Study on Utilization of Plastic Waste in Bituminious Road

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Abstract **- Discard of waste plastic is considered as a major problem in India. It consists of mainly lower density polyethylene Particles. Burning of these waste Particles causes change in environmental conditions and create air pollution. Laboratory studies were conducted which suggest that waste plastic can be considered in the binding property for the mix in Bitumen. Which Increases the properties of bituminous mix provides the solution for discarding it in a useful way. Plastic mix Flexible Pavement mainly use polyethylene carry bags, disposed plastic cups and bottles that are collected from garbage dumps as an important ingredient of the construction material. When mixed with hot bitumen, plastics melt to form a coat over the aggregate and this mixture is laid on the road surface like a normal tar road, this method is being considered as a successful solution. Aim of this Report is to study the use of plastic waste in Flexible pavement construction. In this report We performed various laboratory test like Elongation and flakiness index test, Impact Value of aggregate, softening point of the bituminous mix, and Marshall Stability Test to determine effect of plastic waste with bituminous mix. Large amount of polyethylene waste is generated in India, for which Plastic treating capacity is low. This project aims the effect of use of plastic waste in various percentages on the Marshall Stability Value so as to use maximise amount of Disposed plastic waste in construction of bituminous Flexible pavement. So, a greater number of methodical and advantageous way of disposal of plastic waste can be encouraged.**

Index Terms **- Elongation & flakiness, Impact value, Marshall stability, polyethylene waste, Bituminous mix.**

INTRODUCTION

The amount of Waste in today's reality is increasing Day-by-Day Specially the non-biodegradable waste plastic in country like India, as the non-biodegradable plastic materials have become slice of daily life. Improper waste management causes it mixed with Municipal Solid Waste or get thrown over sewers, bear land which leads to increase in cost for proper Disposal of waste. their present disposing methods are either by land filling or by burn up. Both the processes have bad impacts on our living habitat. On the other side. It is imperishable & it mainly consists of lower-density polyethylene. Burning of these waste plastic bags causes environmental pollution. Laboratory studies suggested that waste plastic enhances the property of the mix on heating at 100 - 160°C, plastics such as polyethylene, polypropylene and polystyrene, soften and exhibit good binding properties which can be considered as beneficial part in Flexible pavement construction industry, Improvement in properties can provide good binding properties with bitumen and easiest and most economical way of disposal. Hence, we are going to use these plastic waste as a mix with bitumen. Plastic mix flexible pavement mainly use plastic carry bags, discarding plastic cups and bottles that are collected from garbage dumps as an important ingredient of the construction material. When mixed with hot bitumen, plastics melt to form an oily coat over the aggregate and the mixture is laid on the road surface like a normal tar road. Bitumen is a useful binder for road construction. Different grades of bitumen like 30/40, 60/70 and 80/ 100 are available on the basis of their penetration values. The steady increase in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature demand improved road characteristics. The waste polymer bitumen blend can

be prepared and a study of the properties can throw more light on their use for Pavement laying.

METHODOLOGY

Proposed Methodology: IS 2386 (part 1)1963 provide guidelines and procedure to determine the Elongation and flakiness index of 10mm & 20mm Aggregate and IS 2386 (part-4)1963 provide guidelines and procedure to determine the Impact Value of aggregate using impact test instrument. IS 1205:1978 provide guidelines and procedure to determine the Softening point of the bituminous mix using softening point test apparatus and Marshall Stability Test on the plastic modified mix specimens to study different parameters and stability of the bituminous mix test procedure are provided from ASTM D 6927 and IRC 111

DETERMINARTION OF FLAKINESS & ELONGATION AS PER IS 2386 (PART 1) 1963

- Flakiness index is the percentage of weight of aggregate which has least dimension (Thickness) i.e., lesser than 1.8 times mean dimension
- Elongation is the percentage by weight of aggregate which has dimension (Length) 1.8 greater than the mean dimension.

Outcomes of flakiness & elongation test of aggregate - 20mm size

Sr. No	I.S Sieve (mm)		Weight of aggregate (Gms)	Weight of aggregate Passing on Thickness Gauge (Gms)	Weight of Non-Flaky Aggregate (Gms)	Weight of aggregate Retained on length (Gms)
	Passing	Retained				
1	40	31.5				
2	31.5	25				
3	25	20	713	63	650	55
4	20	16	1715	135	1580	140
5	16	12.5	980	117	863	115
6	12.5	10	459	49	410	98
7	10	6.3				
8		Total	3867	364	3503	408

Flakiness Index : 9.41%
Elongation Index: 11.64%
Combined Index : 21.06%

Outcomes of flakiness & elongation test of aggregate - 10mm size

Sr. No	I.S Sieve (mm)		Weight of aggregate (Gms)	Weight of aggregate Passing on Thickness Gauge (Gms)	Weight of Non-Flaky Aggregate (Gms)	Weight of aggregate Retained on length (Gms)
	Passing	Retained				
1	40	31.5				
2	31.5	25				
3	25	20				
4	20	16				
5	16	12.5				
6	12.5	10	407	45	362	48
7	10	6.3	203	27	176	35
8		Total	610	72	538	83

Flakiness Index : 11.80%
Elongation Index: 15.42%
Combined Index : 27.23%

2.2 DETERMINATION OF IMPACT VALUE OF AGGREGATES USING IMPACT TEST INSTRUMENT AS PER IS 2386 (PART 4) 1963

The main purpose of this test is to determine suitability of material in pavement construction.

Outcomes of aggregate impact value test

Sr. No	Observation	I	II
1	Initial weight of Material in Gms.	310	300
2	Weight of Material Retained on 2.36mm sieve in Gms. (After Test)	255	261
3	Weight of Material Passing on 2.36mm Sieve in Gms.	55	39
4	Percentage in Impact (D/B) x100	17.74	13.00
5	Average Impact Value	15.37	

2.3 DETERMINATION OF SOFTENING POINT OF THE BITUMINOUS MIX USING SOFTENING POINT TEST APPARATUS (BY RING AND BALL METHOD) AS PER IS 1205:1978

Softening test is a procedure in which at a certain point the temperature of bitumen is increased at which the substance of bitumen gets soften and by which bitumen can be used for different pavement purposes by changing the softening temperature a particular degree of softening under specified conditions of test.

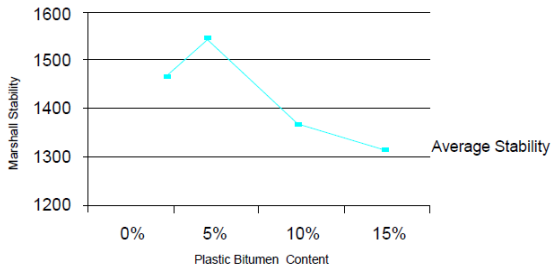
2.4 DETERMINATION OF MARSHALL STABILITY OF PLASTIC MODIFIED MIX SPECIMENS TO STUDY DIFFERENT PARAMETERS AND STABILITY OF THE BITUMINOUS MIX ASTM D 6927 and IRC 111

The stability of the mix is defined as a maximum load carried by a compacted specimen at a standard test temperature of 600° C. The flow is measured as the deformation in units of 0.25 mm between no load and maximum load carried by the specimen during stability test (flow value may also be measured by deformation units of 0.1 mm). This test attempts to get the optimum binder content for the aggregate mix type and traffic intensity. This is the test which helps us to draw Marshall Stability vs. % bitumen.

Percentage Bitumen Content vs. Marshall Stability

Sr. no.	Tests Performed	On Ordinary	On adding 5% with bitumen	On adding 10% with bitumen	On adding 15% with bitumen	As per IS Specifications Minimum values
1	Softening Point Test	52.74 °C	53.26°C	54.30°C	54.80°C	>= 47°C
2	Density Test	2.530	2.668	2.700	2.890	>=2.500
3	Marshall Stability Value	1489	1541	1379.5	1318.5	> 900
4	Flow	3.15	2.93	3.11	2.78	2 - 4

Graph: -



OUTCOMES

I have calculated the Marshall stability of various specimen by adding 5%, 10%, 15% of plastic with bitumen content. The 5% and 10% most probably gives the stability up to similar value as the conventional or ordinary mix. Also, by addition of 5% of plastic with bitumen content there is increase in stability value than the ordinary mix which is used.

As the weight in air is constant as compared with the ordinary specimen but there is increase in absorption factor as the specimen is submerged in water the specimen absorbs slightly more water than the ordinary specimen which gives increased weight of sample in water. Therefore overall there is certain increase in density with increase in plastic content. The overall tests which are carried out for various percentage of addition of plastic in bitumen content which provided comparatively better result upto certain limits than the ordinary mix. These results are all under standard specifications therefore this wet process of addition of waste plastic in bitumen content is technically feasible.

CONCLUSION

The generation of waste plastics is increasing day by day. The major polymers, namely polyethylene, polypropylene, and polystyrene show adhesion property in their molten state. Plastics will increase the melting point of the bitumen. Hence, the use of waste plastics for road construction is one of the best methods for easy disposal of waste plastics. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as creating a source of income. 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 big potholes. It is hoped that in near future we will have strong, durable and eco-friendly roads that will relieve the earth from all type of plastic waste. As i have calculated the Marshall stability of various specimen by adding 5%, 10%, 15% of plastic with bitumen content. The 5% and 10% most probably gives the stability up to the conventional or ordinary mix. This has shown that Use of plastic waste in bituminous road construction is technically feasible. It can be one of the ways for effective disposal of plastic waste.

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[6] IS 2386 (part 4)1963 for impact value of aggregate.
[7] ASTM D 6927 and IRC 111for Marshall stability & IS 1205:1978 for softening.