

## ECO-FRIENDLY BINDER IN FLEXIBLE PAVEMENT

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### ABSTRACT

Plastic is everywhere in today's lifestyle. It is used for packaging, protecting, serving, and even disposing of all kinds of consumer goods. With the industrial revolution, mass production of goods started and plastic seemed to be a cheaper and effective raw material. Hence improper disposal of plastic leads to problems like Acquisition of land under waste plastic, human problems as breast cancer, reproductive problems in humans and animals, genital abnormalities and even a decline in human sperm count and quality.

The molten plastics waste exhibits good i.e. waste plastic and bitumen used suitably in preparation of flexible road construction as per by Ductility test IS 1208—1978. In binding property Use of plastic along with the bitumen in construction of roads not only increases its ductility and smoothness but also makes it economically sound and environment friendly. The ductility test gives the standard value of ductility of homogeneous mixture this paper the results of laboratory ductility tests of bitumen with increasing percentage of waste plastic have been discussed.

**KEYWORDS:** Binding, Ductility, Bitumen, Elongation, Flexible Pavement, Interlocking of Aggregate

### INTRODUCTON

The debate on the use and abuse of plastics on environmental protection can go on, without yielding results until practical steps are initiated at the basic level by everyone who is in a position to do something about it. Use of plastic along with the bitumen in construction of roads not only increases its life and smoothness but also makes it economically sound and environment friendly. The plastic wastes could be used in road construction and the field tests along with the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. The present write-up highlights the developments in using plastics waste to make plastic roads. In the flexible pavement construction where bitumen binders are used, it is of significant importance that the binders form ductile thin films around the aggregates. This serves as a satisfactory binder in improving the physical interlocking of the aggregates.

### DUCTILITY TEST

In the flexible pavement construction where bitumen binders are used, it is of significant importance that the binders form ductile thin films around the aggregates. This serves as a satisfactory binder in improving the physical interlocking of the aggregates. It is necessary that binder should form a thin ductile film around the aggregate so that physical interlocking of aggregate is improved binder material having insufficient ductility get cracked when subjected to respected traffic load & it provide previous pavement surface.

### Objective

- To measure the ductility of given sample of homogeneous mixture i.e. bitumen & waste plastic
- To determine the suitability of homogeneous mixture i.e. bitumen & waste plastic for its use in road construction

### EXPERIMENTAL STUDY

#### Apparatus

The apparatus for standard ductility test IS1208-1978 consist of following

#### Briquette Mould

It is made up of Brass with proper shape, dimensions & tolerance as shown in figure 1. The circular holes are from a briquette specimen of following dimensions



**Figure 1: Briquette Mould**



**Figure 2: Ductility Apparatus**

Total length =  $75.0 \pm 0.5$ mm

Distance between clips =  $30.0 \pm 0.3$ mm

Width of mould at clips =  $20.0 \pm 0.2$ mm

Width of minimum cross section =  $10.0 \pm 0.1$ mm

Thickness through out =  $10.0 \pm 0.1$ mm

#### Water Bath

A bath maintain within  $\pm 0.1$  c of specified test temperature containing not less than 10 liter of water the specimen being submerged to a depth not less than 10cm & supported on a shelf & less than bottom of the bath.

#### Testing Machine

For pulling the briquette of bituminous material apart any apparatus may be used which is so constructed that specimen will be continuously submerged in water while two clips are being pulled apart horizontally at a uniform speed of  $\pm 25$ m/min.

#### Thermometer

Range 0-44 c & readable up to 0.2 c

### **Ductility Apparatus**

The Standard Ductility test apparatus used in laboratory as shown in figure 2.

### **PREPARATION OF WASTE PLASTIC**

There are two types of processes.

- Dry process
- Wet process

### **Wet Process**

In the wet process Blending of shredded plastic and bitumen prior to production of modified bituminous mixes, is at the commercialization stage. The wet process for modification of Bitumen using waste plastic has been patented by CRRRI field trials have also been carried out.

### **Steps in Wet Process Method**

In this process the shredded plastic is mixed with hot bitumen in spite of mixing with hot aggregate.

- Segregation/cleaning
- Shredding
- Heating of bitumen
- Blending of shredded plastic with hot bitumen
- Transfer of mixture to the road
- Laying of road

### **Segregation/Cleaning**

In this process waste plastic is separated from waste material and also cleaning is done if required.

### **Shredding**

In this plastic is cut in to pieces and passes through 4.35 mm IS sieve.

### **Heating of Bitumen**

It is heated up to 160° C.

### **Blending of Shredded Plastic with Hot Bitumen**

The shredded plastic mixed with hot bitumen and mixed properly by manually or mechanically after the preparation of mixture it is transferred to the site and laying of road is started.

### **PROCEDURE**

- Melt the bituminous material completely at a temp of 75 c to 100 c above approximately softening point until it become thoroughly fluid

- Sieve fluid through IS sieve 30
- After stirring fluid pour it in mould assembly & place it on a brass plate
- In order to prevent material under test from sticking to surface of the plate & interior surface of the sides of mould coat with mercury or by mixture of equal part of glycerin & dextrine.
- After about 30-40 min keep the plate assembly along with sample in a water bath maintain temp of water bath at 27 c for 80 to 90 min
- Remove sample & mould assembly from bath & trim specimen by leveling the surface using the hot knife
- Replace the mould assembly in water bath maintain temp of water bath at 27 c for 80 to 90 min
- Remove the sides of the mould
- Hook clip carefully on machine without causing any initial stain
- Start machine & pull two clips horizontally at a speed of 50mm/min
- Note distance of which bitumen thread of specimen break
- Record the observation in table & compute the Ductility value

## OBSERVATION TABLE

**Table 1: Observation Table for Various Percentage of Waste Plastic Added in Bitumen**

Sr. No	Percentage of Waste Plastic Added in Bitumen	Initial Reading x cm	Final Reading y cm	Ductility (y-x) cm	Average Ductility cm
1	Ductility of Bitumen without waste plastic i.e. (0% waste plastic)	0.00	104	104	103.5
		0.00	103	103	
		0.00	103.5	103.5	
2	Ductility of Bitumen with 3% waste plastic	0.00	42	42	42.5
		0.00	43	43	
		0.00	42.5	42.5	
3	Ductility of Bitumen with 5% waste plastic	0.00	37	37	36.73
		0.00	36.5	36.5	
		0.00	36.7	36.7	
4	Ductility of Bitumen with 7% waste plastic	0.00	26	26	26.5
		0.00	27	27	
		0.00	26.5	26.5	
5	Ductility of Bitumen with 9% waste plastic	0.00	14	14	14.57
		0.00	14.7	14.7	
		0.00	15	15	
6	Ductility of Bitumen with 11% waste plastic	0.00	3.7	3.7	3.63
		0.00	3.5	3.5	
		0.00	3.7	3.7	

## INTERPRETATION OF RESULTS

The suitability of bitumen is judged depending upon its type & proposed use. Bitumen with low ductility value may get cracked specially in cold weather specified value of minimum ductility for various grade of bitumen

**Table 2: Specified Value of Minimum Ductility for Various Grade of Bitumen**

Source of Paving Bitumen & Penetration Grade	Ductility Value in cm
<b>Petroleum</b>	
A25	05
A35	20
A45	12
A65,A90,A200	15
<b>Bitumen Source Other Than Petroleum</b>	
S35	50
S45, S65, S90	75

**Table 3: Comparison of Standard Ductility Value & Practical Ductility Value**

Sr. No	% of Waste Plastic Added in Bitumen	Standard Ductility Value in cm	Practical Ductility Value in cm
1	0	75	103.5
2	3	17	42.5
3	5	11	36.73
4	7	9.5	26.5
5	9	7	14.57
6	11	4	3.63

IS: 1208 -- 1978

Standard value for Ductility Test

## CONCLUSIONS

A number of test have been conducted to investigate the effect of waste plastic added in to bitumen. The conclusion of the study are given below:

Percentage of waste plastic added in bitumen, the ductility value of new bitumen is decreases so at certain stage it is less than specified value of minimum ductility for various grade of bitumen so that the test study is 11% of waste plastic added in bitumen it gives a 3.63 cm ductility value which is less than specified value of minimum ductility. If it is less than specified value then road surfaces may get cracked & due to this life of pavement will be reduced. From this test result we use 9 % of waste plastic in flexible road pavement.

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