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POTENTIAL OF PLASTIC USED IN BITUMINOUS ROAD

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ABSTRACT

Plastic trash and its disposal pose a significant environmental problem, resulting in pollution and global warming. The addition of plastic debris to bituminous mixes improves their characteristics as well as their strength1. It will also be a solution for plastic disposal and other pavement faults such as potholes, corrugation, ruts, and so on. Polyethylene, polystyrene, and polypropylene are among the waste plastics used. The discarded plastic is shredded and covered over aggregate before being mixed with hot bitumen and utilised in the creation of pavements. This will not only strengthen the pavement, but it will also make it more durable. The titanium dioxide is utilised as a smoke absorbent substance, absorbing the smoke produced by the automobiles. This cutting-edge technology will be a godsend in India's hot and humid atmosphere. It is cost-effective as well as being environmentally beneficial. We examined soil factors to consider in pavement design, pavement design, and the technique of constructing flexible and plastic-smoke absorbent pavement in this study.

Keywords: PVC, HDPE, Compressive Strength.

I. INTRODUCTION

In India, it is believed that there are about 33 lakh kilometres of road, with around half of these being paved. Due to its flexibility, door-to-door service, reliability, and speed, road transport has risen to the top of the many forms of transportation system. Road transport accounts for over 90% of passenger travel and 70% of freight transport in India. The majority of pavements in India are bituminous because they have a lower starting cost than stiff pavements, such as cement concrete pavements. Due to increases in service traffic density, axle loading, and insufficient maintenance services, road structures have deteriorated more rapidly over time. The increased use and development of modified binders has resulted from the poor performance of bituminous mixtures under higher traffic volume and heavier axle load. Traditional bitumen must be enhanced in terms of performance-related features, such as resistance to permanent deformation (rutting) and fatigue cracking, to reduce pavement surface damage and increase the longevity of flexible pavement. Modification of bituminous binder has been studied in order to improve the performance attributes of road pavements in recent years.

1.1 Objective

The objectives of this project are:

- ➢ Provide more stable and durable mix for construction of flexible pavement.
- ➢ To improve the binding property of bitumen
- ➢ Disposal of waste plastic into bitumen and to achieve Economy.
- ➢ To withstand in higher temperature when used for road construction.

II. LITERATURE REVIEW

Bangalore Process by KK. Poly Flex Pvt. Ltd. (2002) -A study on plastic roadways is given. Bangalore has a 25-kilometer plastic road. In comparison to a plastic-free road installed at the same time, which developed "crocodile cracks" soon after, the plastic road had superior smoothness, uniformity, and less rutting. The CRRI gave their approval to the method in 2003. (Central Road Research Institute Delhi). The tackiness and viscosity of the bituminous mix are improved, which binds the stones more securely together and enhances the mix's water resistance to rain and other elements.

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Justo et al (2002)- The possibility of using processed plastic bags as an ingredient in bituminous concrete mixtures was discussed at Bangalore University's Centre for Transportation Engineering. The modified bitumen's properties were compared to those of regular bitumen. The penetration and ductility of the modified bitumen were found to diminish as the quantity of the plastic addition was increased up to 12 percent by weight. As a result, the life of the pavement surfacing course employing modified bitumen is predicted to be significantly longer than that of standard bitumen.

Mohammad T. Awwad (2007) - Polyethylene is one type of polymer that has been utilised to look into the possibility of improving the characteristics of asphalt mixtures. The goals also include establishing the appropriate type and percentage of polyethylene to employ. To coat the aggregate, two types of polyethylene were used: high density polyethylene (HDPE) and low density polyethylene (LDPE) (LDPE). According to the findings, grinded HDPE polyethylene modifier has superior engineering qualities. By weight of bitumen composition, a 12 percent modifier proportion is recommended. It is discovered that it improves stability, reduces density, and marginally increases air voids and mineral aggregate voids.

Shankar et al (2009) - At specific temperatures, crumb rubber modified bitumen was combined. Marshall's mix design was carried out by varying the modified bitumen content while maintaining the optimum rubber content, followed by testing to identify the various mix design characteristics, as well as for regular bitumen (60/70). When compared to straight flow bitumen, this has resulted in much enhanced properties, and at a lower optimum modified binder percentage (5.67 percent)

Dr. R. Vasudevan (2002) -According to the company, the polymer bitumen blend is a superior binder than ordinary bitumen. With a proper ductility, the blend has a higher Softening point and a lower Penetration value. It can resist higher temperatures and loads when utilised in road construction. Plastics are coated to reduce porosity, moisture absorption, and increase soundness. The polymer-coated aggregate bitumen mix is a better material for constructing flexible pavements. As a result, using waste plastics for flexible pavement is one of the greatest ways to dispose of waste plastics quickly. Plastic bags on the road aid in a variety of ways, including easy waste disposal, improved road conditions, and pollution avoidance.

III. METHODOLOGY

3.1 Central Mixing Plant (CMP)

A central mixing plant can also be used for the dry process. Up the conveyor belt, the shredded plastic is mixed in with the aggregate. This is poured into the steaming cylinder. The bitumen is applied after the aggregate has been covered with plastic. After that, the mixer is placed into a dipper lorry and sent for road laying. CMP allows for greater temperature control and mixing of the material, resulting in a more uniform coating. This has been implemented in our project.

The conventional aggregates and plastic coated aggregates, as well as bitumen and modified bitumen, are all tested in this comparative study (10 percent of bitumen replaced by plastic). The numerous tests that are conducted for the comparison study are as follows.

Following tests were conducted on the various samples prepared.

1 Penetration Test

2 Ductility Test

3 Flash and Fire Point test

4 Softening Point test

5. Specific Gravity test

1 Penetration Test

The penetration test detects whether bitumen is hard or soft by measuring the penetration of a standard needle of 100gm in a bitumen sample held at 25o C for 5 seconds in units of 1/10th of a mm. A softer grade means more penetration. The penetration value of bitumen is used to classify it. The penetration of a bituminous material is defined as the vertical distance a standard needle would penetrate into a sample of the material under standard temperature, load, and time conditions in tenths of a mm.. The apparatus needed to determine the penetration of bitumen is

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i) Penetrometer

ii) Water bath

iii) Bath thermometer – Range 0 to 44 ºC, Graduation 0.2 º C

2 Ductility Test

The formation of ductile thin films by the binders surrounding the aggregate is critical. The test is used to determine bitumen's adhesive properties as well as its stretchability. The ductility of samples containing various percentages of plastic garbage in bitumen was tested. The ductility is measured in centimetres and is defined as the distance a normal bitumen briquette can be stretched before the thread breaks. Pouring temperature, briquette size, briquette placement, test temperature, and pulling rate all affect bitumen ductility. Ductility is measured in centimetres and ranges from 5 to 100. Cracking is implied by a low value. Flexural strength necessitates a certain level of ductility. The absence of ductility does not always imply poor quality.

3 Flash and Fire Point

The flash and fire points of the plastic waste-bitumen blend have been studied to better understand the blend's inflammability. As per IS: 1209 – 1978, this test is performed to assess the flash point and fire point of asphaltic bitumen and fluxed native asphalt, cutback bitumen, and blown type bitumen. The following is the principle underlying this test: "The flash point of a material is the lowest temperature at which a substance's vapour temporarily catches fire in the form of a flash under specific test conditions." "Fire point" refers to the temperature at which a substance will ignite and burn for at least 5 seconds under specific test conditions.

4 Softening Point

Bitumen does not melt, but rather transforms from a solid to a liquid over time. As per IS: 1205 – 1978, this test is used to assess the softening point of asphaltic bitumen and fluxed native asphalt, road tar, coal tar pitch, and blown type bitumen. The theory underlying this test is that the softening point is the temperature at which the substance softens to a specific degree under the test conditions. This test requires the following equipment:

i) Ring and ball apparatus

ii) Thermometer – Low Range: -2 to 80 º C, Graduation 0.2 º C – High Range: 30 to 200 º C, Graduation0.5 º C

5 Specific Gravity

According to IS: 1202 – 1978, this test is used to evaluate the specific gravity of semi-solid bituminous road tars, creosote, and anthracene oil. The ratio of mass of a given amount of bitumen to the mass of an equal volume of water, both obtained at a specific temperature, is the principle.

The apparatus needed to determine specific gravity of bitumen is

i) Specific gravity bottles of 50ml capacity

ii) Water bath

iii) Bath thermometer – Range 0 to 44º C, Graduation 0.2 º C

Take the sample (half the volume of the specific gravity bottles)

IV. RESULTS AND DISCUSSION

Wet technique was used to prepare the sample with the plastic and crumbed rubber replaced. The penetration point, ductility, and softening point of the crumb rubber and plastic blended bitumen are all tested. We've taken 60/70 grade bitumen and added various percentages of plastic, ranging from 5% to 13%. Table Result of Plane Bitumen and Specified Range shows the results of several tests done on plain bitumen of grade 60/70 and their specified range for bituminous pavement construction. The results in Table demonstrate that the simple bitumen values are within the BIS permitted limit for all tests.

SR NO.	TEST CONDUCTED	SPECIFIED RANGE	TEST RESULT PLAIN BITUMEN OF 60/70 GRADE
1	Penetration Test	20mm to225mm	64mm
2	Ductility Test	50cm to 75cm	67.4cm
3	Flash Point Test	Minimum 220°C	240°C

4	Fire Point Test	Minimum 220°C	256°C
5	Softening Point Test	35°C to 70°C	41.5°C
6	Specific Gravity Test	0.97 to 1.02	0.98

V. CONCLUSION

The generation of waste plastics and crumb rubber is increasing day by day. The major polymers namely polyethylene, polypropylene, polystyrene show adhesion property in their molten state. Stone aggregate is coated with the molten waste plastics. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction. Hence the use of waste plastics and crumb rubber for flexible pavement is one of the best methods for easy disposal of waste plastics and crumb rubber. The use of polymer coated aggregate is better than the use of polymer modified bitumen in many respects. Moreover the polymer coated aggregate helps to use modified bitumen resulting in better result. In India more than 33 million km of road is available. There will be less waste plastic available on the road if they are developed as plastic tar roads. It's a green process. These procedures are both environmentally and socially beneficial, resulting in a more flexible pavement. Allow these newest technologies to help us progress. The employment of cutting-edge technology has improved not only road building but also road life, as well as helping to enhance the environment and generate revenue. Plastic roads would be a godsend in India's hot and humid climate, where temperatures regularly exceed 50 degrees Celsius and copious rains cause havoc, leaving most roads with large potholes. It is hoped that in the not-too-distant future, we will have sturdy, long-lasting, and environmentally friendly roadways that will reduce congestion.

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