iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VIII **Month of publication:** August 2022

DOI: https://doi.org/10.22214/ijraset.2022.46250

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

Utilization of Non- Biodegradable Material for Repairing Potholes

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Abstract: ***Today's asphaltic concrete pavements are expected to perform better as they are experiencing increased volume of traffic, increased loads and increased variations in daily or seasonal temperature over what has been experienced in the past. In addition, the performance of bituminous pavements is found to be very poor in moisture induced situations. Considering this lot of work has been done on use of additives in bituminous mixtures and as well as on modification of bitumen. Research has indicated that the addition of polymers to asphalt binders helps to increase the interfacial cohesiveness of the bond between the aggregate and the binder which can enhance many properties of the asphalt pavements to help meet these increased demands. However, the additive that is to be used for modification of mix or binder should satisfy both the strength requirements as well as economic aspects. Plastics are everywhere in today's lifestyle and are growing rapidly throughout particularly in a developing country like India. As these are non-biodegradable there is a major problem posed to the society with regard to the management of these solid wastes. This plastic waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The use of the innovative technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment. 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.***

Keywords: Waste Plastic, Polyethene, Aggregate, Concrete, Asphalt, Bitumen, Pavement.

I. INTRODUCTION

Plastic and tyre is a non-biodegradable material. Despite, the quantum of plastic waste is also increasing day by day which is hazardous to our health. Thus, using plastic waste for construction purpose of flexible pavements will be one of the alternatives for disposing them in an eco-friendly manner. The plastic waste in a road pavement in Bangalore city. Today, every vital sector of the economy starting from agriculture to packaging, automobile, building construction, been virtually revolutionized by the applications of communication or InfoTech has plastics.

II. LITERATURE REVIEW

A. General

Pothole is a depression in a road surface, usually asphalt pavement, where traffic has removed broken pieces of the pavement. It is usually the result of water in the underlying soil structure and traffic passing over the affected area. 'Water first weakens the underlying soil; traffic then fatigues and breaks the poorly supported asphalt surface in the affected area. Continued traffic action ejects both asphalt and the underlying soil material to create a hole in the pavement. Non-biodegradable materials are often synthetic products like plastic, glass and batteries. Because they don't break down easily, if not disposed of properly, non-biodegradable waste can cause pollution, block drains and harm animals. Waste which cannot be decomposed or degrade by the biological process is known as "non-biodegradable wastes". Most of them include inorganic waste is non-biodegradable.

III. METHODOLOGY

A. General

In this chapter, methods used to achieve the desired results are explained. After a thorough study of literature.

B. Work Process

1) In this Project information is obtained from research paper, newspaper and internet.
2) From the information we will find out the methods for repairing potholes.
3) Selection of case study will be done from the information.
4) Traffic survey data will be done to find out the traffic load and analyse accordingly.

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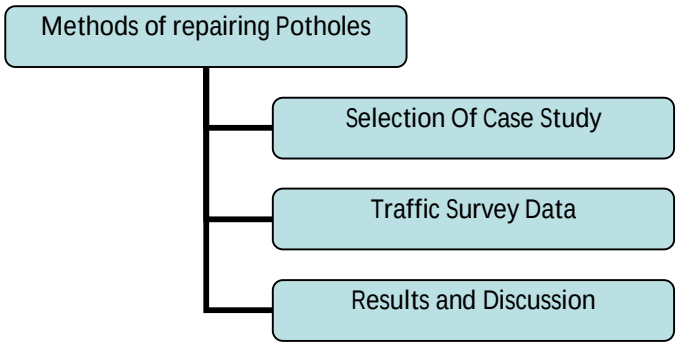
5) Testing of materials used for repairing potholes.
6) Various tests to be carried on Aggregate.
7) Tests to be performed on bitumen sample (polypropylene, polyethene, rubber)

C. Layout of Project



D. Material and Methods Used
1) Preparation of Design Mix
a) Plain Bituminous Mix: Bitumen is a black, oily, viscous material that is a naturally-occurring organic by product of decomposed organic materials. Also known as asphalt or tar, bitumen was mixed with other materials throughout prehistory and throughout the world for use as a sealant, adhesive, building mortar, incense, and decorative application on pots, buildings, or human skin. The material was also useful in waterproofing canoes and other water transport. A good design of bituminous mix is expected to result in a mix which is adequately (i) strong (ii) durable (iii) resistive to fatigue and permanent deformation (iv) Environment friendly (v) economical and so on.

2) Selection of mix Constituents: Binder and aggregates are the two main constituents of bituminous mix
a) Binder: Generally, binders are selected based on some simple tests and other site-specific requirements. These tests could be different depending of the type of binder viz. penetration grade, cutback, emulsion, modified binder etc. For most of these tests, the test conditions are pre-fixed in the specifications. Temperature is an important parameter which affects the modulus as well as the aging of binder. Superpave specifications [Superpave 1997, 2001] suggest that these acceptability tests are to be carried out at the prevalent field temperatures, not in a laboratory specified temperature.
b) Aggregate: Number of tests is recommended in the specifications to judge the properties of the aggregates, e.g. strength, hardness, toughness, durability, angularity, shape factors, clay content, adhesion to binder etc.

3) Plastic Material: Plastics are usually classified by their chemical structure of the polymer's backbone and side chains. Some important groups in these classifications are the acrylics, polyesters, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical process used in their synthesis, such as condensation, polyaddition, and crosslinking. There are two types of plastics: thermoplastics and thermosetting polymers. Thermoplastics are the plastics that do not undergo chemical change in their composition when heated and can be molded again and again. Examples include polyethylene, polypropylene, polystyrene, polyvinyl chloride, and polytetrafluoroethylene.

Types of plastics:
- PET, polyethylene terephthalate
- HDPE, high-density polyethylene
- PVC, polyvinyl chloride
- LDPE, low-density polyethylene
- PP, polypropylene
- PS, polystyrene

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E. Traffic Survey for NH-66 (Mumbai-Goa Highway) Hourly Traffic Volume on Mumbai Goa Road (Indapur)

TABLE 3.3: Traffic Survey

Time Period	2W	3W	Cars	Buses	LCV	Total Vehicles
8 to 9	376	109	197	15	22	719
9 to 10	477	139	250	17	28	911
10 to 11	460	134	241	20	27	822
11 to 12	443	129	232	21	26	851
12 to 13	418	122	219	14	24	797
Total	2174	633	1139	87	127	4160

F. Testing of Material for Pothole Repairing

- Carry Bags (LDPE=low-density polyethylene)
- Waste Milk Cover (HDPE=high-density polyethylene)
- Bitumen
- Aggregate

1) Testing On Material

a) Marshall Stability

The bitumen is heated to 160ºC – 170ºC.
The shredded plastic (plastic covers, milk covers) is added to the bitumen.
The aggregate (19mm,13mm,6.75mm& dust) are weighed to all total of 1200 gm and then heated to 140ºC.
The heated aggregate & the plastic added bitumen is mixed & transferred to the compaction mold.
The specimen is given 75 blows on the topside of the specimen mix with std hammer(45cm,4.86kg).reverse the specimen & 75 blows is given on the other side.
The mold is kept undisturbed for 24hours.
The specimen from the mold is gently removed.
A series of specimens are prepared by a similar method with varying quantities of bitumen content with plastics.
The dry mold is weighed & noted as W1.
The mold is immersed in water & is weighed & noted as W2.
The mold is immersed in water is removed &
weighed asW3.
The mold is immersed in hot water bath at 60ºc for 30min.
The mold is tested for its stability & flow.

b) Softening Point

60/70grade of bitumen is heated to 160ºC-170ºC
The rings are placed on the glass plate to which the heated bitumen is poured (dextrin powder is applied on the surface of glass plate to avoid sticking of bitumen)
The rings with the heated bitumen is kept until it cools to room temperature.
The rings are placed in the stand and then kept in the beaker.
The beaker is filled with ice and kept at 5ºC for 15 minutes.
The thermometer is fixed in the stand for checking the accuracy of temperature
After 15 minutes the apparatus is kept on the flames with a mesh under it
The ball is placed in the centre of the ring and thermometer is placed in the beaker
When the ball comes down along with the bitumen the temperature is noted and that is the softening.

c) Ductility

Bitumen is heated to 160ºC-170ºC
Heated bitumen is poured into the ductility mould
The mould is kept until it cools to room temperature
The mould is placed in ice and kept at 27ºC for 1 hour
The mould is placed in ductility machine
The readings are noted when the bitumen breaks into threads

d) Flash Point Test

Soften the bitumen between 75 and 100oC. Stir it thoroughly to remove air bubbles and water.
Fill the cup with the material to be tested upto the filling mark. Place it on the bath. Fix the open clip. Insert the thermometer of high or low range as per requirement and also the stirrer, to stir it.
Light the test flame, adjust it. Supply heat at such a rate that the temperature increase, recorded by the thermometer is neither less than 5oC nor more than 6oC per minute.
Open flash point is taken as that temperature when a flash first appears at any point on the surface of the material in the cup. Take care that the bluish halo that sometimes surrounds the test flame is not confused with the true flash. Discontinue the stirring during the application of the test flame.

e) Fire Point Test

After flash point, heating should be continued at such a rate that the increase in temperature recorded by the thermometer is neither less than 5oC nor more than 6oC per minute.
The test flame should be lighted and adjusted so that it is of the size of a bead 4mm in dia.

IV. RESULTS AND DISCUSSION

TEST	NORMAL BITUMEN	5% PLASTIC ADDED BITUMEN	7% PLASTIC ADDED BITUMEN	9% PLASTIC ADDED BITUMEN	Range
Ductility (kN)	71	52	49	43	MIN 75
Softening point(˚C)	47	54	56	55	47-80
Flash point(˚C)	180	173	175	177	180-185
Fire point (˚C)	186	180	183	184	185-190
Marshall stability(kn)	17.77	10.11	19.81	11.04	17-18

Table 4: Results and Conclusions

1) The results which we found out from the were according to the is code 1201-1978 and IRC SP: 53:2010
2) The bitumen on which the test were performed was of the best quality.

A. Discussion

1) Plastic will increase the melting point of the bitumen.
2) This innovative technology not only strengthened the road construction but also increased the road life.
3) Plastic roads would be boon for India's hot & extremely humid climate, where temperature frequently cross 50°C.
4) Addition of waste tyres as rubber aggregate modifies the flexibility of surface layer.
5) Optimum content of waste rubber tyres to be used is between the range of 5% to 20%.
6) Problem like thermal cracking and permanent deformation are reduce in hot temperature region.

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V. CONCLUSIONS

In our project we compared the normal bitumen properties with the waste plastic bitumen at different percentages. We infer from our results that the optimum percentage of plastic to be added is 7%. The waste plastic bitumen has 20% better results. This project is also a waste plastic management and also helps in the better disposal of waste plastics.

A. Readings

SR No	Test conducted	7 %	Normal Bitumen	Permissible limit
1	Marshall stability (KN)	19.81	17.77	18
2	Ductility	49	71	MIN 75
3	Softening point(°c)	56	47	47-80
4	Flash (°c)	175	180	180-185
5	Fire (°c)	183	186	185-190

Table 5.1: Readings

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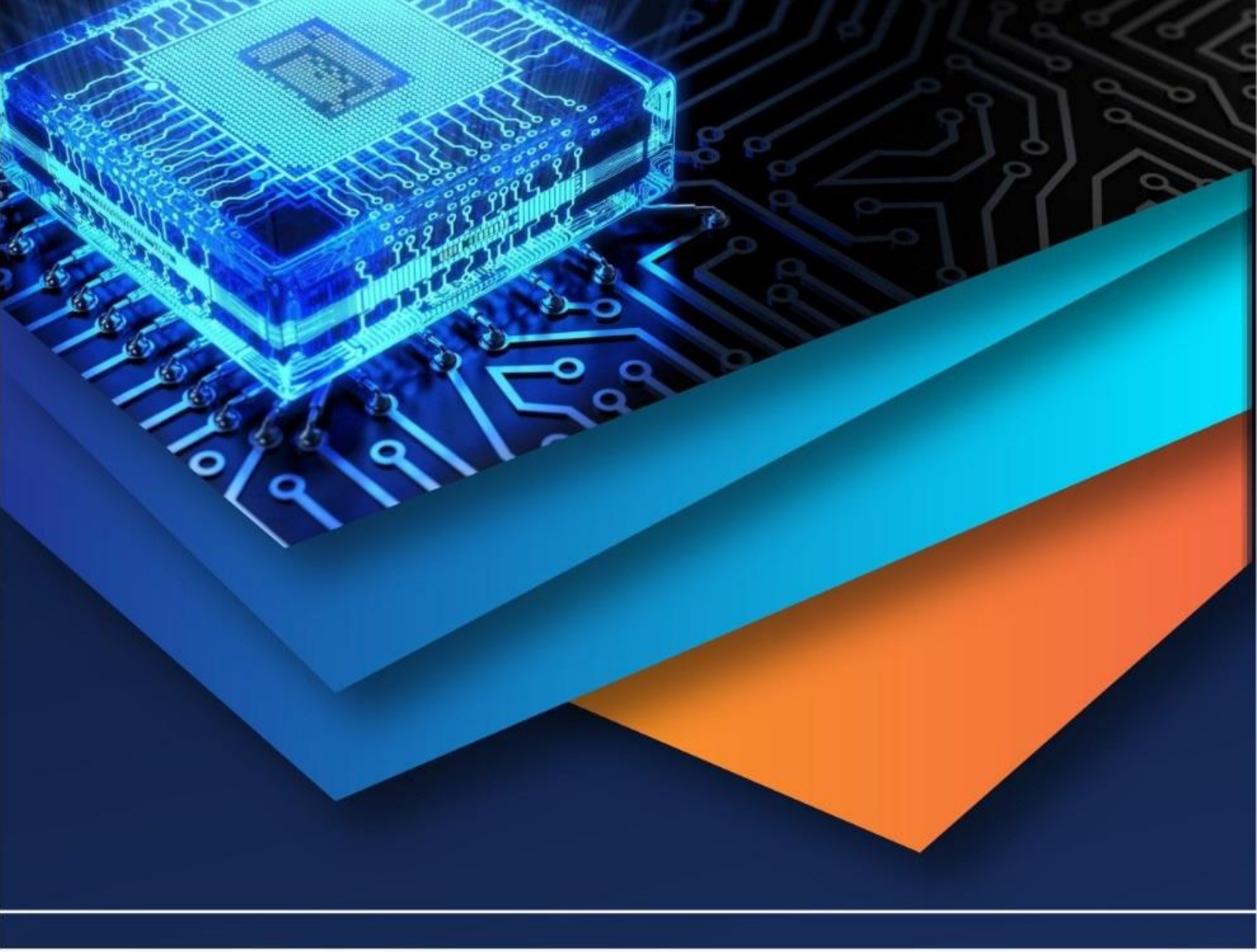

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