UTILIZATION OF WASTE PLASTIC ON FLEXIBLE ROAD PAVEMENT

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Abstract: Plastic is everywhere in today's life. It is used for packaging, protecting, and serving of all kinds of things. With the industrialization, mass production of goods started and plastic seemed to be a cheaper, but it has problem in disposal of plastic to be problems like accumulation of waste plastic, and it leads to human health problems. The molten waste plastic gives good enhancing properties when mixed with bitumen and use in construction of flexible pavement as per by Ductility test IS -1208-1978. In binding property Use of plastic along with the bitumen in construction of roads increases its ductility and smoothness makes it economically sound and ecofriendly. The ductility test gives the standard value of ductility of the 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, Flexible Pavement, Interlocking of Aggregate

1. INTRODUCTION

In general, two types of pavement are mainly used i.e., rigid pavement and flexible pavement for rigid pavement roads, concrete is mainly used and for flexible pavement, bitumen is used. Due to seasonal variation in temperature improved road characteristics. Improvement in property of bitumen is needed. Different grades of bitumen as 30/40, 60/70, and 80/100 are based of their penetration value. Today availability of waste plastic is enormous, as plastic has become part and parcel of our daily life. They either get mixed with Municipal solid waste or spread over the area. If not recycled they degrade the environment. Bitumen is used as binder in flexible road pavement. The binding property of bitumen can be increased by addition of plastic. Studies on this subject are going on both national and international level.

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

ecofriendly. The plastic wastes could be used in road construction also 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 solves environmental problems. In the flexible pavement construction where bitumen is used as a binder, a thin films around the aggregate serves a satisfactory binder in improving the physical interlocking of the aggregates.

2. STUDY OF WASTE PLASTIC

2.1 Waste plastic as binder and modifier

As there is no evolution of harmful gases at 130-180^0 C therefore it is most suitable temperature. Moreover softened plastics have binding property; hence molten plastics can be used as binder with bitumen in asphalting of road.

2.2 Need for the study:

Disposal of waste plastic is major problem as it is non-biodegradable and even though the burning of these plastics causes evolution of harmful gases. It mainly consists of low-density polyethylene. In laboratory performance tests, it has been observed that waste plastic soften with bitumen to form homogeneous mixture.

2.3 low density polyethylene and its origin:

LDPE is found at a greater extent in our surrounding as it is obtained from bags, sacks and detergent bottles of pharmaceuticals, disinfectants, milk, fruit juices and bottle caps etc.

2.4 Materials used:

1. Aggregates: 12mm, 6mm, dust and cement as a filler.
2. Bitumen 60/70 grade of bitumen.
3. Waste plastic in shredded form.

2.5 Tests on materials

1) Bitumen
   a) Penetration test
   b) Ductility test
   c) softening point test
2) Aggregate
   a) Aggregate impact value
   b) specific gravity and water absorption
3) Plastic

Type of plastic- low density polyethylene (LDPE) its Chemical formation (-CH2-CH2-) its density is calculated as 0.9to0.95 its softening point is 100c to 120c.

With trial and error method percentage of bitumen mix has been decided.

Aggregate 1:- 37%
Aggregate 2:- 48%
Dust 13%

S. N.	Size sieve (mm)	Metal 1 37%	Metal 2 48%	Metal 3 -	Dust 13%	Filler 2%	Combined gradation	Norms
1	13.2	30	48	-	20	2	100%	**100%**
2	9.5	18.6	48	-	20	2	90.6%	**90-100%**
3	4.75	3.9	19.68	-	19.8	2	45.38%	**35-51%**
4	2.36	1.8	8.16	-	19	2	30.96%	**24-39%**
5	1.18	-	1.5	-	13.4	2	16.9%	**15-30%**
6	0.3	-	0.48	-	6.4	2	9.1%	**9-19%**
7	0.75	-	0.05	-	1.2	2	3.25%	**3-8%**

Table2.5.1 Combine gradation of Aggregates

Filler 02%

3. PROCEDURE

3.1 Properties of test specimen:

Initially 3 conventional moulds were prepared with conventional gradation. The bitumen was replaced with plastic by 5%, 7%, and 10% and the aggregate sample was heated at 130c – 180c and the moulds Were prepared three each with replacement
And average was taken.

Trail no.	Material	% by wt. of Total Mix	% by wt. of total aggregate.
1.	Bitumen Metal1 12mm Metal2 6mm Dust Filler	5.26%= 60gms 25%= 285gms 50%=570gms 23%=262.20gms 2%=22.80gms	5.00 23.75 47.50 21.85 1.90
2.	Bitumen + plastic Metal1 12mm Metal2 6mm Dust Filler	5%+3%=58.2+1.8= 60gms 25%= 285gms 50%= 570gms 23%= 262.20gms 2%= 22.80gms	4.85+0.15= 5.00 23.75 47.50 21.85 1.90
3.	Bitumen + plastic Metal1 12mm Metal2 6mm Dust Filler	5%+7%= 55.8+4.2 = 60gms 25%= 285gms 50%= 570gms 23%= 262.20gms 2%= 22.80gms	4.89+0.36= 5.00 23.75 47.50 21.85 1.90
4.	Bitumen + plastic Metal1 12mm Metal2 6mm Dust Filler	5%+10%= 54+6= 60gms 25%= 285gms 50%= 570gms 23%= 262.2.gms 2%= 22.80gms	4.73+0.52= 5.00 23.75 47.5 21.85 1.90

Table3.1.1 Preparation of moulds with various contents of Mix

3.2 Properties of compacted specimens:

The various properties tested are specific gravity; percentage voids, specific gravity, percentage air voids, percentage air voids filled with bitumen (VFB) and bulk density. The variations of these plastic with percentage of bitumen as shown in figure; the tests results for different specimens is given below.

4. TEST RESULTS AND ANALYSIS:

The Physical Properties Of Plastic Mine Bitumen Are Shown In Table below. Marshal stability The Properties like Density (2.45, 2.46, and 2.43.) & (1323, 1354, and 1339.)Are Improved With Partial replacement Of Plastic Sample By 5%, 7%, & 10% Of Bitumen. The Results Is Shown in table below.

Figure 4.1.1 showing Preparation of Mould

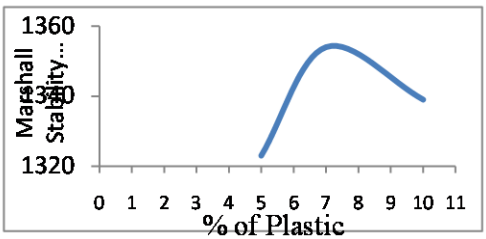
Trial No.	Mould No.	Ht. of Mould corre. factor	Wt of mould in air gms (WA)	Wt. of mould in water gms. (WB)	Vol.v = WA-WB	Bulk den. Of mix BDM= WA/V	Dial Gauge reading	M.S. Corrected With calibration.	M.S. Corrected With ht.	M.F. Dial reading	M.F.mm
	1	60/1.08	1144	676	468	2.44	750	1176	1270.08	8	2
A.	**2**	60/1.08	1170	697	473	2.47	850	1280	1382	8.5	2.12
	3	60/1.08	1158	687	473	2.45	650	1220	1317	9	2.25
		AVERAGE				**2.43**			**1323**		**2.12**
	1	60/1.08	1164	689	475	2.45	815	1190	1285	9.5	2.37
B.	**2**	60/1.08	1159	691	468	2.48	775	1271	1372	10	2.5
	3	60/1.08	1169	692	477	2.45	700	1300	1404	10.5	2.62
		AVERAGE				**2.46**			**1354**		**2.49**
	1	60/1.08	1163	684	479	2.42	815	1098	1185	11	2.75
C.	**2**	60/1.08	1160	686	474	2.44	800	1321	1426	11.5	2.875
	3	60/1.08	1168	690	478	2.44	815	1300	1404	12	3
		AVERAGE				**2.43**			**1339**		**2.875**

Table4.1 Bulk Density of Mix, Marshall Stability& Marshall Flow

5. RESULTS & DISCUSSION:

5.1 Marshall Stability Value:

The following graph shows that stability with the varying percentage of plastic in sample of bitumen .this shows that there is increase in stability with 5 to 7 % replacement of bitumen with plastic. Plastic percentage is on X-axis and Marshall Stability is on Y-axis.

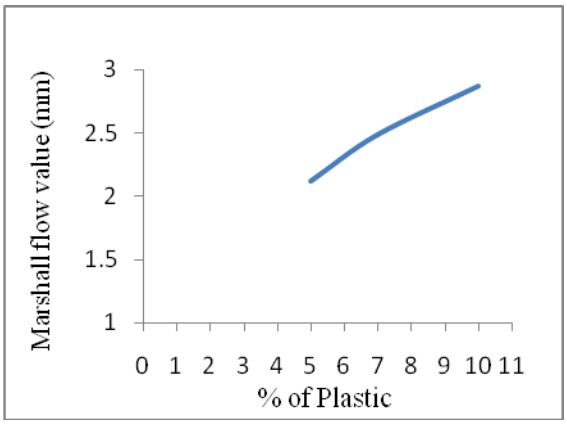


Graph 5.1 Graphs Showing the Stability with the Varying Percentage of Plastic

5.2 Marshall Flow Value:

The above graph showing the flow value with the varying percentage of plastic in sample of bitumen. This shows that there is increase in flow value with 5 to 7 %

replacement of bitumen with plastic. Plastic percentage is on X-axis and Marshall Flow value on Y-axis.



Graph 5.2 Graph showing the Flow Value with the Varying Percentage of Plastic

6. CONCLUSION:

The generation of waste plastics is increasing day by day. The major polymers namely polyethylene, polypropylene, polystyrene show adhesion property in their molten state. Plastics will increase the melting point of the bitumen. The waste plastic bitumen mix forms better material for pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for pavement is one of the best method for easy disposal of waste plastics.

With a view to improve the pavement characteristics of the flexible pavement using plastic coated aggregates, the following conclusions are made.

1. The properties of aggregates which mainly cause rutting action are improved using plastic coated aggregates.
2. Considerable increase in Marshall Stability value.
3. The optimum bitumen content is reduced.
4. Above all the waste plastic which is a pollution menace can find its use in road construction and thereby solving the problem of pollution to a certain extent.
4. Partial Replacement Of Bitumen With Plastic Umpired The Characteristics Of Pavement.
5. Marshall Satiability Has increased.
6. Bitumen Content Has Reduced And Economy Has Achieved.
7. Most Vitally, The Plastic Has Been Utilized In Construction Of Flexible Road Pavement.

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