

Quality Improvement Practices in Bituminous Road Construction

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Abstract - An efficient transport system is a pre-requisite for the sustainable development of a country. Which plays a very important role in the speedy and economic growth of a country. In India mostly bituminous roads are preferred. The significant change in seasonal temperature demands improved road characteristics. With developments in science and technology, the use of non decaying materials such as plastic, blast furnace slag, scrap tyres electronics waste etc. offers an economically viable and sustainable alternative towards increasing demand for better road construction. Nowadays, the rate of production of waste has increased tremendously in almost all parts of the world in past few decades. Electronic waste management has always been big issue in India and other countries. Disposal of electronic waste is difficult because of non degradable plastic content and metals like lithium, copper and aluminum which may leads to adverse effect on environment. Objective is to improve the quality by coating the aggregates with plastic to reduce the deterioration and to what extent bitumen and aggregate replaced by waste plastic and e-waste. The bitumen is partially replaced by polythene bags and aggregate partially replaced by e-waste.

Keywords: Improvement, Replacement, E-waste and waste Plastic, bituminous road, Economical.

1. INTRODUCTION

The factors causes' failure in flexible pavements in the form of ruts, fatigue cracks etc. and also ruts affect the riding comfort, increase in wear and tear of the vehicle and reduce life of flexible pavements. So

improvement in the property of bitumen and bituminous mixes is needed. So disposal of different wastes from different industries is great problem. Plastic and electronic waste used everywhere in today's life. Researchers have proven the health hazards caused by improper disposal of plastic waste and e-waste.

It is necessary to be environment friendly because of increased global warming and climate change. Becoming environment friendly in transportation projects implies environment friendly construction of roads with the availability of alternative materials. In developing countries like India, considerable amount of e-waste is generated every year. This huge amount of problems with respect to handling and storage, which are important both from the economic and environmental point of view. In this way these materials can be utilized in an eco friendly way, providing solutions to their disposal with a commitment towards development of infrastructure and accountability towards society at large. With increased industrialization and growth in population there is increase in demand for traditional road construction materials such as bitumen, aggregate etc. the question is of sustainable development. To deal with the problem, study on use of plastic waste as partial replacement to bitumen in flexible pavement is considered in the present work.

2. OBJECTIVE

- To find a suitable alternative method for disposal of plastic waste and electronic waste in eco-friendly way.

- To overcome the problems new technologies and alternative methods has potential to improve the quality of work.
- To find suitable alternative over conventional materials with improvement in strength.
- To use waste material in flexible pavement without increasing cost per unit and sacrificing durability.

2.LITERATURE REVIEW

Mr. Randive and Tapase [1] reported that the effect of plastic waste as a replacement to bitumen by dry mix process in bituminous concrete layer of flexible pavement. Tests for different percentage of bitumen content ranging from 4.5-6 percent by an increment of 0.5 percent and bitumen replaced by plastic in range of 5 percent to 20 percent were taken. It is observed that aggregates coated with plastic waste before mixing with bitumen results sudden increase in stability. It is because plastic coated aggregates do not allow water to enter inside and increase its stripping value.

Ajay Swarup, Pradeep Kumar Agarwal, Abdul Bashit Khan [2] says the existing huge rural road network is highlighting the need to take some effective measures for controlling and maintaining the deterioration of the rural road infrastructure in the country. The various strategies are used in reducing cost of construction of road. 1. Strategies by moderation of geometric standard 2. Strategies for need based stage construction 3.Strategies for use of locally available material 4.Strategies using iron slag for road Construction 5. Strategies by using ground improvement techniques.

Achal Garg and Harvinder Yadav [3] says that applications of industrial wastes have been considered in road construction with great interest in many industrialized and developing countries. The use of these materials in road construction is based on various technical, economic and ecological criteria for which a critical review has been presented in this paper.

3. EXPERIMENTAL RESULTS

I. Study of physical properties of experimental materials. To check the suitability of material for use in road pavement construction, numbers of tests were carried out on the materials.

1. Bitumen is defined as, "A viscous liquid or a solid, consisting essentially of hydrocarbons and their derivatives, which is soluble in trichloroethylene and its substantially non volatile and softens gradually when heated. Bitumen is obtained as the last residue in fractional distillation of crude petroleum.
2. Aggregates are natural materials and are the most important constituents of road construction. Aggregates are also used as base material under road construction. Aggregate contributes up to 90-95 percentage of the mixture weight and contributes to most of the load bearing & strength characteristics of mixture.
3. Electric and electronic waste (e-waste) is currently the largest growing waste stream. It is hazardous, complex and expensive to treat in an environmentally sound manner and there is a general lack of legislation or enforcement surrounding it. Today, most e-waste is being discarded in the general waste stream.
4. Safe disposal of waste plastic is a serious environmental problem. Being a non degradable material it does not decay over time and even if dumped in landfills, finds its way back in the environment through air and water erosion, can choke the drains and drainage channels. Bottles, containers and packing strip etc is increasing day to day.

II. Following are some important features of the experimental work-

- a. Specimen: Cylindrical 100 mm diameter specimen which is compacted with hammer on either side with 75 blows, as per MORTH 2001.

- b. Type of waste: HDPE plastics carry bags in shredded form. Electronic chips, circuit boards in shredded form.
- c. Bitumen type 80/100 grade
- d. Type of test- Marshall Stability test

In the present investigation an attempt has been made to see the effect of e-waste as partial replacement of

aggregate by volume and plastic waste as partial replacement to bitumen by weight in flexible pavement.

Following parameter are to be check in testing program.

- a. Stability
- b. Percent air voids
- c. Percent voids in mineral aggregate
- d. Bulk density
- e. Flow

Table -3.1: Test Result of Bitumen

Sr. No	Tests Conducted	Temperature Maintained During Test	Result Obtained	Permissible As Per MORTH 2001
1	Ductility	27°C	71.26 cm	75 cm minimum
2	Softening Point	-	47.25°C	40°C -55°C
3	Penetration	25°C	90	80/100
4	Specific Gravity	27°C	1.02	1.00

Table -3.2: Test Result of Natural Aggregate

Table -3.3: Properties of Bitumen mix

Sr. No	Property	Name Of The Test	Actual Value	Permissible Value As Per MORTH 2001
1	Strength	Crushing Strength	20.7 %	30% Max
		Los Angeles Abrasion Value	17.32	30%Max
		Impact Value	14.45	24%Max
2	Average Specific Gravity	Specific Gravity	2.6	2-3
3	Water Absorption	Water Absorption	1.26	2%Max
4	Particle Shape	Flakiness	13	30%Max
		Elongation	14	30%Max
5	Stripping	Coating And Stripping Of Bitumen Aggregate Mixture	Retained 97	Minimum Retained 95%

Sr. No	Properties	Properties of Mix with Different Percent of Plastic + E-waste						
		Control mix	(5+7.5)%	(5+10)%	(5+15)%	(7.5+7.5)%	(7.5+10)%	(7.5+15)%
1	Marshall Stability	8.85	9.24	8.98	8.25	9.38	9.06	7.80
2	Bulk Density	2.30	2.42	2.34	2.31	2.56	2.40	2.29
3	Air voids (%)	5.87	6.27	5.92	5.80	6.42	6.08	4.61
4	V.M.A (%)	16.2	16.72	16.38	15.21	16.86	16.25	15.38
5	Flow (mm)	2.38	2.98	2.52	2.26	2.71	2.63	2.32

4. ADVANTAGES OF PROJECT

- a. Poor locally available aggregates can be used by coating them with waste plastic which will ultimately reduce the haulage cost and improve the physical properties of aggregate.
- b. Stone aggregate is coated with the molten plastic waste .The coating of plastic reduces the porosity, absorption of moisture and improves stripping value.
- c. The polymer coated aggregate bitumen mix forms better material for flexible pavements as the mix shows higher Marshall Stability value.
- d. This process is eco friendly and has economical, environment and social relevance.
- e. Hence the use of plastic waste and e-waste for flexible pavement is one of the best method for easy disposal of waste.

5. CONCLUSION

An experimental approach towards waste management and finding alternative to conventional materials in flexible pavements. The objective of work is to investigate the effect of waste plastic and e-waste in flexible pavement. The process is environment friendly and eco friendly. The use of e-waste in road construction will serve two purposes: one to reduce the construction cost and the second a contribution towards an efficient waste management of this undesirable material. Different performance parameters of specimen are studied for varying percent of plastic waste, e-waste and bitumen content. The use of modified bitumen with the addition of processed waste plastic of about 7.5% by weight of bitumen helps in substantially improving the Marshall Stability, strength, fatigue life and other desirable properties of bitumen and marginal saving of bitumen.

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