

# USE OF WASTE PLASTIC IN CONSTRUCTION OF BITUMINOUS ROAD

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**Abstract**— Bottles, containers and packing strips etc. is increasing day by day. As a result amount of waste plastic also increases. This leads to various environmental problems. Many of the wastes produced today will remain in the environment for many years leading to various environmental concerns. Therefore it is necessary to utilize the wastes effectively with technical development in each field. Many by-products are being produced using the plastic wastes. Our present work is helping to take care of these aspects. Plastic waste, consisting of carry bags, cups and other utilized plastic can be used as a coating over aggregate and this coated stone can be used for road construction. The mix polymer coated aggregate and tire modified bitumen have shown higher strength. Use of this mix for road construction helps to use plastics waste. Once the plastic waste is separated from municipal solid waste, the organic matter can be converted into manure and used. Our paper will discuss in detail the process and its successful applications.

**Keywords**— Plastic Waste, Modified Bitumen, Bitumen, Aggregates And Plastic Roads.

## I. INTRODUCTION

Now-a-days disposal of different wastes produced from different Industries is a major problem. These materials create environmental pollution in the nearby locality because many of them are non-biodegradable. Generally soil, stone aggregates, sand, bitumen, cement etc. are used for road construction. Natural materials being exhaustible in nature, its quantity is lower gradually. Also, cost of extracting fine quality of natural material is increasing. Concerned about this problem, the scientists are looking for alternative cheap and effective materials for highway construction, and industrial wastes product is one such category. If these materials can be effectively utilized in highway construction, the pollution and disposal problems may be partly reduced. In the absence of other options, these solid wastes have occupied several hectares of land around plants throughout the country. Keeping in mind the need for huge use of these solid wastes in India, it was thought expedient to test these materials and to develop specifications to increase the use of these industrial wastes in road making, in which higher economic returns may be possible. The possible use of these plastic materials should be arise for construction of low volume roads in different parts of our country. The necessary specifications ought to be formulated and attempts are to be made to enhance the use of solid wastes in different layers of the road pavement. Post construction pavement performance

studies are to be made for these waste materials for construction of low volume roads with these following aspects:

(a) It will help clear valuable land from large amount of dumps of wastes;

(b) it will also help to protect the natural reserves of aggregates, thus saving the environment. Plastics are user friendly but not eco-friendly as they are non-decomposable generally, it is disposed by way of Land filling or incineration of materials which are hazardous. Plastic is all around material and becomes a problem to the environment after its use. The better compiling property of plastics in its molten state has helped in finding out a solution of safe disposal of waste plastics. Road surface with neat bitumen can cause bleeding during high temperature, may develop cracks during low temperature, possess fewer loads bearing capacity and can cause worst damages because of excessive axle load in present conditions due to rapid infrastructure development. Generally useful life of bituminous overlays has reportedly decrease 7- 8 from average life of 5-6 years in the past to about 3-4 years at present as compared to average pavement life (5-6 years) in abroad. India has to enhance transportation system to a higher level both in aspect of length and quality. This study shows the use of waste in hot bituminous mixes to rises pavement performance, protect environment and provide low cost roads. Plastic modified bitumen, often abbreviated as modified bitumen is obtained with the inconvenience of selected thermoplastics and shredded plastic from discarded waste, natural plastic in bitumen.

## II. LITERATURE REVIEW

Prof.C.E.G. Justo States that addition of 8.0 % by weight of processed plastic for the preparation of improved bitumen results in a saving of 0.4 % bitumen by weight of the mix or about 9.6 kg bitumen per cubic meter (m<sup>3</sup>) of Bituminous Concrete mix. Modified Bitumen increase the stability or strength, life span and other useful properties of bituminous concrete mix.

Dr. R. Vasudevan states that the polymer bitumen blend is a better adhesive collate to plain bitumen. Blend

Has increment in Softening point and decrement in Penetration value with a suitable ductility. When it is used for road construction it can withstand enhance temperature and load. The coating of plastics decreases the porosity, absorption of moisture and improve soundness. The polymer coated aggregate bitumen mix makes better material for adaptable pavement construction as the mix shows enhance Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for adaptable pavement is one of the best methods for easy ejection of waste plastics. Use of plastic bags in road help in various ways like Easy disposal of waste, better road and prevention of pollution and so on.

According to V.S. Punith, (2001), some inspire results were reported in this study that there is opportunity to enhance the performance of bituminous mixes of road pavements. Waste plastics (plastic bottles etc.) on heating soften at around 130°C. Thermo gravimetric aspects has shown that there is no gas produces in the temperature range of 130-180°C. Softened plastics has an adhesive property. Hence, it can be used as a binder for road construction. Sundaram & Rojasay (2008) studied the impressive blending technique for the use of plastic waste into bitumen for road constructions and Polymer-bitumen mixtures of various compositions were prepared and used for carrying out different tests. Verma S.S. (2008). State that Plastics will rise the melting point of the bitumen. This technology not only strengthened the road construction but also enhance the road life.

Dr. R.Vasudevan and S. Rajasekaran, (2007) Conclude that the polymer bitumen mix is a better binder compared to plain bitumen. Mix has enlarge Softening point and reduces Penetration value with a desirable ductility. Mohd. Imtiyaz (2002) Stated that the mix produce with modifiers shows:-Higher opposition to permanent contortion at higher temperature. Sabina (2001) conclude the relative performance of properties of bituminous mixes holds plastic/polymer (PP) (8% and 15% by weight of bitumen) with formal bituminous concrete mix (prepared with 60/70 penetration grade bitumen). Betterment in properties like Marshall Stability, retained stability, indirect tensile strength and rutting was discovered in Plastic modified bituminous concrete mixes. The laboratory studies supervise by CRRI in development of waste plastic bags in bituminous concrete mixes have sanctioned that these increases the properties of mix in sum up to solving disposal trouble. The result shows that there was a betterment in strength properties when compared to a conventional mix. Therefore, the life span of pavement surfacing used in the waste plastic is likely to increase substantially in equivalence to the use of standard bituminous mix.

### III. METHODOLOGY

Waste plastic bags were gathered from roads, garbage trucks, dumpsites and compost plants, rag pickers, waste-buyers at Rs 5-6 per kg. Household plastic was also gathered for the project work, like empty milk bags, used plastic bags etc. The gathered Plastic waste was arranged as per the required thickness. Generally, poly Ethylene Terephthalate (PET) of 60 micron or below is used for the advance process. Less micron plastic is simply mixable in the bitumen at higher temperature (160°C-170°C).It is clean by de-dusting or washable if required. Gathered Plastic bottles was cut into fine pieces as far as possible. The plastic pieces were sieved through 4.75mm sieve and retaining at 2.36mm sieve was assembled. Firstly, Bitumen was heated up to the temperature range 160°C to 170°C which is its melting temperature. Pieces were added wisely to the hot bitumen of temperature around 160 to 170°C. The mixture was stirred up manually for about 20-30 minutes. In that

duration, temperature was kept never ending of about 160 to 170°C. Polymer-bitumen mixtures of various compositions were prepared and used for carrying out tests i.e. Penetration test, Ductility test, Flash point test & Fire point test, Softening Test, Specific Gravity Test and Marshall Stability value test.

### IV. RESULTS

The increase in percentage of polymer decreased the penetration value. This shows that the addition of polymer increases the hardness of the bitumen. The penetration values of the blends are decreasing depending upon the percentage of polymers and the type of polymer added. The ductility decreased by the addition of plastic waste to bitumen. The decrease in the ductility value may be due to interlocking of polymer molecules with bitumen. Flash and fire point increased with the increase in the percentage of polymer. The polymer bitumen blend road surfaces are less affected by fire hazards. This shows that the blend has better resistance towards water. This may be due to better binding property of the polymer bitumen blend. The softening point increased by the addition of plastic waste to the bitumen. Higher the percentage of plastic waste added, higher is the softening point. The influence over the softening point may be due to the chemical nature of polymers added. The increase in the softening point shows that there will be less bleeding during summer. Bleeding accounts, on one side, increased friction for the moving vehicles and on the other side, if it rains the bleedings accounts for the slippery condition. Both these adverse conditions are much reduced by polymer-bitumen blend.

### V. SUMMARY OF MARSHALL STABILITY TEST

#### 5.1 Mix design for bitumen:

The Marshall ratio is also within the permissible limit of tolerance, thus showing that the plastic waste blended bitumen mix is better and more suitable for flexible pavement construction.

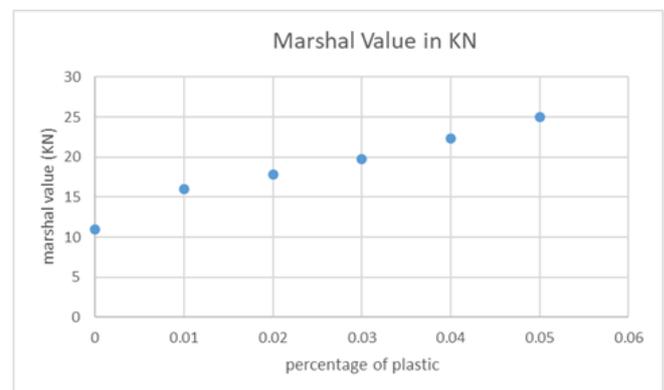


Figure 1: Mix design for bitumen

The polymer bitumen mixture is a better binder compared to plain bitumen. The mixture has increased Softening Point and decreased Penetration Value with a suitable ductility. When it is used for road construction it can withstand higher temperature. That's why it is suitable for tropical regions. It has reduce Penetration Value. Hence its load carrying capacity is increased. So it can resist the effect of water. The Marshall Stability Value is high. The quantity of bitumen required can be reduced depending upon the % of polymer added. It is a good saviour. No toxic gas is produced. Disposal of waste plastic will no longer remain as a problem. The use of waste plastics on the

road has helps to provide better place for dumping the plastic waste without causing disposal problem. At the same time, a better quality road is also constructed. It also helps to avoid the general disposal methods of waste plastics namely land-filling and the incineration, which have certain side effects on ecology.

## VI. CONCLUSION

1. The addition of waste plastic in bitumen modifies the properties of bitumen.
2. The modified bitumen gives good result when compared to standard results.
3. The optimum quantity of waste plastic can be used more than 5%. The problems like bleeding are reduce in high temperature region.
4. Plastic has a property of absorbing sound, which also help in reducing the noise pollution of heavy traffic.
5. The waste plastics thus can be use and it ultimately improves the quality and performance of road.
6. It also helps to reduce the cost of road construction.

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