

Study of Waste Plastic as an Effective Construction Material in Flexible Pavement

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ABSTRACT: The use of plastic and related materials is increasing exponentially due to tremendous growth in population, urbanization and changed life style leads to widespread littering of plastic on the landscape. Disposal of waste plastic is a serious problem globally due to their non-biodegradability and hazardous to human health, since these are not disposed scientifically and thus, creates ground and water pollution. If this curse to mankind in the form of waste plastic is used as a boon for mankind by using it as additives in road construction, it will proved to be a best solution over worst road condition. In the present paper techniques has been developed to use plastic waste for construction of bituminous roads and flexible pavements. In general bitumen is used as binder in road construction. Binding properties of this bitumen can be modified by blending it with waste plastic pieces. It can be used for construction purpose. Waste plastic coated road aggregates can improve road strength. This modified bitumen mix and aggregates show better binding property, stability, density and more resistant to water thus increasing durability of roads with increased resistance to wear and tear of road.

KEYWORDS: Bitumen, Plastic, Flexible pavement.

I. INTRODUCTION

Building, Transportation facilities, Hydraulic structures etc. are some of broadly classified infrastructures. Today for developing countries transportation are one of the most important infrastructure, and within transportation the flexible pavement is very much important. Engineers use basically aggregate, bitumen and filler material. However, construction using such materials comes with great cost in country's budget. As a result finding construction materials the best withstand the worst environmental condition fulfilling all requirement of strength, flexibility, cost effectiveness, durability and environmentally friendly is main issue.

On the other hand, plastic is everywhere in today's lifestyle. Plastic is a versatile material and a friend to common man. Become a problem to environment after it's use. Today in India nearly 14 million tons of plastic are used and it is hoped to reach 22 million tons by 2020. Plastic such as polyethylene, polystyrene, high density polyethylene, low density polyethylene, polypropylene etc. products are growing rapidly and the problem is what to do with plastic waste and the plastic is most hazardous to environment.

Recycled polythene carry bags were shredded into small sizes and mix with bitumen for wet process otherwise mix or coated to aggregate at specified temperature, and Marshall method is adopted for mix design.

II. LITERATURE REVIEW

2.1. S.Rajasekaran, et al., states that the construction of asphalt pavement, hot bitumen is coated over hot stone aggregate mixed, laid and rolled. Bitumen acts as a binder. Use of plastic (virgin as well as waste) to modify the bitumen and also the use of plastic coated aggregates are being studied to improve performance of the pavement. Some of the properties improved are durability, fatigue life, resistance to rutting, softening point, visco elastic property etc. The major obstacle to widespread usage of polymer modified bitumen in paving practice has been their tendency towards gross phase separation under quiescent conditions.

S.Rajasekaran concluded that, In addition to the improvement of the quality of the road, this technology has helped to use the waste plastics obtained from domestic and industrial packing materials. This has already been accepted by the Central Pollution Control Board, New Delhi. They have already released a guideline on the technique of the road laying by dry process and its advantage. By this technique, which is in-situ, waste polymer like carry bags, foam, laminated sheets, cups are all used for road laying. Moreover, the use of polymers helps to reduce equivalent quantity of bitumen, thus reducing the cost of the road laying.

2.2 Bindu C.S, et al., states 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. The coating of plastics reduces the porosity, absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better ma-

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 disposal of waste plastic.

Some encouraging results were reported in this study that there is possibility to improve the performance of bituminous mixes of road pavements. Thermo gravimetric analysis has shown that there is no gas evolution in the temperature range of 130-180°C. Softened plastics have a binding property. Hence, it can be used as a binder for road construction.

Bindu C.S concluded that , Based on this study of the utilization of shredded plastic in SMA mixtures, the following findings were made:

- The Marshall Stability value of stabilized SMA was found to be 17kN, which is higher than the prescribed value of 6.2 kN and the percentage increase in stability value has been found to be 64%as compared to the conventional mix.
- The shredded plastic was effective in preventing excessive drain down of the SMA mixtures (i.e. bleeding phenomenon) and at 10% plastic content the drindown reduces to 0.09%.

2.3. Mrs.Vidula Swami, et al., states that, various activities like packing consume almost 50-60%of the total plastics manufactured. There has been tremendous increase in the consumption of plastic raising from 4000 tons/annum (1990) to 4 million tons annum (2009) and it is still expected to rise upto significant level of 12 million tons/annum by 2016.It becomes hard to recover useful substances from plastic waste since rubber compound in tyre because compounds like black carbon, zinc oxide, process oil, and sulphur are present in vulcanized stage. The process of retarding produces tyre crumb as it's by-product . Hence, before applying new rubber the old tread of tyre is buffed to produce crumb. The reclaim process is not environmentally friendly unless expensive scrubbers and effluent treatment plants are installed.

Mrs . Vidula Swami concluded that,

- The addition of waste plastic modifies the properties of bitumen.
- The modified bitumen shows good result when compared to standard results.
- The optimum content of waste plastic to be used is between the range of 5% to 10%.
- Total material cost of the project is reduced by 7.99%

2.4.Sasane Neha , et al.,states that the concept of using plastic in flexible pavement has been done sine several years ago in India. Plastic has played a very vital role in increasing the strength of bitumen as well as aggregate. the use of waste plastic in road construction as an effective way to reutilize the plastic waste. Properly selected and graded aggregates are mixed with bitumen to form hot mix asphalt (HMA) pavements. Aggregates are the principal load supporting components of HMA pavement.

Sasane Neha , concluded that, It shows that with the increase of waste plastic in bitumen increases the properties of aggregate and bitumen.

□ □ The optimum use of plastic can be done up to 10%, based on Marshal Stability test.

2.5. Pratiksha Singh Rajput , et al.,states that the Use of plastic waste in flexible pavements would open up a solution for the disposal issues regarding plastic wastes. They concluded that the Marshall stability value of plastic modified mix was found to be 51 percent more than that for the normal mix which indicates an increase in load carrying capacity. The 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 disposal of waste plastics.

Pratiksha Singh Rajput concluded that,

- The coating of aggregates with waste plastic reduces the absorption of moisture.
- There is significantly a decrease in the aggregates impact value and aggregates crushing value if compared with the values of conventional aggregates without plastic.

2.6. Rema devi M, et al.,states that the concept of utilization of waste plastic in the construction of pavements has been done for more than fifteen years. A common method to improve the quality of bitumen is to add polymers at specified temperature to the hot bitumen. Polymer modified bitumen has better resistance to water which reduces the stripping of bitumen from aggregate. the aggregate with waste plastic and it is reported that significant improvements .the use of waste plastic in road construction as an effective way to reutilise the plastic waste. Again it is reported that in Tamil Nadu lengths of road around 1000m in various stretches were constructed using waste plastic as an additive in bituminous mix under the scheme “1000km plastic tar road “ and found that the performance of all the roads are

satisfactory. However standard specifications are not available on the use of waste plastic in bituminous road construction.

Rama devi M concluded that,

- Considerable increase in Marshall Stability value.
- The optimum bitumen content is reduced.
- Above all the waste plastic which is a pollution menace can find its use in road construction and thereby solving the problem of pollution to a certain extent.

2.7. Mr. Mahesh M Barad, et al., states that the addition of 8.0 % by weight of processed plastic for the preparation of modified bitumen results in a saving of 0.4 % bitumen by weight of the mix or about 9.6 kg bitumen per cubic meter (m³) of BC mix. Modified Bitumen improves the stability or strength, life and other desirable properties of bituminous concrete mix. 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. When it used for road construction it can withstand higher temperature and load. 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 disposal of waste plastics.

Mr. Mahesh M Barad concluded that, Polymer Modified Bitumen is used due to its better performance. But in the case of higher percentage of polymer bitumen blend, the blend is a more polymer dispersion in bitumen, which get separated on cooling. This has resulted in reduced rutting, ravelling, and there is not pothole formation. The road can withstand heavy traffic and show better durability

2.8. Mr. H. K. Sharma, et al., states that the plastics can stay unchanged for as long as 4500 years on earth with increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. For rigid roads material used is concrete and for flexible roads bitumen is used. In India mostly the flexible pavement roads are available. Bitumen is a useful binder for road construction. Different grades of bitumen like 30/40, 60/70 and 80/ 100 are available on the basis of their penetration values. The steady increase in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature demand improved road characteristics.

Mr. H. K. Sharma concluded that, The use of the innovative technology not only strengthened the road but also increased the road life as well as will help to improve the environment and also creating a source of income. It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste. In short we can conclude that, using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road.

2.9. Sandeep R Unde, et al., states that the Plastic is everywhere in today's lifestyle. Plastics, a versatile material and a friend to common man become a problem to the environment after its use. There by plastic waste disposal throws many challenges to the society due to its non-bio degradability. Plastics such as polyethylene, polystyrene, high density polyethylene, low density polyethylene, polypropylene etc., are used in bags, sacks, detergent bottles, bottles of disinfectants, milk, fruit juices, bottle caps, film wrapping for biscuits, microwave trays for ready-made meals, mineral water bottles, credit cards, toys, pipes, pens, medical disposables, etc.

Sandeep R Unde concluded that,

- Aggregate Impact value of control specimen was 5.75%. It reduced to 4.91% for PP8 and 4.2% for PP10. Reduction in value was 22% for PP10. This shows that the toughness of the aggregate was increased to face the impacts.
- Crushing Value was reduced from 19.25% to 12.25% and 9.70% for PP8 and PP10 respectively. Value reduced by 30% for PP8 and 50% for PP10. Low aggregate crushing value indicates strong aggregates, as the crushed fraction is low.
- Los Angeles Abrasion Value of the control specimen was found to be 13.42%. Coating of polymer over aggregate for PP8 increased abrasion value by 19.97% and 29.88% for PP10. This indicates the hardness of the aggregate.

2.10. Afroz Sultana. SK, et al., states that The behavior of asphalt cement in service is governed by their initial engineering properties as well as by the mechanical and environmental conditions to which they are subjected. Under these situations, it is essential to modify the asphalt cement using modifiers to improve its engineering properties. On the other hand, the environmental problem such as disposal of waste plastic is major concern. To overcome the problems the modifiers (waste plastic) are used. Among various types of modifiers, polymers are probably the most promising.

Afroz Sultana. SK concluded that,



- Aggregate Impact value of control specimen was 5.75%. It reduced to 4.91% for PP8 and 4.2% for PP10. Reduction in value was 22% for PP10. This shows that the toughness of the aggregate was increased to face the impacts.
- Crushing Value was reduced from 19.25% to 12.25% and 9.70% for PP8 and PP10 respectively. Value reduced by 30% for PP8 and 50% for PP10. Low aggregate crushing value indicates strong aggregates, as the crushed fraction is low.
- Water Absorption is also reduced to nil for PP8 and PP10 from 1.7% for control specimen.

2.11. Sukaina Kazmi, et al., states that the Utilization of plastic materials is ubiquitous in some form or other; more so in the form of carry bags made out of polyethylene (PE), polypropylene (PP), or polyethylene terephthalate (PET) in view of their convenience, light weight and their availability in plenty, they are not easily degradable, and take pretty long time which is of the order of 100-500 years. This causes a heavy burden on the environment to degrade them. One of the approaches is to go for land filling while the other is to dump them into sea; both are not practicable. Hence, the use of plastics (particularly PE) has received wide criticism all over the world. Hence, efforts have been consistently made to find out the alternatives to dispose off the used plastic bags and materials.

Sukaina Kazmi concluded that, The use of the innovative technology not only strengthened the road but also increased the road life as well as will help to improve the environment and also creating a source of income. In short we can conclude that, using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road, avoid use of anti stripping agent, avoid disposal of plastic waste by incineration and land filling and ultimately develop a technology, which is eco friendly. Increased traffic conditions will and are reducing the life span of roads. Plastic roads are means of prevention and ultimately will be the cure. It will save millions of dollars in future and reduce the amount of resources used for construction.

2.12. ABEY LULSEGED, et al., states that Today, where a transport system covers vast amount of the infrastructure industry, finding economical, durable and environmentally friendly AC mix is the main concern of engineers and researchers. Hence, till this time in order to find strong and durable asphalt concrete pavement engineers use basically aggregate, bitumen and filler materials. As a result, finding construction materials that best withstand the worst environmental conditions fulfilling all the requirement of strength, flexibility, cost effectiveness, durability and environmentally friendly is the main issue. Thus, this research focuses on minimizing such costs and increase the durability of the pavement by using waste plastics as one construction material.

Abey Lulseged concluded that, The result of the tests using plastic coated aggregate clearly shows that the Los Angeles abrasion value has a significant change.; the aggregate crushing value doesn't show any significant change. On the other hand; the plastic coated aggregates have shown to have a better resistance to water absorption as the results are indicating, the plastic coated aggregate has a very small to negligible water absorption property.

III.METHODOLOGY

The methodology follow in concluding effect of plastic added in bitumen as , Firstly we selected the topic as we have to research on topic and gathering information of bitumen and plastic , then we did some literature survey, and then on basis of literature survey do some report writing and literature study. And then after that we make some practical study for that we make some specimen and conducting bitumen tests, and then we concluding the project base on results obtained from various tests.

IV.SCOPE

As the blend of plastic and bitumen are used for laying of flexible pavement which solves so many problem of mankind. The waste plastic is dump on land and creates environmental problem now that plastic is used and the waste plastic is reduces. Also the cost of the bitumen is high as by adding plastic we can reduces the quantity of bitumen, ultimately the cost of construction is reduces. And as by adding plastic we can reduces the quantity of waste plastic which makes environmental healthy atmosphere.

The plastic blended bitumen has more durability than ordinary bitumen, and day to day the road network in India is increases rapidly. That's why it is important to make good quality, durable, environmental friendly and economical roads. In these all cases the plastic blended bitumen is help us to get good results.

V.SUMMARY

As India is developing country, and day by day infrastructure is increasing and so we need to apply modern techniques to develop infrastructure. So in India, for infrastructure of road network mostly flexible pavement is use. So to increase road network we have to use optimum bitumen content or to modify bitumen properties. And on other hand day by day



due to haphazard use of plastic ,the plastic waste is generated and which is non biodegradable so that waste creates many problem to nature and mankind , so we have to use that plastic waste so that the waste generated is minimize and the which doesn't harm to nature.

So we finalise by literature survey to work on addition of plastic in bitumen so minimize the bitumen content and by adding plastic the properties of bitumen is modified which is harmless to nature.

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