

Effective Utilization of Waste Plastic In Construction Of Flexible Pavement For Improving Their Performance

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ABSTRACT: Solid waste management is the thrust area. Of this various waste materials, plastic waste and municipal solid waste are of great concern. On the other side, the road traffic is increasing. The traffic intensity is increasing. The load bearing capacities of the road are to be increased. Our present work is helping to take care of both these aspects. Plastic waste, consisting of carry bags, cups and Thermocols can be used as a coating over aggregate and this coated stone can be used for road construction. By this process a road of 1 Km length and 3.375M width of single lane can consumes 10, 00000 carry bags and the road strength is increased by 100% and there found no any pot hole. The mix polymer coated aggregate 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. The main object of paper is to analyze & study how the waste plastic will be effectively utilized in construction of flexible pavement as a binder material for replacing the content of bitumen and in detail process & its successful application.

1. INTRODUCTION

In general there are two types of road rigid pavement roads and flexible pavement roads. For rigid roads material used is concrete and for flexible roads bitumen is used. In India mostly the flexible pavement roads are available. And for economical road construction new techniques, new material is used. The significant variation in daily and seasonal temperature demand improved road characteristics. Any improvement in the property of the binder is needed. 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. Any improvement in the property of the binder is the needed.

Today the availability of the waste plastics is enormous, as the plastic materials have become part and parcel of daily life. They either get mixed with Municipal Solid Waste and/or thrown over land area. If not recycled, their present disposal is either by land filling or by incineration. Both the processes have certain impact on the environment. Under this circumstance, an alternate use for the waste plastics is also the needed. Plastic waste when mixed with hot bitumen, plastics melt to form an oily coat over the aggregate and the mixture is laid on the road surface like a normal tar road.

In the construction of flexible pavements, bitumen plays the role of binding the aggregate together by coating over the aggregate. It also helps to improve the strength of the road. But its resistance towards water is poor. Anti-stripping agents are being used. A common method to improve the quality of bitumen is by modifying the rheological properties of bitumen by blending with organic synthetic polymers like rubber and plastics. Studies on this subject are going on both at national and international level. This Concept of Utilization of Waste Plastic in Bituminous Mixes for Road Construction has been done since 2000 in India, They can return to the earth as beneficial additives in bitumen roads.

2. STUDY OF WASTE PLASTIC

2.1 Waste plastics - as binder and modifier:

130°C Thermo gravimetric analysis has shown that there is no gas evolution in the temperature range of 130-180°C. Moreover the softened plastics have a binding property. Hence, the molten plastics materials can be used as a binder and/or they can be mixed with binder like bitumen to enhance their binding property. This may be a good modifier for the bitumen, used for road construction.

2.2 Need for the study:

- 1) Disposal of waste plastic is a major problem
- 2) It is non-biodegradable
- 3) Burning of these waste plastic bags causes environmental pollution.
- 4) It mainly consists of low-density polyethylene

- 5) To find its utility in bituminous mixes for road construction
- 6) Laboratory performance studies were conducted Waste plastics (polythene carry bags, etc.) on heating soften at around d on bituminous mixes. Laboratory studies proved that waste plastic enhances the property of the mix
- 7) Improvement in properties of bituminous mix provides the solution for disposal in an useful way.

2.3 Different type of waste plastic (polymer) and its Origin

Type of waste plastic (polymer)

Low density polyethylene (LDPE):

High density polyethylene (HDPE):

Polypropylene (PP):

Polystyrene (PS):

Foamed Polystyrene:

Polyvinyl Chloride (PVC):

Origin

bags, sacks, bin lining and Squeezable detergent bottles etc bottles of pharmaceuticals, disinfectants, milk, fruit juices, bottle caps etc

bottle cap and closures, film wrapping for biscuits, microwave trays for ready-made Meals etc.

yoghurt pots, clear egg packs, bottle caps.

food trays, egg boxes, disposable cups, protective packaging etc

mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, furniture, folders and pens; medical disposables; etc

2.4 Materials used:

1) AGGREGATE

- Aggregate of 20mm, 10 mm.
- Stone Dust and Lime as Filler



2) BITUMEN

- 60/70, 80/100 grade bitumen



3) WASTE PLASTIC:

Waste plastic in the shredded form



2.5 Tests conducted on materials

1. Bitumen

- i) Penetration Test – 35 mm
- ii) Ductility Test – 6.5 N/mm²
- iii) Softening Point Test – 70° C
- iv) Flash & Fire Point – 265° C & 290° C

2. Aggregate

- i) Specific Gravity - 2.82
- ii) Water Absorption Test - 2.1 %
- iii) Impact Value Test - 8.77 %
- iv) Abrasion Test – 15.7 %

3. Plastic

Type Of Plastic	Chemical Formation	Density (gm/cm ³)	Softening point
Low Density Poly-ethylene Plastic (LDPEP)	(-CH ₂ -CH ₂ -) _n	0.9 to 0.95	100° C to 120° C
High Density Poly-ethylene Plastic (HDPEP)	(-CH ₂ =CH ₂ -) _n	0.95 to 0.96	120° C to 130° C

3. RESEARCH METHODOLOGY

After identification of problem and setting the objectives of the research, the research methodology has carefully designed to achieve these objectives.

- ✚ Collection and study of literature pertaining to the dissertation work.
- ✚ Determine the relevant index and engineering properties of plastic waste and compare them with conventional bitumen
- ✚ Cast various trial mixes with varying percentages of plastic waste and compare for the compressive strength.
- ✚ Select the optimum percentage of plastic waste to be blended with commonly used bitumen to produce maximum compressive strength.
- ✚ Prepare test samples with the percentage value obtained in step four and test these samples for the various pavements properties.
- ✚ To comment on the suitability and limitations of plastic waste for partial blending material with conventional bitumen in construction of flexible pavements.

4. 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. Plastics will increase the melting point of the bitumen. The waste plastic bitumen mix forms better material for pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for pavement is one of the best method for easy disposal of waste plastics.

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. Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. 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.

5. REFERENCES

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