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Utilization of Waste Plastic in Flexible Pavement

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Abstract: *There are many changes taking place in this new century, yet new materials and processes are not being developed as quickly. Some people utilise a partial replacement of bitumen and tar, which produces acceptable results. However, subsequent research reveal that none of those materials possess all of the needed qualities. During this time, investigators focus on recycling materials such as rubber and plastic. They discovered that both materials produce acceptable outcomes. On the other hand, the use of plastic (polyethylene bags, pet bottles, polystyrene, and other plastic products) is increasing every day, resulting in a significant amount of pollution from plastic trash. In the soil, this plastic material takes hundreds of years to disintegrate.*

Keywords: plastic, bitumen, Roads

I. INTRODUCTION

Every day, India produces 1,88,000 tonnes of rubbish. Plastic garbage, in various forms, accounts for almost 9% to 12% of municipal solid waste, which is harmful by nature. Empty plastic bags and other types of plastic packaging material polluting the roads and drains is a typical sight in both urban and rural locations. It causes water stagnation and associated hygienic issues due to its poor biodegradability. Experiments have been carried out to see if this waste plastic may be utilised profitably in order to contain this problem. Experiments at numerous institutes and private organisations have shown that when waste plastic is mixed with hot aggregate bituminous mix, it forms a fine plastic film over the aggregate. When aggregate is combined with the binder, the road gains greater strength, water resistance, and long-term performance. Road surfacing can be done with waste plastic such as carry bags, disposable cups, and laminated pouches like chips, pan masala, aluminium foil, and packaging material used for biscuits, chocolates, milk, and supermarket items. Roads made of plastic trash have been built in states such as Tamil Nadu, Karnataka, Himachal Pradesh, and to a lesser extent Goa, Maharashtra, and Andhra Pradesh, employing basic process innovation. In 2001, the "Use of Plastic Waste in Road Construction" concept was introduced as a response to the major problem of plastic waste disposal. Plastic Waste in India. . With the above benefits in mind, CIPS has started documenting the use of waste plastic in road construction. The goal is to compile a document on current technologies, as well as their related economic, environmental, structural, and technological issues, in one place for dissemination and possible replication in other states for the betterment of society as a whole.

II. AIM AND OBJECTIVES OF THE PROJECT

- A. Understand the administrative processes involved in the use of plastic waste in road construction.
- B. Evaluate the state Government's implementation strategy, the concerns faced by implementing agencies and the resolution mechanism.
- C. To make Roads that are Eco-friendly.
- D. To improve water resistance on the road.
- E. To extend life of road.
- F. How to make fatigue life better.
- G. For a km of road, approximately 2 tonnes waste plastic can be used.

III. REVIEW OF LITERATURE

A) *Dr. Rajgopalan Vasudevan:*

Rajagopalan vasudevan responsible for laying down more than 5,000km worth of plastic road in at least 11 states across the country. Popularly known as the plastic man of India.

Accordingly, Dr. Vasudevan succeeded in presenting an efficient, economical and environmentally friendly solution: "Waste plastic can be used as an excellent binder material to develop good roads and thus ensure better transport. The plastic coating will improve the service life of the road and this can be done by slightly modifying the existing technology. India's per capita consumption of plastic is expected to double in the coming five years with the central pollution control board starting that about 15,000 tons of plastic waste is released every day in the nation this proportion may come to life sooner than expected, where on other hand there are governmental organizations, The road by reusing plastic wastes pollutant free and completely eco-friendly and natural an safely in road constructed.

He states that the polymer bitumen blend is better binder compared to plain bitumen. Blend has increased softening point and decreased penetration value with a suitable ductility. When it is used for road construction it can withstand higher temperature



and load. The coating of plastics reduces the porosity, Absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy and prevention of pollution and so on.

B) Miss Apurva Chavan

The plastic wastes road construction central institutes of plastic engineering and technology are developed in plastic mix concrete road is a cost is a high but maintenance is 10% is a low and concrete patches to cover and large pavement design with central plant hot-mixrecycled asphalt mixes in a concrete road its easy maintain road and longtime workable

The Union minister said there is a huge difference between costs of bitumen and these three wastes. "Bitumen is costing around Rs 45 per kg hereas the cost of these wastes is around Rs 12 per kg in road.

C) Swati Raj

Has adopted a unique way to use fully discarded plastics. In the first of its kind attempt, the discarded plastics mixed with bitumen are being utilized to construct roads here in Capital City. According to the officials, after checking out the durability of the roads, the project will be extended to different wards in the days to come.

Initiating the work of construction of roads on pilot basis from Dhurwa area (ward 40) using plastic wastes, a 2500 feet long road is being constructed using this formula. The Executive Engineer associated with RMC said that of the total, plastic wastes and non- recyclable stuffs was added in 200 feet stretch of bituminous concrete road.

According to an RMC City Manager, after analyzing the reports about the trial projects involving use of waste plastic in constructing small road stretches at different places across the country, the civic body here has taken up the project. "Taking the opinion of experts, the project has been started. The Municipal Corporation has decided to further explore how plastic can be used in road construction. After checking out the sustainability of this project, we will extend this in other wards too. Also, this step will ensure that plastic wastes are fully discarded.

IV. METHODOLOGY

Waste plastic is made powder and varying percent plastic is mixed with bitumen. Plastic increase the melting point of the bitumen and makes the road flexible during winters resulting in its long life. By mixing plastic with bitumen the brittleness overcomes and elastic nature enhances. The plastic waste is melted and mixed with bitumen in a particular ratio. There are two important processes used for bitumen mix flexible pavement, they are:

- Dry process
- Wet process

A. Dry Process:

Hot stone aggregate (170°C) is mixed with hot bitumen (160°C) for the flexible pavement, and the mixture is used for road laying. According to IS code, the aggregate is chosen for its strength, porosity, and moisture absorption capacity. The binding property, penetration value, and viscous-elastic property of the bitumen are all factors in its selection. Plastic coating increased the aggregate's quality in terms of voids, moisture absorption, and soundness.

Shredded plastics are poured over heated aggregates to create plastic coated aggregates, which are then mixed with hot bitumen to create a plastic coated aggregate bitumen mixture for road paving. The application of a plastic coating reduces porosity and aids in the improvement of aggregate quality & its performance in the flexible pavement.

V. TEST AND RESULT

Test conducted on materials:

- On Bitumen
- On MIX (of separate mixing percentage of Plastic)

A. Penetration Test:

It determines the hardness or softness of the bitumen by measuring the depth in tenths of milli meter will penetrate vertically in five seconds. Table. 1 show the penetration test result for various percentage of plastic added with bitumen is given below



Table 1: Penetration Test Values

| % of Plastic | Penetration | | |
|--------------|-------------|---------|---------|
| | Trail 1 | Trail 2 | Trail 3 |
| 0 | 85 | 87 | 86 |
| 6 | 64 | 63 | 63.5 |
| 8 | 63 | 61 | 62 |
| 10 | 59 | 57 | 58 |

B. Viscosity Test on Bitumen and Waste Plastic Mix

Generally, viscosity is inverse of fluidity. Viscosity test is carried out determine the consistency of the material. The table 2 shows the viscosity test result for various percentage of plastic added with bitumen are given below:

Table 2: Viscosity Test Values

| % of Plastic | Viscosity value (seconds) | | |
|--------------|---------------------------|---------|---------|
| | Trail 1 | Trail 2 | Trail 3 |
| 0 | 40 | 38 | 39 |
| 6 | 59 | 63 | 61 |
| 8 | 76 | 74 | 75 |
| 10 | 80 | 78 | 79 |

C. Marshal Stability and Flow Test on Bitumen and Waste Plastic Mix

Marshall Method for designing hot asphalt mixtures is used to determine the optimum bitumen content to be added to specific aggregate blend resulting a mix. The table 3 shows the marshal stability test result for various percentage of plastic added with bitumen and table 4 shows the flow test of the marshal

Table 3: Marshal Stability Test Values

| % of Plastic | 5.5% Bitumen (KN) |
|--------------|-------------------|
| 0 | 17.6852 |
| 6 | 20.5789 |
| 8 | 21.5168 |
| 10 | 22.4356 |

Table 4: Marshal Flow Test Values

| % of Plastic | 5.5% Bitumen (mm) |
|--------------|-------------------|
| 0 | 4.4011 |
| 6 | 4.8652 |
| 8 | 4.9588 |
| 10 | 5.0567 |

Diff between BC mold with & without plastic



Marshal Stability Test



VI. CONCLUSION AND DISCUSSIONS

The plastic is combined with bitumen and gravel to improve the road's performance. The aggregates are coated with a polymer that decreases voids and moisture absorption. This prevents the formation of potholes and reduces the number of ruts. Plastic pavement is more durable than flexible pavement and can resist heavy traffic. The usage of plastic mix lowers the bitumen concentration by 10% while increasing the road's strength and performance. This innovative technology is non-polluting. The amount of garbage plastic produced is increasing every day. The melting point of bitumen will be raised as the principal polymers, such as polyethylene, polypropylene, and polystyrene, display adhesion properties in their molten state plastics. Because the waste plastic bitumen mix has a greater Marshall Stability value and a sufficient Marshall Coefficient, it is a better material for road building. As a result, one of the greatest techniques for easy disposal of waste plastics fibre is to use it in road construction. According to the marshal stability test, the best use of plastic is between 10% and 15% of bitumen. This has increased the benefit of limiting plastic trash disposal as an environmentally friendly strategy.

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