

USE OF WASTE PLASTIC IN BITUMEN EMULSION: A REVIEW

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Abstract—Solid waste management is a key field nowadays. There are two major problems: Firstly, the management of municipal solid waste, particularly with regards to used plastic which have overwhelmed major cities and towns: Secondly, The formation of potholes on roads attributable to excessive traffic and axle weight. Bottles, chocolates, chips, hand bags, and other forms of plastic create significant environmental and economic drawback. Use of plastic is a priority to handle and pack things comfortably attributable to its light weight, cost effectiveness and strength. Plastics cannot be banned as it will result in usage of natural resources paper, wood at a great extent. Burning of these chlorines containing substance release toxic heavy metals and emits noxious gases like dioxins and furans, which causes health problem including damage to the reproductive and immune system and cancer. The above two problems can be eliminated partially if waste plastic can be used in bituminous products. This paper reviewed the research conducted on possible use of waste plastic in bitumen emulsion.

Index Terms—Plastic waste, Aggregates, Bitumen;

I. INTRODUCTION

Plastic in different forms is found to be almost 5% in municipal solid waste, which are toxic in nature. It is common sight in both urban and rural areas to find empty plastic bags, cold drink bottles and all other forms of plastic packing material. Plastic waste in municipal solid waste is been increasing day by day attributable to increase in population, urbanization, development activities, which is leading to wide spread of land use for the disposal of waste. Plastic is a non-biodegradable material and researchers are found that the material can remain on earth for 4500 years without degradation. Several studies have proven that the health hazard caused by improper disposal of plastic waste is tremendous. The health hazards includes reproductive problems in human and animal, genital abnormalities, cancer etc. Looking forward the scenario of present life style a complete ban on the use of plastic cannot be put, although the waste plastic taking the face of devil for the present and future generation.

Traditionally soil, coarse aggregate, fine aggregate, coal dust, bitumen, cement etc, are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Also, cost of extracting good quality of natural materials is increasing.

Post construction pavements performance studies are to be done for these waste materials for construction of low volume roads with two fold benefits: Firstly, it will help in clear valuable land of huge dumps of waste; Secondly, it will also help to preserve the natural resource of aggregate, bitumen.

Studies have shown that plastic waste after proper process can be used in the construction of bituminous pavements. Such pavements show enhanced properties and increased life spans, thus making the road construction more economical and solving the environmental problem at the same time.

Table 1.1: Plastic Consumption in India. [3,7]

Sr. No	Year	Consumption(tonnes)
1	1996	61,000
2	2001	4,00,000
3	2006	7,00,000
4	2011	1,35,00,00
5	2016	2,98,00,00

Waste plastic can be used in flexible pavements in such a manner that it gets coated over the surface of aggregate by heating (1400c–1600c) because plastic like PE, PS PP used in bottles, disposal glasses, handbags, covers of various appliances etc. Soften up to 1600c. The various experiments conducted by litterateur in laboratory depict fruitful results can substantially increase the stability and durability of road plus making it a very effective step towards eco-friendly compared to conventional and traditional techniques of flexible pavements construction.

Bitumen is a viscous liquid or semi solid material, black or brown in colour having adhesive property consisting essentially of hydrocarbons, derive from crude petroleum or occurring in natural asphalt and soluble in carbon di-sulphide. Bitumen materials used in highway construction are broadly classified into bitumen and tar. Bitumen further divided into petroleum asphalt and native asphalt. The viscosity of bitumen is sometimes reduced by a volatile diluents, is term as cutback. Mixture of two or more liquid that are unblended is known as emulsion.

The plastic waste are shared in shredding machine and used in different percentage bitumen. Shredding is the process of cutting the plastic into 2.36mm to 4.75mm with plastic shredding machine.

Below is the photo of plastic waste landfill at Pirana Ahmadabad which Spread over an area of 84 hectares. The Pirana landfill has been the city's major dumping yard since 1982. Every day the Ahmadabad Municipal Corporation (AMC) collect approximately 4,700

metric ton of solid waste to dispose of at the landfill. The landfill is characterised by three 75-foot-high massive mounds of garbage, each weighing 69 lakh metric ton.



Fig1.1: Pirana landfill, Ahmadabad [8]

Mr. Gaurav Anand,[7] Senior Manager of JUSCO stated that there are no maintenance costs for the first five years. Some of the major returns from the developing roads from plastic waste which include plastic waste free clean due to rain or traffic load, saving natural resource, effective and eco friendly and economical use of plastics.

II. LITERATURE REVIEW

M. Mahalakshmi et al. 2014[11] conducted research on utilization of waste plastic in bitumen. Effect of using plastic waste in pavement was investigated throughout laboratory testing. The laboratory testing involved routine material characterization, marshall stability, Ductility, Flash point test, Fire point test. In marshall stability check 1200gm of aggregate and filler material is heated to a temperature of 1750c-1900c. Bitumen is heated to a temperature of 1210c-1250c with first trial percentage of 4% by weight of material aggregate, and mix is prepared by applying bitumen on plastic Added aggregate. The mix is compacted by a rammer with 50 blows at temperature of 1380c-1490c. This study showed that plastic waste can be used to increase stability, softening point. Addition of LDPE plastic has reduced the bitumen content in pavement and it is also better way of waste plastic disposal.

Justo and veeraragavan, 2002[9] has conducted study on utilization of waste plastic bags in bituminous mix for improved performance of road in which various percentage of process plastic is applied on aggregate. The result have shown that addition of 8% of processes plastic by weight of is desirable in saving 0.4% bitumen by weight of mix (9.6 kg bitumen per cubic meter of bitumen concrete mix) which improves the stability, life strength, durability and other desirable properties of bitumen.

A. Yakub et al. 2017[4] has studied about the replacement of asphalt with waste polythene in bitumen road. They compared plain bitumen and bitumen replaced by waste plastic with 10%, 20%,30%, and 40%. The result have shown that used of 10%of waste plastic for 1km road with 25mm thickness reduces cost of construction is around 31,590 Rs.

J.k.Appiah et al. 2007[8]conducted research on use of waste plastic materials for road construction in Ghana. There are two main objective of research. Firstly, it was to modify and characterize the rheological properties of waste plastic modified bitumen for road construction and repair in Ghana. Secondly, to determine the optimum amount of plastic used for stable blending with bitumen, and to conduct different tests including viscosity, softening point, penetration tests on the plastic bitumen blends. Researcher study two method for modifying bitumen for road construction namely dry mix process and wet mix process. This study result in showing that polymer modified bitumen is more viscous than unmodified bitumen, as it take long time to become brittle. The durability of the pavement can be improved. It also show that for a single lane road 1 ton bitumen is required, when modified with 3% of plastic bitumen use it save up to 30 kg of bitumen with strengthen the road.

L. Flynn, 1993[10] has discussed on recycle plastic finds it home in asphalt binder. Studies have shown that the use of recycle plastic in bitumen pavement mix reduce the permanent deformation in the form of rutting (surface deformation in wheel path) and low temperature cracking of pavement surfacing.

Gurav Anand, [6] has discussed on maintenance cost for the first five years, he said that some of the major returns out of developing roads from plastic which give free clean environment, better road without any deformation due to rain or traffic load, saving of natural resource, effective and eco friendly use of waste plastic.

Deepti Yellanki, P.Gopi , 2016[5] has studied about the use of waste plastic in construction of bituminous road. Study shown that use of waste plastic in road construction they applied following steps. Firstly, they collected the waste plastic form the road site, dumpsites, and waste buyers. Then the collected waste plastic were sorted as per the required size for aggregate mix. The waste plastic cut down in size of 2.26mm-6mm as per IRC-SP-20 in the plastic cutting machine. It has been observed that use of waste plastic coated aggregate have already given better result in sub base of highway pavement, highway medians, sound barriers and other transportations structure. The Addition of plastic in bitumen mix decrease the quantity of stone aggregate by volume of total material and increase the flexibility and strength of the top layer of the highway. This study showed that waste plasticare used to thermal cracking and permanent deformation in hot region. It is also save conventional stone aggregate to a certain quantity.

V. Swami et al. 2002[12] has presented paper on use of waste plastic in construction of bituminous road. The litterateur stated that the increase in percentage of polymer decrease the penetration value and increase the hardness of bitumen. The study concluded with three major conclusion. Firstly, load carrying capacity of waste plastic bitumen pavement is higher than standard bitumen pavement. Secondly, plastic has property of absorbing sound, which help in reducing the sound pollution of heavy traffic. Thirdly, Use of waste plastic in bitumen pavement reduce total material cost of the project by 7.99%.

A.s.Wayal and D.Wegle, 2013[2] conducted research using marshall test on use of waste plastic and waste rubber in aggregate and bitumen for road materials. The litterateur state that the use of 8% polymer and crumbed rubber is blended in the mix the value of marshall testes viz.. Marshall stability (kg), Flow (mm), Density of the bitumen (kg/m³), Air voids(%), Voids filled by bitumen (%) goes on increasing as compared to conventional mix. The coating of plastic and rubber reduce porosity, absorption of moisture and improve soundness, hence the use of waste plastic and rubber tires in the form of powder for flexible pavement material is one of the best method for easy disposal of waste.

III. CONCLUSION

Day by day the waste plastic is increasing, and by reviewing the above paper it has been observed that use of the above innovative technology will modify the properties of recycled bitumen. It will generate jobs for rag pickers. It will help in reducing cost of waste collection and the bleeding problems in hot region. Waste plastic helps in increasing the stability and durability of roads to a greater extent. These techniques are very eco-friendly as it uses the waste plastic which is being disposed in oceans, land, etc. Replacement of bitumen with plastic reduces the cost of the construction significantly. It helps to improve the environment and reduce the need of bitumen by 10%.

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