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# Experimental Study on Bitumen Road by Using Crumb Rubber and Plastic Waste

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**ABSTRACT:** Aiming at reducing the negative impact of plastic pollution and waste crumb rubber on our planet, plastic garbage is commonly seen around the country and has started causing several problems. Many studies have been done to find other alternative material to use as modifiers in bitumen mixes on the improvement of its properties and highway quality. Plastic waste clogs drains, causing floods. It chokes animals who eat plastic bags, etc. The durability of the road surfaces depends largely on the type and quality of bitumen used. Rubber modified bitumen uses stress absorbing membrane that reduces the reflective cracking because of its elastic properties. With fewer cracks there are fewer repairs, so crumb rubber assisting in reducing maintenance cost. Thus the pavement construction with rubber bitumen has long lifespan. In this research a Rubber in the form of tire rubber crumb and plastic has been used as bitumen modifier.

**KEYWORDS:** - Crumb Rubber, plastic waste Bitumen.

## I. INTRODUCTION

Roadways are considered one of the most important elements of infrastructure and they play an essential role in our daily lives. In road pavement construction, the use of crumb rubber plastic waste in the modification of bitumen binder is considered as a smart solution for sustainable development .By reusing waste materials. And since the abundance and increase of waste tyre and plastic disposal is a serious problem that leads to environmental pollution. Crumb rubber obtained from shredding of those scrap tires has been proven to enhance the properties of plain bitumen since the 1840s. It can be used as a cheap and environmentally friendly modification process to minimize the damage of pavement due to increase in service traffic density, axle loading and low maintenance services which has deteriorated and subjected road structures to failure more rapidly. Use of crumb rubber and plastic waste leads to excellent pavement life, driving comfort and low maintenance.

## AIM

Aiming at reducing the negative impact of plastic pollution on our planet and also it also produces roads that are stronger and last longer than regular asphalt roads.

## OBJECTIVE

The major objective of the project is to reduce bitumen content in the mixture, increase bond strength, increase lifespan and reduce the disposal of waste tires and plastics. Some of the relative objectives are:

1. To study the strength & stability characteristics of bituminous mix for 60/70 grade bitumen.
2. To study the effect of waste crumb rubber and plastic strength and stability characteristics in Bituminous mix.
3. To analyze the stability of rubber and plastic bituminous mix.
4. Maintenance of rural road network.
5. To produce environment friendly mixes.
6. To develop labor friendly method.
7. To avoid imports to save foreign exchange.



**II. PROBABLE IMPLICATIONS**

Applying New carpet layer of Bitumen on road by adding plastic waste and crumb rubber. “Salod Paloti Road Sawangi Dist. Wardha.

**TEST ON MATERIAL**

**LAB TESTS ON BITUMEN TO CHECK QUALITY**

There are a number of tests to assess the properties of bituminous materials. The following tests are usually conducted to evaluate different properties of modified (5% Crumb Rubber) bituminous materials.

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test
5. Viscosity test
6. Flash and Fire point test
7. Float test
8. Water content test
9. Loss on heating test

**1. PENITRATION TEST**

**Table No. 1 -Observation table for Penetration Value**

Penetrometer Dial Reading	Sample 1	Sample 2	Sample3
Initial Reading (a)	16	22	65
Final Reading (b)	81	89	67
Penetration Value (b-a)	65	67	69
		Average	67

**2. DUCTILITY TEST**

**Table No.2 - Observation Table for Ductility Test of Bitumen**

Description	Sample -1	Sample -2
Initial Reading (a) in mm	0	0
Final Reading (b) in mm	52	54
Ductility (b-a) in mm	0	54



### 3. SOFTING POINT TEST

**Table No.3- Observation Table for Softening Point Test of Bitumen**

Description	Ball No. – 1	Ball No. – 2
The temperature when the ball touches the bottom plate °C	<b>60</b>	<b>64</b>
	<b>Average</b>	<b>62</b>

### TESTS ON AGGREGATE

Aggregate plays an important role in pavement construction. Aggregates influence, to a great extent, the load transfer capability of pavements. Hence it is essential that they should be thoroughly tested before using for construction. Not only that aggregates should be strong and durable, they should also possess proper shape and size to make the pavement act monolithically. Aggregates are tested for strength, toughness, hardness, shape, and water absorption.

In order to decide the suitability of the aggregate for use in pavement construction, following tests are carried out:

1. Crushing test
2. Abrasion test
3. Impact test
4. Soundness test
5. Shape test
6. Specific gravity and water absorption test
7. Bitumen adhesion test

#### 1. CRUSHING TEST

Weight of empty cylinder (w1) = 11070gms  
 Wt. of cylinder + aggregate (w2) = 14170gms  
 Wt. of fraction passing through 2.36mm (w3) = 530gms  
 Wt. of aggregate (w4) = 3100gms  
 Crushing value of aggregate =  $w3/w4 \times 100$   
 =  $530/3100 \times 100$   
 = **17.09 %**

#### 2. ABRASION TEST

Total wt. of aggregate (w1) = 5000 gms  
 Wt. of aggregate retained (on 1.7mm Sieve) (w2) = 3890gms  
 Loss of aggregate due to abrasion (w1-w2) = 5000-3890  
 = 1110 gms  
 Abrasion Value =  $w1-w2/w1 \times 100$   
 =  $5000-3890/5000$   
 = 22.2%

#### 3. IMPACT TEST

- 1) Wt. of empty cylindrical measure (w1) = 1110gms
- 2) Wt. of cylindrical measure + wt. of aggregate (w2) = 1726gms
- 3) Wt. of aggregate w3 = (w2-w1) = 1726-1110 = 615gms
- 4) Wt. of Aggregate passing through 2.36mm sieve (w4) = 45mm gms

Impact Value =  $w4/w3 \times 100$

= 45/615x100  
= 7.314%

### III. EXPERIMENTAL PROGRAMME

#### MATERIAL:



Fig No.1-Rubber Crumb



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Fig No. 2-Plastic Waste

#### PLASTIC WASTE:

India generates 1, 88,000 tons garbage every day. Plastic Waste in different forms is found to be almost 9% to 12% in municipal solid waste, which is toxic in nature. Non-biodegradability of plastic in the environment has created numerous challenges for both urban and rural India. Common problems are choking of drains, stagnation of water, and release of toxic gases upon open incineration.

Research experiments in the public and private sector have been undertaken to address the growing environmental challenge

#### RUBBER CRUMB:-

Tens of millions of tires are discarded across the Middle East every year. Disposal of waste tires is a challenging task because tires have a long life and are non-biodegradable. The traditional method of waste tires management have been stockpiling or illegally dumping or landfilling, all of which are short-term solution. Crumb rubber is a term usually



applied to recycled rubber from automotive and truck scrap tires. There are two major technologies for producing crumb rubber – ambient mechanical grinding and cryogenic grinding. Of the two processes, cryogenic process is more expensive but it produces smoother and smaller crumbs.



Fig No. -Road Length & Width

Table No.4- Calculation

Vehicle capacity is	400cuft, 450, 600cuft	as contractor vehicle availability
We have to take	400cuft vehicle.	
Vehicle Capacity	400cuft	
Width of Road	3.75mm	
Compacted thickness of carpet	20mm	
And at the time of laying loose thickness count	27mm	
	400cuft	= 11.34m <sup>3</sup> (400/35.28)
		=11.34/0.027 =420.00Sqm
	420/3.75=112.00	running meter <sup>3</sup> .As per No. 1 trial taken



Thickness of carpet	20mm compacted.	
Size of fine Aggregate		As per IRC SP-20 (page no 199)
Metal	=10sq.area	22.4 to 11.2 = 0.18m3
		11.2 to 5.6mm= <u>0.09m3</u>
		= 0.27m3
For 1 sq. area		=0.027m3
Bitumen		=1.46 kg/ m2
Length		=112.00m
Width		= 3.75m
Thickness		=0.027m =27mm
		112x3.75x0.027 =11.34m3
		For 112.00x3.75 =420Sqm area
Waste plastic	8%	116.8 gm. /m2
Rubber crumb	5%	73gm/m2

For one tipper of material

Waste plastic = 1 x 420m2 x 116.80 = 49056gm

= 49.056 kg

= 49 kg

Crumb Rubber 1x 420 x 73 = 30660 gm.

=30.660 kg

Bitumen = 1.46kg/m2

=1460gm/m2

If waste plastic used =116.00gm

Crumb rubber =73gm

-----  
189.80gm/m2

Required Bitumen = 1460

= 189.80

-----  
1270.20gm



Fig No. 4 –Practical Road Implication



#### IV. CONCLUSION

We can conclude that, this project study includes a comparative study on prevention system analysis and application of plastic waste and rubber crumb in Flexible Pavement. Plastic waste and rubber crumb improves the properties of aggregates uses for road construction work. Disposal of plastic waste and waste tire can minimize land filling and make its eco- friendly. By modification of bitumen with rubber crumb and plastic waste the problems like bleeding in hot temperature regions and it ultimately improves the quality of road. The bituminous mix plastic and rubber crumb is suitable to use in hot climatic areas. Plastic waste roads are means of prevention and ultimately will be the cure. It will save large expenses in future and reduce the amount of resources used for construction.

- Plastic-tar and rubber crumb roads have benefits over conventional roads
- Overall reduction in bitumen consumption by 8%, enhanced load carrying strength, reduced wear and tear.
- Prevents release of 3 tones of CO<sub>2</sub> (through disposal by burning) into the atmosphere.
- Increased road strength.
- Excellent resistance to water and water stagnation.
- No stripping and potholes formation.
- Enhanced binding & reduced rutting and raveling.
- Improved soundness property.
- Negligible maintenance cost of the road.
- No leaching of plastics and no effect of UV radiation.
- Waste plastic that can be used include cups, carry bags, polythene and polypropylene foams and thermocol.
- Polyvinylchloride cannot be used as it is toxic in nature.

#### V. BENEFITS OF INNOVATION

There are various benefits which are drawn by implementation of this innovative technology. To enumerate a few of these advantages are:

- The risks to public health and security will decrease with proper waste management.
- The cost in laying road is significantly reduced due to the reduced quantity of bitumen used.
- These water proof roads provide considerably increased durability.
- No stripping of roads happen as this kind of roads resist the permeation of water.
- This innovation provides road with durable strength, thus increasing higher load - carrying capacity.
- No maintenance will be required for years as the surface remains without any cracking or potholes.

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