

# “Experimental Study on Waste Plastic Bitumen”.

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**Abstract** – India is one of the largest consumers of plastic in the world. The usage ranges from packing materials to single-use items like bags, bottles, and cutlery. This waste plastic improper disposal causes leads to the pollution of water bodies, soil, and air.

This waste plastic can be used in the road construction, which improves the road quality and also increases the Marshall stability and Flow value of the road. Till the plastic content reaches the optimum plastic content by weight of bitumen. After that we can see a gradual decrease in the Marshall stability and Flow value.

**Key Words:** Waste Plastic, Bitumen, Optimum Plastic Content, Marshall stability, Flow value.

## 1.INTRODUCTION

Plastic, a versatile and ubiquitous material, has revolutionized countless aspects of modern life, from packaging and transportation to healthcare and electronics.

Plastic was invented in early 20<sup>th</sup> century. this plastic has more used nowadays this plastic has to be recycled other wise it is creating a bad impact on the human beings, and pollution of soil, air, and water.

So, by using waste plastic in the road construction can control pollution up to 50% which is happening due to improper disposal methods of plastic.

Plastic can be used as additive to bitumen to improve the properties of the bitumen in the road construction.

Which can also help in the economically and environmentally to both human beings and animals.

## 2. Problem Statement.

Plastic poses several significant problems, many of which impact the environment, human health and ecosystem.

1.Plastic, due to their durability and resistance to degradation, persist in the environment for extended periods.

2.Improper disposal of plastic waste leads to pollution in water in water bodies, soil and air affecting ecosystems and wildlife.

3.Many plastics contain harmful chemicals such as bisphenol A (BPA) and phthalates, which can leach into the environment and potentially contaminate water and food supplies.

4.Plastic pollution in oceans poses a severe threat to marine life, leading to entanglement ingestion, and habitat destruction.

## 3.OBJECTIVES

The objectives of present study are

➤ To evaluate properties of Plastic-coated aggregates (PCA) and comparing it to conventional aggregates.

➤ To select an optimum waste plastic content for the mixture after the analysing the test results.

## 4.MATERIALS AND METHODOLOGY

### 4.1 MATERIALS

Materials used for the plastic bitumen's roads

1.Coarse Aggregate: Coarse aggregates are irregular broken stone or naturally-occurring rounded gravel used for construction works. Materials which are large to be retained on 4.7 mm sieve size are called coarse aggregates.

2.Bitumen: The term bitumen refers to a substance produced through the distillation of crude oil. Bitumen is known for its waterproofing and adhesive properties and is commonly used in the construction industry, notably for roads and highways.

3.Plastic: Plastic is a material consisting of a wide range of synthetic or semi-synthetic organic compounds that are malleable and therefore, can be moulded into solid objects. Plasticity is the general property of all materials that involves permanent deformation without breaking. There are many types of plastic are present in the world LDPE (Low density polyethylene), HDPE (High density polyethylene), PET (Polyethylene Teryphthalate), and etc. Among these we used PET type waste plastic.

### 4.2 TEST ON MATERIALS

TEST ON AGGREGATES.	TEST ON BITUMEN.
Water absorption test.	Ductility test.
Los Angeles Abrasion Test.	Softening point test.
Aggregate Impact Value Test.	Penetration value test.
Crushing Value Test.	Flash & Fire point test.

### 4.3 METHODOLOGY

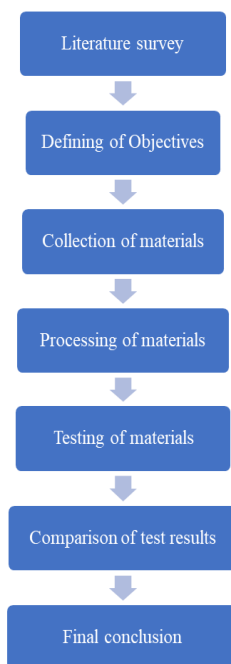


Fig 4.1: Flow chart representing methodology.

### 5.RESULT AND DISCUSSIONS

Table 5.1: conventional aggregates test result

TESTS	values	Limits	Test methods
Water Absorption Test	0.9%	< 2%	IS:2386 Part III
Los angeles Abrasion test	24.15%	< 30%	IS:2386 Part IV
Crushing Value test	28.98%	< 30%	IS:2386 Part IV
Aggregate Impact value Test	28.59%	< 30%	IS:2386 Part IV

The above table shows the test values of the different coarse aggregate tests. The test values are under the specified limit as per IRC:111-2009. The aggregate can be used in the pavement.

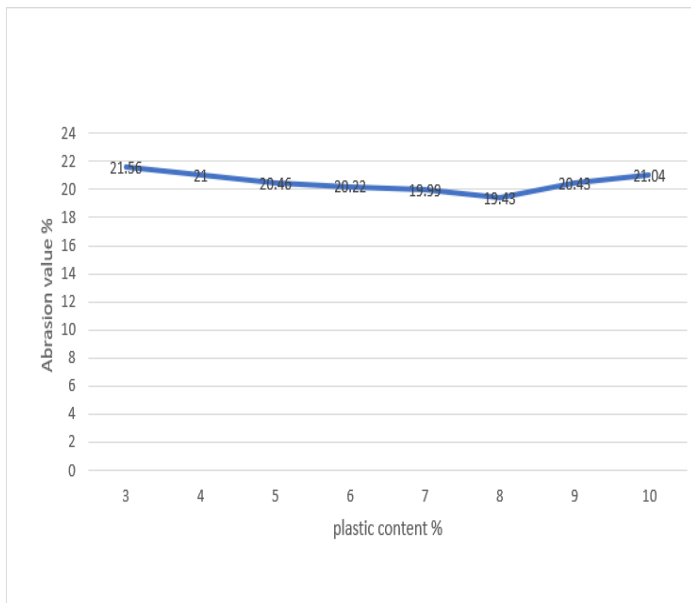
**The conventional aggregates are coated with the shredded plastic then the tests were conducted. the test results are showed in the below table2.**

- Steps followed in coating of plastic with coarse aggregate.
  - Coarse aggregate is sieved from Is 12.5mm sieve.
  - Aggregate is heated in the metal tin upto 160°C.
  - Then shredded plastic is add to the heated aggregates.
  - After addition of the shredded plastic is slowly starts coating on the coarse aggregate.
  - After the completing coating of plastic with aggregates it is taken out & then aggregates are cooled and transferred to the bags.

TABLE 5.2 :Test results of Plastic-coated aggregates.

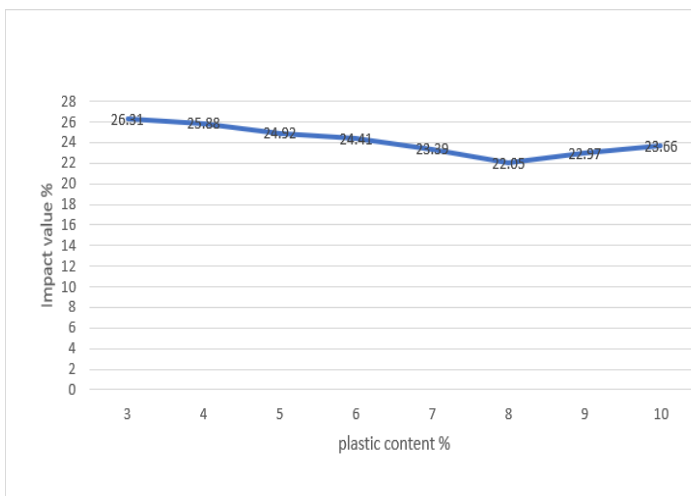
Plastic coated %	Water absorption test	Abrasion test	Impact value test	Crushing strength test
3%	1%	21.56%	26.31%	24.33%
4%	0.9%	21%	25.88%	23.25%
5%	0.5%	20.46%	24.92%	22.7%
6%	0.4%	20.22%	24.41%	21.28%
7%	0.2%	19.9%	23.39%	20%
8%	NILL	19.43%	22.05%	18.98%
9%	NILL	20.43%	22.97%	20.52%
10%	NILL	21.04%	23.66%	21.48%
Limit	<2%	<30%	<30%	<30%
Test methods	IS:2386 Part III	IS:2386 Part IV	IS:2386 Part IV	IS:2386 Part IV

The test results of the plastic-coated aggregates are came satisfactory as told in the IRC:111-2009.then the aggregates can be used in the pavement construction.



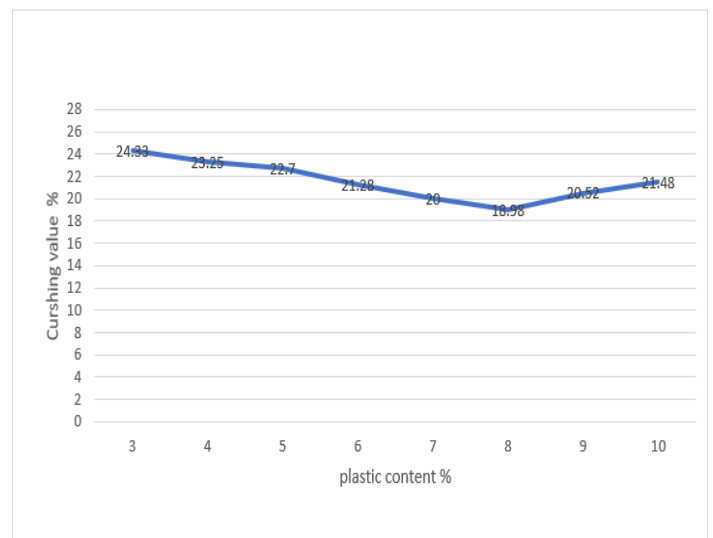
**Fig 5.1:** Abrasion value v/s Plastic content.

The above graph shows that the abrasion value decreases with increase in the plastic content upto the optimum plastic content 8% by weight of bitumen. The decrease in the abrasion value indicates the higher strength of aggregate.



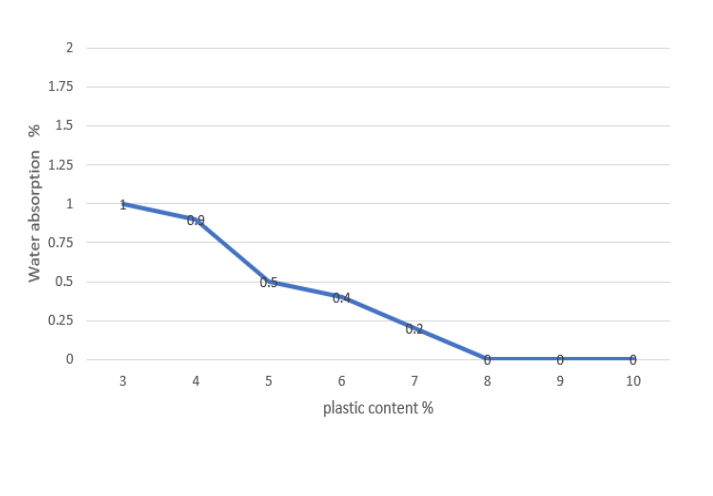
**Fig 5.2:** Impact value v/s Plastic content.

The above graph shows that the impact value decreases with increase in the plastic content upto the optimum plastic content 8% by weight of bitumen. The decrease in the impact value indicates the higher strength of aggregate.



**Fig 5.3:** Crushing value v/s Plastic content.

The above graph shows that the crushing value decreases with increase in the plastic content upto the optimum plastic content 8% by weight of bitumen. The decrease in the crushing value indicates the higher strength of aggregate.



**Fig 5.4:** Water absorption v/s Plastic content.

The above graph shows that the water absorption will decrease with increase in plastic content. The decrease in water absorption is good for pavement construction. Less water absorption means pavement can withstand in the heavy rainfall areas and pavement shows better quality than the normal pavement.

Table 5.3: Bitumen test results.

TESTS	Test method	Values	Limits AS per IS 73:2013
Penetration test	IS:1203-1978	70mm	>45mm
Ductility test	IS:1208-1978	56cm	>40cm
Flash point	IS:1209-1978	220°C	>220°C
Fire point	IS:1209-1978	250°C	>220°C
Softening point test	IS:1205-1978	56°C	>47°C

The bitumen of grade VG30 is tested in the laboratory & the test results are shown in the above table the results came are satisfactory referring to IS 73:2013 code book.

Table 5.4: Marshall stability and Flow test results.

Sample no.	Plastic content (% by weight)	Density of Core (gm/cc)	Marshall stability (KN)	Flow value (mm)	Marshall Quotient (KN/mm)
1	0	2.39	10.34	3.85	4.29
2	3	2.38	12.16	3.73	3.26
3	4	2.37	13.24	3.64	3.63
4	5	2.38	14.33	3.51	4.08
5	6	2.4	15.28	3.38	4.52
6	7	2.41	16.18	3.21	5.04
7	8	2.40	17.06	3.10	5.50
8	9	2.39	16.47	3.67	4.48
9	10	2.4	15.66	4	3.92
Limit	-	-	For PCA(>12Kn) For CA (>10KN)	For PCA (3-5) For CA (2-4)	For PCA (2.5-5) For CA (2-4.5)

\*PCA-Plastic-coated aggregates. \*CA-Conventional Aggregates.

The above table 5.4 shows the Marshall stability and flow value of the conventional & plastic-coated aggregate. The

plastic-coated aggregate shows the more stability than the conventional aggregates

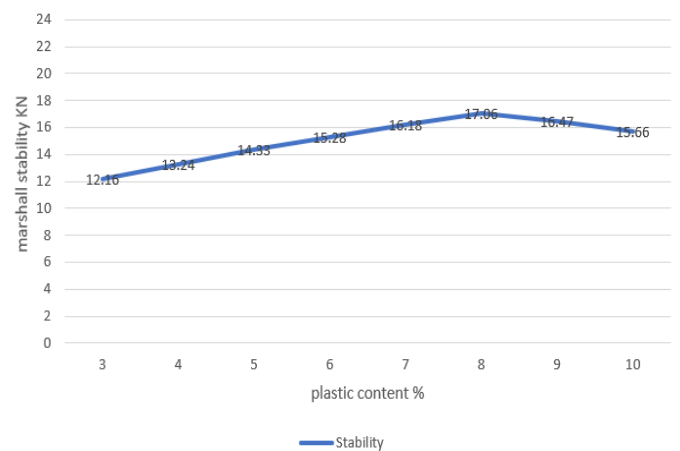


Fig 5.5: Marshall stability v/s Plastic content.

The above stability graph shows that the stability will increase with increase in plastic-content upto the optimum plastic content 8% by weight of bitumen. Then the stability will slowly decrease with increase with the plastic content.

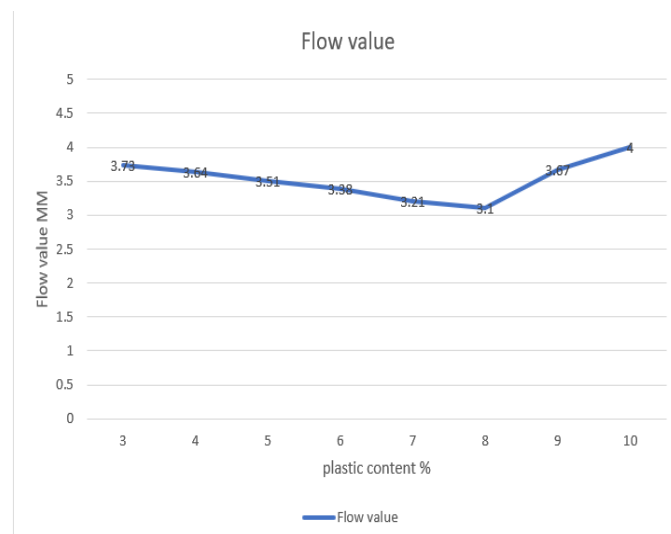


Fig 5.6: Flow value v/s Plastic content.

The above graph shows that the flow value decreases with increase with the plastic content upto the optimum content of the plastic 8% by weight of bitumen. Then flow value will gradually increases.

## 6. CONCLUSIONS

From the above study we can conclude that the plastic-coated aggregates show better resistance to the deformations under the heavy wheel loads. Addition of

plastic to the aggregates increases the strength of the conventional or natural aggregate.

The optimum plastic content OPC is found by the study is 8% by weight of bitumen. The Marshall stability value also increases upto the OPC. Then the Marshall stability will gradually decrease if we continue the addition of plastic content. The plastic content also decreases the flow value of the Marshall Moulded then the conventional aggregates which indicates that the plastic-coated aggregates are more resistance to the loads. Hence, we can use the plastic-coated aggregates for the bitumen road construction.

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