EXPERIMENTAL STUDY ON BITUMEN WITH SYNTHETIC FIBER

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ABSTRACT *: Disposal of waste materials including waste plastic bags has become a serious problem and waste plastics are burnt for apparent disposal which cause environmental pollution. Utilization of waste plastic bags in bituminous mixes has proved that these enhance the properties of mix in addition to solving disposal problems. Plastic waste which is cleaned is cut into a size such that it passes through 1-2 mm sieve using shredding machine.The aggregate mix is heated and the plastic is effectively coated over the aggregate. The use of the innovative technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment. The study was conducted to study the effects of the use of pieces of rubber as a partial substitute in bitumen.*

Bitumen is one of the binder materials used in construction of roads and pave has increased prices and costs to achieve it. As a result of increasing economic and traffic load, road bitumen structure designed should have the durability and capability services play a key role in the communication network, the most important.Objective of this study is to reduce the quantity of bitumen used and replaced with pieces of rubber. Therefore, many efforts have been undertaken to improve the quality of the existing bitumen. In this study, bitumen grade is done with the addition of various pieces of rubber per cent content. Percentage of rubber used is 0%, 2%, 4%, 6%, 8% and 10% of the total amount of bitumen used. Overall analysis will shows, the addition of pieces of rubber in the mixture can enhance the capability of the mixture pave flexible.

1. INTRODUCTION

Plastics, a versatile material and a friend to common man become a problem to the environment after its use. Today, in India nearly 4 million tones of plastics are used and it is hoped to reach 12 million tones by 2010. Their visibility has been perceived as a serious problem and made plastics a target in the management of solid waste. Plastics are non-biodegradable. They also have very long lifetime and the burning of plastics waste under uncontrolled conditions could also lead to generation of many hazardous air pollutants (HAPs) depending upon the type of polymers and additives used. However, the end-of-life plastics can be recycled into a second life application but after every thermal treatment, degradation of plastics takes place to a certain extent.

Polymer modified bitumen is emerging as one of the important construction of flexible pavements. The polymer modified bitumen show better properties for road construction and plastics waste can find its use in this process and this can help solving problem of pollution. The studies on the thermal behavior and binding property of molten plastics promoted a study on the preparation of plastic waste-bitumen blend and its properties to find the suitability of the blend for road construction.

An alternate method to use higher percentage of plastic waste in flexible pavement is by using plastic coated aggregate (PCA). This method is known widely as dry process. The aggregate coated with plastic was used as the raw material. The bitumen was not blended with plastic waste.

- The term bituminous materials are generally used to denote substances in which bitumen is present or from which it can be derived [Goetz and Wood, 1960]. Bitumen is defined as an amorphous, black or dark-colour, (solid, semi-solid, or viscous) cementations substance, composed principally of high molecular weight hydrocarbons, and soluble in carbon disulfide. For civil engineering applications, bituminous materials include primarily asphalts and tars. Asphalts may occur in nature (natural asphalts) or may be obtained from petroleum processing (petroleum asphalts). Tars do not occur in nature and are obtained as condensates in the processing of coal, petroleum, oil-shale, wood or other organic materials. Pitch is formed when a tar is partially distilled so that the volatile constituents have evaporated off from it. Bituminous mixtures are generally used to denote the combinations of bituminous materials (as binders), aggregates and additives.
- The basic principles and practices of the usage of bituminous materials in pavement construction. In recent years, the use of tars in highway construction has been very limited due to the concern with the possible emission of hazardous flumes when tars are heated.
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LITERATURE REVIEW:

Effect of the use of rubber material as partial pieces damages bitumen in flexible pavement ***Suriani bte1, NgatimanAsri bin Selamat2, Atan bin Haji Hussein3, Ahmad bin Esa4 and Fakulti Pendidikan Teknikal5***

Since several decades, many studies have been done to reuse waste materials in road construction industry.

Study the uses of piece of tires as a partial replacement applicable in pave bitumen have been conducted with so widely around the world since three decades ago. Results from studies carried out byImtiaz Ahmed, (1995) use a number of advantages of rubber material has been identified. Among them include:

i. Reduction in the reflections and fractures pave.
ii. Increased resistance of vehicle thirst tires.
iii. Increased slip resistance surface roads.
iv. Reduce effects of noise by friction between tire and road surface.
v. Reuse of waste tires that are still applicable disposal is a major problem.

AN EXPERIMENTAL PAVEMENT BOUND WITH A BITUMEN-RUBBER MIXTURE - HOLLAND IN 1929

The first use of this binder in the United States was made in 1947 when a section was laid Akren, Ohio. The pavement was conventional, except that finely divided rubber amounting to 5 – 7.5 % of the bitumen by weight was included since that time experimental roads have been laid by (among others) the state highway departments of Virginia, Ohio, Texas, Massachusetts, California, Colorado, and Utah the cities of New York and Baltimore and the great Britain. In addition, bituminous binders modified with rubber have used for seal coats. In sum however the conclusions of a 1954 analysis by the Bureau of public roads still appears to be valid. It stands than an appraisal of the real economic value of the addition of rubber to asphalt must wait on further observation of the behavior of experimental pavements under the influence of age, weather and traffic.

2. CHARACTERISTICS OF PLASTIC WASTE

2.1 Thermal Study

A study of the thermal behavior of the polymers namely polyethylene, polypropylene, polystyrene, shows that those polymers get softened easily without any evolution of gas around 130-140^{0}C, this has been scientifically verified.

At around 350^{0}C they get decomposed releasing gases like methane, ethane etc and at 700^{0}C they undergo combustion, producing gases like CO and CO_2.

2.2 Binding Property

The molten plastic waste inhibits good binding property. Following experiments were carried out to study the binding property.

1. The aggregate was heated to around 170^{0}C and the shredded plastic waste was added. Plastics got softened and coated over the aggregate. The mix of aggregate and plastic was compacted and cooled. The block was very hard and showed compressive strength not less than 130 MPa and binding strength of 500 kg/cm^2. This shows that the binding strength of the polymer is good.
2. The polymer coated aggregate was soaked in water for 72 hours. There was no stripping at all. This shows that the coated plastic material sticks well with the surface of the aggregate.

TYPES OF BITUMEN TEST:

- Penetration Test
- Ductility Test
- Viscosity Test
- Float tests
- Specific gravity tests
- Softening tests
- Flaws and fire point tests
- Solubility test
- Spot tests
- Loss on heating test

PROCEDURE:

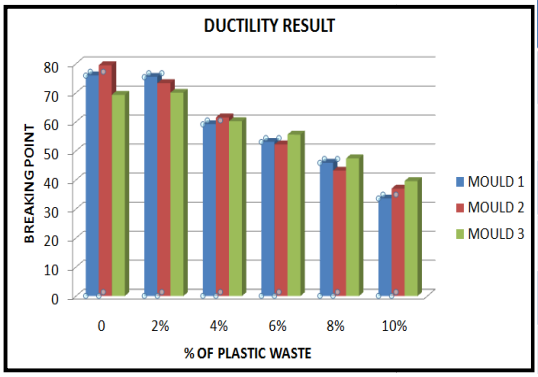
DUCTILITY TEST:

Completely melt the bituminous material to be tested by heating it to a temperature of 75 to 100^{o}C above the approximate softening point until it becomes thoroughly fluid. Assemble the mould on a brass plate and in order to prevent the material under test from sticking, thoroughly coat the surface of the plate and the interior surfaces of the sides of the mould with a mixture of equal parts of glycerine and dextrin. While filling, pour the material in a thin stream back and forth from end to end of the mould until it is more than level full. Leave it to cool at room temperature for 30 to 40 minutes and then place it in a water bath maintained at the specified temperature for 30 minutes, after which cut off the excess bitumen by means of a hot, straight-edged putty knife or spatula, so that the mould is just level full.

Place the brass plate and mould with briquette specimen in the water bath and keep it at the specified temperature for about 85 to 95 minutes. Remove the briquette from the plate; detach the side pieces and the briquette immediately.

Attach the rings at each end of the two clips to the pins or hooks in the testing machine and pull the two clips apart horizontally at a uniform speed, as specified, until the briquette ruptures. Measure the distance in cm through which the clips have been pulled to produce rupture. While the test is being done, make sure that the water in the tank of the testing machine covers the specimen both above and below by at least 25mm and the temperature is maintained continuously within ± 0.5°C of the specified temperature.

S.NO	TEST	PLAIN BITUMEN	MODIFIED BITUMEN plastic replaced)				
			2%	4%	6%	8%	10%
1	Penetration	86	76	69.5	63.5	62	58
2	Ductility	79.5	75.5	61.5	55.6	47.4	39.6



S.NO	% REPLACE	DUCTILITY	VG
1	0	79.5	75
2	2	75.5	75
3	4	61.5	50
4	6	55.6	50
5	8	47.4	25
6	10	39.6	25

5.2 Economy of the Process and the Plastic Waste Available

A comparative study for 25mm thickness SDBC (Semi-Dense Bituminous Concrete) – 10m^2 has been made. Three kilogram of bitumen is saved and three kilogram of waste plastic is used. The coast of bitumen is much higher than that of plastics and this process also helps to save the natural resources. There is no maintenance cost for a minimum of five years. Hence the process is cheap and eco-friendly.

6. ADVANTAGES AND DISADVANTAGES

6.1 Advantages:

- Better binding property
- Higher Softening point; withstands high temp.
- Lower penetration value; withstands higher load.
- No stripping – Resists the permeation of water.
- Higher Marshall Stability–increased strength of road.
- Operation temperature range: 160-170^{0}C.
- Cost less compared to bitumen road. Use of waste Plastics (MSW, road side etc.).
- Better disposal of waste plastics.
- Ten lakhs or one ton carry bags in one kilometer road.

6.2 Disadvantages:

- The burning of plastic waste creates air pollution and also health hazards.

7. CONCLUSION

The generation of waste plastics is increasing day by day. The major polymers namely polyethylene, polypropylene, polystyrene show adhesion property in their molten state. The plastic coated aggregate bitumen

mix and plastic modified bitumen forms better materials for flexible pavement construction as the mixes shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods of easy disposal of waste plastics. The use of polymer coated aggregate is better than the use of polymer modified bitumen in many aspects. Foe example if all the roads in India (3.3 million km) are converted into plastic tar road, all the waste plastic available will be used on the road and the disposal of waste plastics will no longer be a problem. But as the burning of plastic waste creates health hazards and also air pollution, the use if this should be restricted to open areas or in lesser populated areas. Also; the workers involved should be provided with proper safety devices.

These processes are socially highly relevant, giving better infrastructure. Let us grow with these newer technologies.

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