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Construction of Bituminous Pavement by Using Plastic Waste

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Abstract: The waste plastic and its dumping is a major threat to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength. In addition it will also be a solution to plastic disposal and various defects in pavement. The waste plastic is ragged and coated over aggregate and mixed with hot bitumen and resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases its durability

Keywords*:* Plastic, Flexible Pavement, Strength, Bitumen, Aggregate.

I.INTRODUCTION

Plastics, a versatile material and a friend to common man become a problem to the environment after its use. Disposal of a variety of plastic wastes in an eco- friendly way is the prod area of today's research. Looking forward the situation of present lifestyle a complete ban on the use of waste plastic cannot be put, although the waste plastic taking the face of a devil for the present and the future generation. But the use of waste plastics in road construction is purchase importance these days because plastic roads perform better than ordinary ones and the plastic waste considered to be a pollution menace, can find its use. The use of waste plastic for coating the aggregates of the bituminous mix found to improve its performance characteristics. Recycled polyethene carry bags were shredded into small sizes and is coated on aggregates of the mix at a specified temperature.Bituminous mixes were prepared with 80/100 bitumen and plastic coated aggregates/ordinary aggregates with dust as a filler material. The uses of plastic waste help in substantially improving the abrasion and slip resistance of flexible pavement and also allows to obtain values of splitting tensile strength satisfied the specified limits while plastic waste content is beyond 30% by weight of mix. If the consistent mixing time and mixing temperature are not provided for bitumen– modifier mix, modified bitumen cannot exhibit good performance in situ, thus premature failures will occur. Therefore, there are certain recommended mixing time, mixing temperature and modifier content for all the polymers with a trademark. This all should be taken in mind while mixing and laying of roads is to be done using plastic waste. The plastic road would be a boon for India. In hot and extremely humid climate durable and eco-friendly plastic roads are of greatest advantages. This will also help in releasing the earth from all type of plastic waste.

II.PRESENT WORK

1.1 WHAT IS PLASTIC?

A material which contains one or more number of polymers having large molecular mass solid in its finished state or same state developed or processing into finished articles is known as Plastic. Looking to the global issue of environmental pollution by post-consumer plastic waste, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner.

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Types of Plastic	Description	Some uses ofvirgin plastic	Some uses ofrecycled plastic
polyethylene terephthalate (PET)	Clear tough plastic, may be used as fiber	Soft drink andmineral water bottles	Clear film forpackaging, carpet fiber
Low density polyethylene(LDPE)	Soft, flexible plastic, milkywhite	Lids of ice-cream container, bins&garbage bags	Film for builders,industry
High density polyethylene(HDPE)	Very common plastic, usually white or coloured	Crinkly shopping bags, freezerbags	Compost bins, detergentbottles
polypropylene (PP)	Hard but flexibleplastic	Ice-cream container, stools and chairs	Compost bins,kerb side recycling crates
polystyrene (PS)	Rigid, brittle plastic may be clean glassy	Cheap, transparent kitchen ware,light fitting bottles	Clothes pegs,coat hangers and video andCD boxes

TABLE NO 1

III PREVIOUS RESEARCHES

3.1 Fransis Hveem (1942)

"Optimum quantity of bitumen inroads" who was a project engineer of California Department of Highways, has developed the Hveem stabilometer in 1927. He did not have any previous experience on judging, the required mix of its colour, hence he decided to measure various mixture parameters to find the optimum quantity of bitumen. [Vallerga and Lovering 1985]. He had used the surface area calculation concept, (which was already in use, at that time for the cement concrete mix design), to estimate the quantity of bitumen actually required.

3.2 Dr. R. Vasudevan (2007)

He stated that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased softening point and decreased Penetration value with a suitable ductility.

3.3 Zahra Niloofar Kalantar (2012)

Many researches on PMA mixture have been conducted for the past two decades. Although addition of virgin polymers. to asphalt for the purpose of enhancing the properties of asphalt over a wide temperature range in paving applications was contemplated quite some time ago, recycled polymer added to asphalt have also shown almost the same result in improving the road pavement performance as compared to virgin polymers. In this study, a critical review on the history and benefits of using waste and virgin polymer in asphalt is presented followed by a review of general studies on using polymers in asphalt in order to improve the properties of pavement.to asphalt for the purpose of enhancing the properties of asphalt over a wide temperature range in paving applications was contemplated quite some time ago, recycled polymer added to asphalt have also shown almost the same result in improving the road pavement performance as compared to virgin polymers. In this study, a critical review on the history and benefits of using waste and virgin polymer in asphalt is presented followed by a review of general studies on using polymers in asphalt in order to improve the properties of pavemen

IV. EXPERIMENTAL INVESTIGATION

4.1 Quality control tests on Normal aggregates & Plastic Coated Aggregates

The comparative study is done by testing the normal aggregates & plastic coated aggregates by adding plastic 5%, 8% & 10 % to check the optimum proportion to suit the aggregate for Bituminous pavement The various tests that are carried out on aggregate are listed below

4.2 Aggregate Impact Test (as per IS 2386 Part IV - 1963)

The test is designed to estimate the toughness of stone or the resistance of the aggregates to fracture under repeated impacts is called impact test. The aggregate impact test is commonly carried out to estimate the resistance to impact of aggregates and has been homogenous by ISI.Aggregate Impact Value (AIV) = (W2/W1) X 100. Where, W1 = Original Weight of Sample.
W2 = Weight of Sample passing through 2.36 mm IS Sieve.

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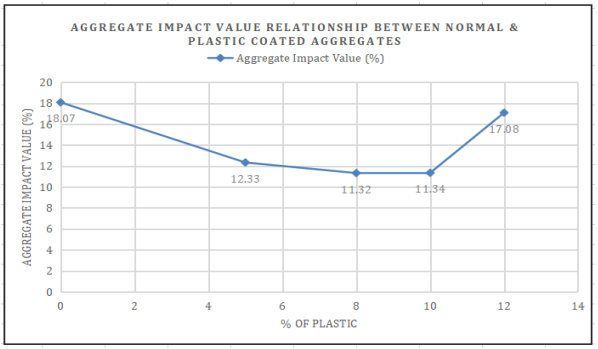
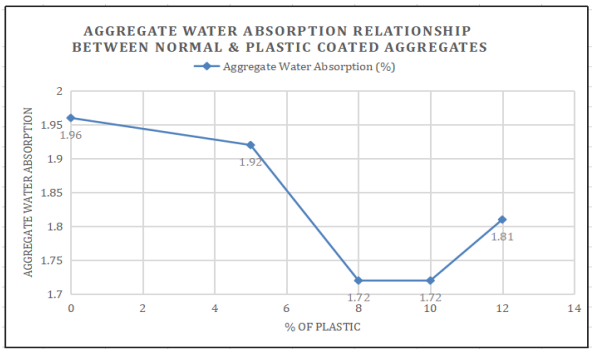
4.3 Results table of Aggregate Impact Value

% of Plastic	W1	W2	WA
	gm	gm	%
0	1020	1000.4	1.96
5	1019	999.8	1.92
8	1014.8	997.6	1.72
10	1015.65	998.4	1.73
12	1017.75	999.6	1.82

TABLE NO 2



Graph.1 Aggregate Impact Value Relation



Graph.2 Aggregate Water Absorption Relation

As per IRC Maximum Value of AIV = 30 % for Wearing Course.As per IRC Lowest Aggregate impact Value is chosen to give good toughness.From Above Table & Graph Optimum % of Plastic is added to aggregates is 8 % of Bitumen, to give good toughness

4.4 Aggregate Water Absorption Test (as per IS 1124 – 1974)

The water absorption of coarse aggregate is measured by the percentage increase in weight of an oven dry sample after immersion in water for 24 hours. Water Absorption (WA) = (W1-W2/W2) X 100 Where, W1 = Weight of Saturated Aggregate. W2 = Wight of Oven Dried aggregate.

Result Of Water Absorption Test

% of Plastic	W1	W2	AAV
	gm	gm	%
0	2500	580	23.2
5	2502	528.4	21.12
8	2503	497.3	19.87
10	2500	481.2	19.25
12	2501	508.9	20.35

TABLE NO 3

Aggregate Abrasion Value (AAV) (Los Angel's Abrasion Test) (as per IS 2386 Part IV - 1963)

Due to the movements of traffic, the road stones used in the surface course are subjected to wearing action at the top. Hence road stones should be hard enough to resist the abrasion due to traffic. Abrasion tests are carried out to test the hardness property of stones and to decide whether they are suitable for the different road construction works.

Abrasion Value = (W2/W1) X 100.

Where, W1 = Weight of oven dried sample before applying abrasive charge.

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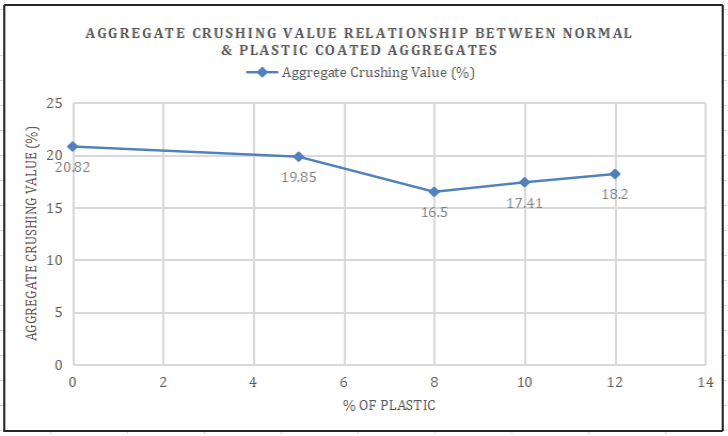
W2 = Wight of Sample passing through 1.7 mm IS Sieve, after applying abrasive charge



Aggregate Crushing Value (ACV) (as per IS 2386 Part IV - 1963)

The power of the coarse aggregate may be assessed by aggregate crushing test. The aggregate crushing value provides a relative measure of resistance to crushing under gradually applied compressive load. To achieve a high quality of pavement, aggregates possessing high resistance to crushing or low aggregate crushing value re preferred.
Aggregate Crushing Value = (W2/W1) X 100. Where W1 = Weight of oven dried sample = 3860 gm.
W2 = After applying compressive load Weight of sample passing through 2.36 mm IS Sieve.

Result Of Crushing Value Test

% of Plastic	W1	W2	ACV
	gm	gm	%
0	3860	804	20.83
5	3950	784	19.85
8	3795	626	16.5
10	3894	678	17.41
12	3984	725	18.2

TABLE NO 4

Quality control tests on Bitumen
A Hydrocarbon material of either natural or pyrogenous origin, found in liquid, semi-solid or solid in state and completely soluble in carbon-disulphide is called as bitumen.

Properties of bitumen.
It is usually solid or semi-solid in state.
It melts and gives distinctive odor when heated.
It possesses adhesive properties when softened by heat.

Penetration Test (as per IS 1203 – 1978): It measures the hardness or softness of bitumen by measuring the depth in tenths of a millimeter to which a standard loaded needle will penetrate vertically in 5 seconds. BIS had standardized the equipment and test procedure

Results table of Bitumen Penetration Value

Penetration Value		
96	78	102
Avg Penetration Value = 92		

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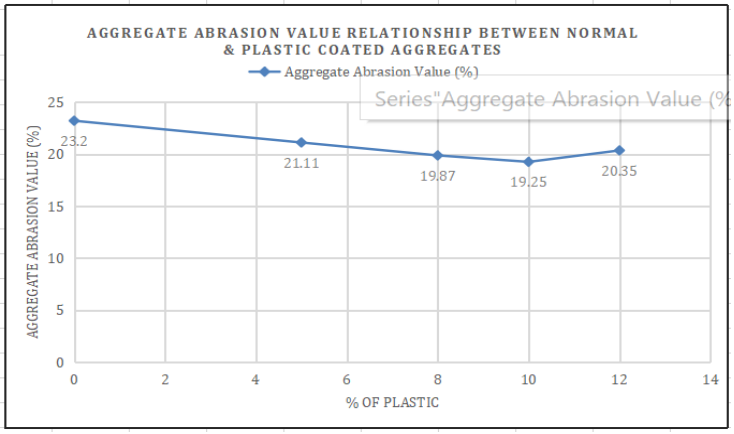

V. CONCLUSION

- The Optimum Plastic to be coated in the aggregate is 8 % of Bitumen.
- The Bitumen content is reduced up to 8 % & then this can be replaced by adding the plastic.
- The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income.
- Plastic roads would be a boon for India's hot and extremely humid climate, leaving most of the roads with big potholes.
- Hence the use of waste plastics for pavement is one of the best methods for easy disposal of waste plastics.

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