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Maintenance and Rehabilitation of Flexible Pavement (Kosmadi Patia to Sevni village,Kamrej, Surat)

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ABSTRACT

In India, flexible pavements with bituminous surfaces are widely used. Due to increased traffic intensity of roads, overloading of commercial vehicles and temperature variation of pavements due to climatic changes leads to formation of various distresses like rutting, shoving, bleeding, cracking and potholing of bituminous surfacing. Due to high temperature, bitumen becomes very soft in summer and brittle in winter. Also, in a developing country like India, roadway construction is taking place at a very high pace which require large demand of construction material that too eco-friendly and economical. Several Studies have revealed that properties of bitumen and bituminous mixes can be improved/ modified with addition of certain additives and the bitumen premixed with these additives/modifiers is known as "modified bitumen". The present study aims for use of modified bitumen by using plastic waste for road construction. The paper includes details of methodology of using modifiers in bitumen and aims to provide highway construction in a eco-friendly and economical way. The modified bitumen mix shows better binding property, stability, density and more resistant to water.

Keywords: Maintenance, Rehabilitation, Plastic Waste, Modified Bitumen, Bitumen, Aggregates, Plastic Roads.

INTRODUCTION

Transportation infrastructure plays a lead role in economic growth and development of country. India has the second largest highway and road networks system on the world. They carry almost 90 percent of the country's passenger traffic and 65 percent of its freight. However, most highways in India are narrow and congested with poor surface quality. Also most of India's villages do not have access to all weather roads.

All civil infrastructures have a definite life span. In other words, all structures are designed to fail at some point but the life of structure is extended by the maintenance and rehabilitation activities. The maintenance and rehabilitation activities of pavement structures become increasingly important as pavements deteriorate with time and traffic. The combined effects of traffic loading and the environment will cause every pavement, no matter how well-designed/constructed to deteriorate over a period of time.

Quality of the road surface, stiffness and thickness of pavement layers are important parameters which influences the performance and efficiency of roads. Pavement evaluation plays a very important role in repair and rehabilitation of existing roads and quality control of new roads.

Flexible pavement is made with different layers with different material. It is important to design all layers carefully. It transmits the load by grain to grain contact.

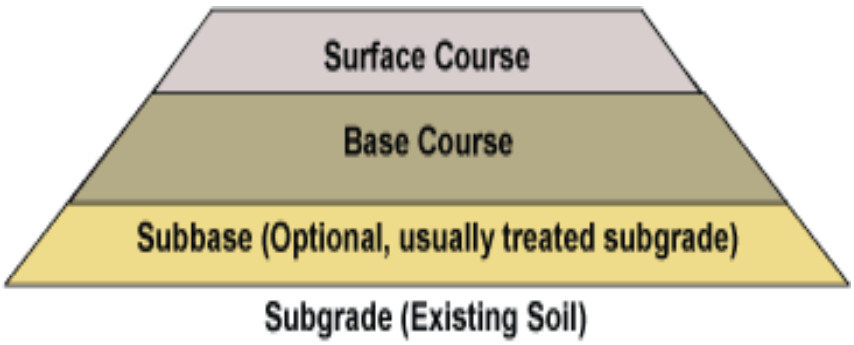

Fig 1- Flexible Pavement Layer

The aim of the thesis is Maintenance and Rehabilitation of flexible pavement and special focus on the performance of the pavement, find out the different aspect of deterioration of roadway, therefore suggest the suitable measure for the improvement of the selected road as per IS standard.

OBJECTIVE OF STUDY

Objectives for the present studies are as follows:

1. To identify the different aspects of deterioration of roadway.
2. To suggest the suitable measure for the improvement of the selected stretch.

METHODOLOGY

Waste plastic bags were collected from roads, garbage trucks, dumpsites and compost plants, rag pickers, waste-buyers at Rs 5-6 per kg. Household plastic was also collected for the project work, like empty milk bags, used plastic bags etc. The collected Plastic waste was sorted as per the required thickness. Generally, polyethylene of 60 micron or below is used for the further process. Less micron plastic is easily mixable in the bitumen at higher temperature (160°c-170°c).It is clean by de-dusting or washing if required. Collected Plastic 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 collected. Firstly, Bitumen was heated up to the temperature about 160°c-170°c which is its melting temp. Pieces were added slowly to the hot bitumen of temperature around 160-170°c.The mixture was stirred manually for about 20-30 minutes. In that time period, temperature was constant about 160-170°c. Polymer-bitumen mixtures of different compositions were prepared and used for carrying out tests.

WASTE PLASIC

Plastics can also be classified according to their chemical sources. According to sources of plastic, there are six general groups: Cellulose Plastics, Synthetic Resin Plastics, Protein Plastics, Natural Resins, Elastomers and Fibres. Table 2 gives the source of waste plastic generation. Only plastic conforming to Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), PET and Polyurethane shall only be used in pavement construction.

Table 2 Waste Plastic & its Source [2]

Waste Plastic	Origin
Low Density Polyethylene (LDPE)	Carry bags, sacks, milk pouches, bin lining, cosmetic And detergent bottles.
High Density Polyethylene (HDPE)	Carry bags, Bottle Caps, House hold articles etc.
Polyethylene Terephthalate (PET)	Drinking water bottles etc.
Polypropylene (PP)	Bottle caps and closures, wrappers of detergent, biscuit, wafer packets, microwave trays for readymade meal etc.,
Polystyrene (PS)	Yoghurt pots, clear egg packs, bottle caps. Foamed Polystyrene: food trays, egg boxes, disposable cups, protective packaging etc.

DESIGN OF MIX

Table 3 Requirements for Waste Plastic Modified Dense Graded Bituminous Pavement Layers [2]

Minimum stability (kN at 60°C)	12.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Marshall Quotient (kN/mm)	2.5-5
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Quantity of Waste Plastic % by weight of bitumen	6 to 8 depending on low rainfall or high rainfall areas

SUMMARY OF MARSHALL STABILITY TEST

Mix design for Bitumen

Bitumen Content	Stability (KN)	
	Plain bitumen	6 % bitumen replaced by plastic waste
4.5 %	16.23	19.98
5.0 %	17.00	20.93
5.5 %	16.81	20.69
6.0 %	16.02	19.72

Summery for Flow

Bitumen Content	Flow (mm)	
	Plain bitumen	6 % bitumen replaced by plastic waste
4.5 %	2.08	2.57
5.0 %	2.23	2.82
5.5 %	2.40	3.05
6.0 %	3.1	3.15

CONCLUSION

- The addition of waste plastic modifies the properties of bitumen.
- The modified bitumen shows good result when compared to standard results.
- The problems like bleeding are reduce in hot temperature region.
- Plastic has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic.
- The waste plastics thus can be put to use and it ultimately improves the quality and performance of road.

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