructed in Madhya Pradesh Rural Road Development Authority [MPRRDA] in 2014 in 17 districts with plastic waste materials.
- **In Surat** In January 2017, it was executed that to construct plastic roads by using pastic mix. In a place Where roads were layered with plastic waste as no cracks is developed the problem of potholes was gently reduced.
- **In Meghalaya** for road construction the technology of using plastic waste has deeply penetrated by converting 430 kgs of waste plastic from a village which was used in constructing a kilometer long plastic road. In the year 2018 this road was constructed.

VII CONCLUSION

We can conclude that, the durability of the roads arranged out with shredded plastic waste is much more compared with roads with asphalt with the standard road. Roads arranged with plastic waste combine are found to be higher than the traditional once. Plastic coating on aggregate is employed for the higher performance of roads. This helps the binding property of plastic makes the road last longer besides giving side strength to face up to a lot of loads as compare to traditional roads, avoid use of anti-stripping agent, avoid disposal of plastic waste by burning and land filling, that is eco-friendly.

In addition to the advance of the standard of the road, this technology has helped to use the waste plastic obtained from domestic and industrial material. Dry method that is use for the development of plastic-coated flexible pavement helps to dispose 80%of waste polymers by an eco-friendly methodology.

The studies on the performance of plastic tar road once and for all proves that it's sensible for significant traffic because of higher binding and higher surface condition for a prolong amount of exposure to variation in environmental condition changes.

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