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Utilization of Mobile Waste in Construction Industry in Preparation of Flexible Pavement

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ABSTRACT

Bituminous mixes are most commonly used all over the world in flexible pavement construction. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together, laid down in layers and then compacted. Under normal circumstances, conventional bituminous pavements if designed and executed properly perform quite satisfactorily but the performance of bituminous mixes is very poor under various situations. Today's asphaltic concrete pavements are expected to perform better as they are experiencing increased volume of traffic, increased loads and increased variations in daily or seasonal temperature over what has been experienced in the past. In addition, the performance of bituminous pavements is found to be very poor in moisture induced situations. Considering this a lot of work has been done on use of additives in bituminous mixtures and as well as on modification of bitumen. Research has indicated that the addition of mobile chips and waste LPDE plastic to asphalt binders helps to increase the interfacial cohesiveness of the bond between the aggregate and the binder which can enhance many properties of the asphalt pavements to help meet these increased demands. However, the additive that is to be used for modification of mix or binder should satisfy both the strength requirements as well as economical aspects. In this research work we will add LPDE plastic waste 4% by weight and mobile chips as an aggregate replacement as 10%, 15%, 20% and 25% by weight. To determine the best suitable and stable replacement of bitumen in construction industry.

Keywords : Bitumen, Plastic, Mobile Chips, Stability, Penetration, Sample, Ductility.

I. INTRODUCTION

Plastics are everywhere in today's lifestyle and are growing rapidly throughout particularly in a developing country like India. As these are non-biodegradable there is a major problem posed to the society with regard to the management of these solid wastes. Low density polyethylene (LDPE) has been found to be a good modifier of bitumen. Even, the reclaimed polyethylene originally made of LDPE has been observed to modify bitumen. Latest innovations in the field of science and technology have changed the very lifestyle of common man. Much electronic equipment that was beyond reached earlier is now available at affordable prices. On one hand this development has made life easy for all but on the other hand it has encouraged use and throws mentality. Nowadays people prefer to buy a new appliance rather than taking the pains to get the older one repaired. Such a trend not only leads to increase in volume of electrical and Mobile waste but also poses serious threat to public health and environment. E-waste is growing exponentially in recent years because the markets for these products are also growing rapidly. The US-EPA has estimated an increase of 5 to 10% in the generation of e-waste each year globally of which only 5% is being recovered. Thereby the amount of e-waste that needs

to be disposed off in an environmental friendly manner is increasing day by day. The fraction including iron, copper, aluminum, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70% [2]. The e-waste inventory based on this obsolescence rate and installed base in India for the year 2005 has been estimated to be 146180.00 tones. This is expected to exceed 8, 00,000 tone by 2012. In India, e-waste is mostly generated in large cities like Delhi, Mumbai and Bangalore. In these cities a complex e-waste handling infrastructure has developed mainly based on a long tradition of waste recycling. Sixty five cities in India generate more than 60% of the total e waste generated in India. Ten states generate 70% of the total e-waste generated in India. Maharashtra ranks first followed by Tamil Nadu, Andhra of e-waste generating states in India. Among top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmadabad, Hyderabad, Pune, Surat and Nagpur. There are two small WEEE/E-waste dismantling facilities are functioning in Chennai and Bangalore. There is no large scale organized e-waste recycling facility in India and the entire recycling exists in unorganized sector.

II. Literature Review

Aslam and Rahman (2009) studied both dry and wet mix and concluded that the dry process is more economical and beneficial for construction of flexible pavements. Because in case of higher percentage of polythene in wet process they get separate out from bitumen on cooling, so it needs some additives.

Moghaddam and Karim (2012) reported that the utilization of waste material in asphalt pavement would be beneficial in order to find an alternative solution to increase service life of asphalt pavement and reduce environmental pollution as well. Form their study it is concluded that Polyethylene Terephthalate (PET) reinforced mixtures possess higher stability value, flow, fatigue life in comparison with the mixtures without PET.

Pareek et al. (2012) carried out experimental study on conventional bitumen and polymer modified binder and observed a significant improvement in case of rutting resistance, indirect tensile strength and resilient modulus of the bituminous concrete mix with polymer modified bitumen. They also concluded that Polymer modified bitumen results a high elastic recovery (79%) and better age resistance properties (The loss in weight on heating in thin film oven is 6 times higher as compared to conventional bitumen of 60/70).

Sangita et al. (2011) suggested a novel approach to improve road quality by utilizing plastic waste in road construction. According to them India spends Rs 35,000 crores a year on road construction and repairs, including Rs 100,000 crores a year just on maintenance and roads by bitumen modification lasts 2-3 times longer, which will save us Rs 33,000 crores a year in repairs, plus reduced vehicle wear and tear.

III. Objectives

A comparative study has been made in this investigation in SMA mixes with plastic content (4%) and mobile waste chips in different sample as 10%, 15%, 20% and 25%.

The objectives of this investigation are to observe the followings;

- Study of Marshall properties of mixes using both

1. mobile chips as aggregate replacement.

2. plastic waste as an bitumen replacement.

- The effect of polyethylene as admixture on the strength of bituminous mix with different filler and replacing some percentage of fine aggregate by mobile chips.

Table 1 : Properties of bitumen

Test description	Results	Standard values
Penetration at 25°C (1/10 mm)	66	50 to 90
Softening point °C	64.6	>48 oC
Ductility cm	> 80	>50
Specific gravity	1.02	-

Fig 1: Sample Prepared

Fig 2: Mobile Waste

Experimental Investigation:

Determining the Marshall Stability of Bituminous Mixture

This test is done to decide the Marshall strength of the bituminous blend according to ASTM D 1559. The standard of this test is that Marshall Stability is the imperviousness to plastic stream of a bituminous blend stacked on the parallel surface. It is the heap conveying limit of the blend at 60oc and is measure in kg. The mechanical assembly expected to decide Marshall Stability of bituminous blend is

(i) Marshall Stability Apparatus
(ii) Balance and Water Bath

The specimen required is from Marshall Stability diagram, select extents of coarse totals, fine totals and filler in such a route, in order to satisfy the required details. The heaviness of the blend ought to be 1200g.

Fig 3 : Marshal Stability Test

IV. Experimental Result

Table 2: Marshal Stability Results

Sr. No.	Type of Mix	Flow Value	Va (%)	VMA (%)	VFB (%)	Marshall Stability value (kg)
1.	SMA mix with 10 % chips as a aggregate replacement	3.5	4.4	7.75	70.3	1560
2.	SMA mix with 15 % chips as a aggregate replacement	3.8	2.43	8.28	69.80	1640
3.	SMA mix with 20 % chips as a aggregate replacement	4.1	3.0	9.48	68.3	1700
4.	SMA mix with 25 % chips as a aggregate replacement	4.0	2.8	8.85	68.9	1686

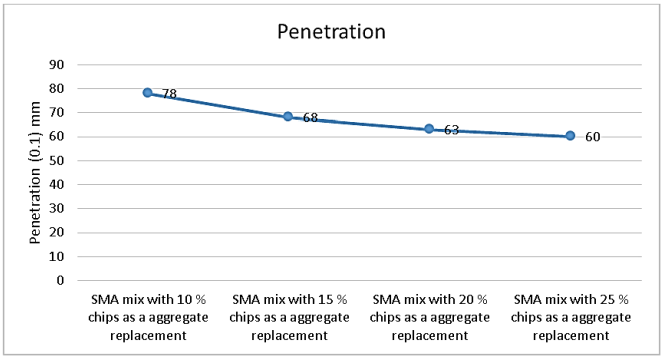

Fig 4: Penetration Value

V. CONCLUSION

- Marshall Test conducted on bituminous mix with combination 20% mobile chips and have higher value of stability 1700 kg correspondingly the values of flow is 4.1, percentage air voids is3.0 %, VMA is 9.48% & VFB is 68.30%.
- It is observed that by addition of mobile chips to the mixture, the resistance to moisture susceptibility of mix also increases. BC with polyethylene results in highest tensile strength ratio in SMA mix.
- From the study it is concluded that mobile case increases the binding property of the mix in a natural way.
- The ductility of the sample increases with increase in mobile chips as it provides good tensile strength to the sample.
- As per the cost cutting in construction this method is very valuable and as it is very helpful in cost cutting of bitumen in a mix.

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