International Journal of Advance Research in Science and Engineering
Volume No.07, Issue No.10, October 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

A REVIEW REPORT ONUSE OF WASTE PLASTIC AND CRUMB RUBBER AS BINDING MATERIAL IN FLEXIBLE PAVEMENT

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ABSTRACT

The quantity of plastic waste in municipal solid waste (MSW) is increasing because of increasing population, urbanization, various development activities and changing lifestyle. Crumb rubber is the rubber obtained from the waste tyres of vehicles. The traditional techniques of disposing waste plastics and rubber are landfilling, incineration etc. Both the techniques have hazardous consequences over the environment.Hence there is need to find a more eco-friendly way of disposal of waste plastics and crumb rubber.

The better binding property of plastic and rubber in their molten state has helped in finding out a method of safe disposal of waste plastic and rubber, i.e.by using them in flexible pavement as binding material along with bitumen.Modified Bitumen is one of the important construction materials for flexible pavements. Use of plastic waste (LDPE-Low Density Polyethylene) and Crumb Rubber in the construction of flexible pavement is gaining importance. Hence in this study, an approach is made to understand the improved properties of flexible pavement materials by introducing waste plastic and crumb rubber.

Keywords:*Crumb rubber, Flexible pavement, Low Density Polyethylene, Marshal Test, Waste plastic*

I.INTRODUCTION

There are several issue existing regarding reducing waste. A major environmental issue is waste incinerators, furnaces for burning trace garbage and waste plastic. These incinerators produce 210 different dioxin compound as well as mercury, cadmium, nitrous oxide, hydrogen chloride, sulphuric

acid and fluorides. Particulate matter is also produce in incinerators. Additionally waste incinerators generate more CO_2emissions than coal, oil, natural gas fueled power plant. Hence, disposal of waste in an eco-friendly way is the thrust area of today's research. The recent technique is to use waste plastic for the construction of asphalt pavement. The process helps to dispose the waste by eco-friendly method. The waste plastic modified bitumen mix shows better binding property, stability, density and more resistance to water.

[1]India has a road network of over 56 lakh kilometers as on 31st March 2016. It is the 2nd largest road over the world. Several studies has revealed that the properties of the bitumen and bituminous mix can be improved by addition of certain additives. These additives are known as 'Bitumen Modifiers' and the bitumen premixed with these modifiers is known as modifiers bitumen. Different types of bitumen used are polymers, national rubber and crumb rubber.

II.OBJECTIVE

1. To learn and understand the practical utilization of plastic waste generated as municipal solid waste in bituminous pavements.
2. To evaluate the properties modification because of plastic and rubber addition in bituminous pavements.
3. To study the effect of waste plastic on strength and stability characteristics of Bituminous Concrete Mix.
4. To study the strength characteristics of waste plastic.

NEED

1. Disposal of waste plastic and rubber is major problems.
2. It is non-biodegradable.
3. Burning of waste plastic cause environment pollution.
4. To find the utility of waste plastic and crumb rubber in bituminous mixes for road construction.
5.Addition of plastic waste and crumb rubber improves the properties of bituminous mix.

SCOPE

The main scopes of plastic roads are:

1. Economic in term of bitumen: The shredded plastic in form of polymer cover the aggregate and thus occupies a larger portion of road reducing the quantity of bitumen needed.

2. Efficient management of non-biodegradable waste: Plastics harmful and non-biodegradable waste responsible mainly for land pollution. Utilizing it for road construction will result in its efficient management.
3. Easy process without any new machinery: It is simple and easy technique which does not involve any complex or mew machinery.
4. Enhanced durability: The addition of plastic to bitumen will help in improving the strength and durability of the pavement.

PLASTIC ROADS

Plastic roads are the roads made either entirely of plastic or of composites of plastic with other materials. These roads are different from standard roads in the respect that standard roads are made asphalt concrete which consist of mineral aggregate and asphalt. Plastic roads have better characteristics than asphalt concrete roads, specifically they show better wear resistance, water resistance, improved strength, etc.

[2]Since the construction of roads using waste plastic is a new idea, the construction processes may be different. In Jamshedpur, India roads are built using a mixture of plastic and bitumen. In Indonesia also the roads are constructed using plastic and asphalt mix.

III.METHODOLOGY

Waste plastic is made powder and varying percent plastic is mixed with bitumen. Plastic increase the melting point of the bitumen and makes the road flexible during winters resulting in its long life. By mixing plastic with bitumen the brittleness overcomes and elastic nature enhances. The plastic waste is melted and mixed with bitumen in a particular ratio. There are two important processes used for bitumen mix flexible pavement, they are:

1. Dry process
2. Wet process

1. Dry Process:

   For the flexible pavement, hot stone aggregate (170°C) is mixed with hot bitumen (160°C) and the mix is used for road laying. The aggregate is chosen on the basis of its strength, porosity and moisture absorption capacity as per IS coding. The bitumen is chosen on the basis of its binding property, penetration value and viscous-elastic property. The aggregate,

when coated with plastics improved its quality with respect to voids, moisture absorption and soundness.

In this process the shredded plastics are poured over the heated aggregates, thus forming plastic coated aggregates which are then mixed with hot bitumen to form plastic coated aggregate bitumen mixture for laying roads. The coating of plastic decreases the porosity and helps to improve the quality of the aggregate and its performance in the flexible pavement.

2. Wet Process:

These are the method used for formation of polymer based modified bitumen, in which the waste polymer directly added with bitumen and heated up to temperature of 170℃ so that proper blend is to be formed with proper dispersion of waste polymer into bitumen, then the hot mix is then cooled up to 120℃ into another chamber, which is then added to the aggregate in paddling chamber. The mix is to be cooled because when hot mix poured on aggregate then there are chances to form air pocket into small gap of aggregate and chances in lower the strength of roads and chances of rutting of roads. After addition of modified bitumen at 110℃ on aggregate, it is then laid on the road and then spreader material is compacted by 8 ton roller.

IV.LITRETAURE RIVEW

[3]Anzar Hamid Mir (2015) studied the viscoelastic nature of binders and found that the complex modulus & phase angles of the binders, need to be measured, at temperatures and loading rates which different resemble climatic and loading conditions.

[4]Sasane Neha .B (2015) polyethylene as one sort of polymers is used to investigate the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be used and its proportion. Two types of polyethylene were added to coat the aggregate High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). The results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air voids and the voids of mineral aggregate.

[5]Vatsal Patel (2014) described that the effect of wax in bitumen can be reduced by adding EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The addition of 4% EVA or 6% SBS or 8% resin in waxy bitumen effectively reduces the Susceptibility to high temperatures, bleeding at high temperature and brittleness at a low temperature of the mixes.

[6]Patel, C.B. (2013) worked on the wet process and resulted that softening point, penetration and ductility of blended bitumen were improved. Penetration and ductility was decreased while softening point increased.

[7]Amit P. Gawande (2013) evaluated flexural fatigue life of asphalt concrete modified by 3% crumb rubber as part of aggregated and reported that fatigue life and creep properties of the polymer modified mixes increased significantly as compared to unmodified asphalt mixes.

[8]Wayal, A.S. (2013) this study gives results of both wet and dry processes and determined an increase in the strength due to accumulation of waste to the bitumen. The toughness of coarse aggregates was improved by coated rubber powder and waste plastic. Also reduces the porosity, absorption of moisture and enhancement in the ductility recorded.

[9]Rokade S. (2012) concluded that maximum of 25% Marshal Stability values can be increased by using LDPE (Low-density polyethylene) and CRMB (Crumb rubber modified bitumen). Also the dry process was concluded that a huge improvement in the aggregate properties.

[10]Ahmadinia, E. (2011) reported that using PET (polyethylene Terephthalate) blend the Marshall Stability results 6% optimum content.

[11]Vasudevan, R. et.al.(2011) worked on the plastic coated aggregates along with plastic blend mixture of bitumen basic properties were checked and field assessment was also reported. It was determined that using dry process the plastic coated aggregates shown greater results and can improve the flexible pavement properties. By field valuation, it was seen that high percentage of plastic waste could be used. Possibly 10% of bitumen can be reduced to get better results. This process can reduce the coast of the pavement along withincrease in the strength. Due to better binding, these roads can be used for heavy traffic.

[12]Chaudhary, A.K. (2010) used Kharkai River, Jamsedhpur, and Jharkhand (India) soil along with HDPE waste from local rag picker. The waste strips were cut into 12mm length and placed arbitrarily in the soil sample with different percentage of 0.25%, 0.5%, 1.0%, 2.0% and 4.0% waste. The CBR test was completed over the test specimens and it was determined that the CBR value of the specimens increased almost three times than that of the controlled sample.

[13]Naskar, M 2010) used 60/70 grade bitumen as controlled sample and blended it with waste plastic films of 2mm x 2mm size. The deliberation of waste to bitumen in blend was taken as 0,1,3,5 and 7% by weight of bitumen. Tests for thermal, rheological and physical properties were done and it was concluded that bitumen ability was improved by blending it with waste plastic. The optimum waste plastic content was taken as 5%.

V.CONCLUSION

Review of several studies suggested that the use of recycled materials has positive impact through different aspects. This include the benefits in enhancing sustainability of the construction industry while reducing cost, providing solutions to environmental pollution and reducing the need for natural resources.Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with heavy distresses. This adversely affects the life of the pavements. The polymer modified bitumen show better properties for road construction and plastics waste which otherwise are considered to be a pollution menace. It can find its use in this process and this can help in solving the problem of pollution because most of the plastic waste is polymers.

In the modified process (dry process) plastics-waste is coated over aggregate. This helps to have better binding of bitumen with the plastic-waste coated aggregate due to increased bonding and increased area of contact between polymer and bitumen. The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air. The road can withstand heavy traffic and show better service life.

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