Effect of Plastic Waste (Polypropylene) in Bitumen

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Abstract:- **Discarding of plastic waste is a global problem due to its non biodegradability. The plastic waste when mixed with bitumen improves desired mechanical properties in particular road mix. Bitumen is used as a binding material in construction of flexible pavement, So our team work is to utilize the waste plastic water packets utilized in the road construction to decrease the plastic content. So we are Partially replacing the Plastics(Polypropylene) in a bitumen by 5%, 5.25%, 5.5%, 5.75%, 6%,6.25% using various grades like VG(Viscosity Grade) and RS(Rapid Setting Emulsion) and we are investigated the effects of plastic waste in bitumen comparatively in the method of MARSHALL STABILITY. Our Ultimate aim is to determine and investigate the Stability and Flow Values.**

INTRODUCTION

In this chapter we shall know about the information about the project, the main aim is to determine the effects of plastic waste in bitumen. Rapid industrial and population increase has resulted in increasing the various types of waste materials. Considerable measure has been done for the disposal of these waste plastic. These plastics are considerably non biodegradable so that can be used as a modifier in bitumen and to enhance their strength. This utilization of waste plastic in hot bitumen and aggregate to change pavement performance, to protect environment and to provide low cost roads. These materials can be suitable in highway construction. The pollution and disposal problem reduced .keeping in mind the need for bulk use of these solid waste in India. It was thought expedient to test these material and develop specification to enhance the use in Road making In which higher economic return are possible. The necessary specification should be formulated and attempts are to be made to maximum use of waste plastic in upper layer of road pavement.

OBJECTIVES

- To investigate the marshal stability and flow value of the sample when bitumen is partially replaced by the polypropylene.
- To determine the properties of bitumen, softening point and penetration of an bitumen.
- To utilize the waste plastic as a useful way by adding water packet plastics in the bitumen.
- It reduce soil fertility, biodegradable condition because of using plastic.

FEATURE SCOPE

- Compute the Percentage of Plastic composition for bitumen content.
- Investigate the relationship between the plastics(Polypropylene) to the strength of bitumen component.
- Determine and conclude all the data of Marshall stability and flow value came out with result related to the objective.

SIGNIFICANTOFSTUDY

Bitumen is used as a binding material in construction of flexible pavement, So our team work is to utilize the waste plastic water packets utilized in the road construction to decrease the plastic content. So we are Partially replacing the Plastics(Polypropylene) in a bitumen. It reduce the disposal Problem in Plastic.

BITUMEN/ASHPALT &TAR RELATION

Bitumen also known as Ashpalt, but the Ashpalt it is produced in .Plants that heat, dries and mix aggregate, bitumen and sand or some fillers into a composite mix called Ashpalt. Bitumen widely used in road construction for a binder as a glue content mixed with aggregate for paving purpose in Highways and District Roads.Tar is also known as Liquor Carbonis Detergens(LCD)is a very thick,black and Sticky. a dark brown or black bituminous usually odorous viscous liquid obtained by destructive distillation of organic material (such as wood, coal, or peat).

1.2 DESCRIPTION OF MATERIALS

1.2.1 BITUMEN

Bitumen is Obtained from Crude oil Petroleum as a Last Stage End Product. Any of various flammable mixtures of hydrocarbons and other substances found in asphalt and tar. Bitumens occur naturally or are produced from petroleum and coal.

1.2.1.1 PROPERTIES OF BITUMEN

1) Bitumen has excellent adhesive qualities provided the conditions are favourable.
2) When one takes a thread of bitumen from a sample and stretches or elongates it, it has the ability to return to a length close to its original length .

3) when a load is applied to bitumen, the bitumen will flow, but will not return to its original position when load is removed.
4) Bitumen has a Viscoelastic character. Its behavior may be either viscous or elastic depending on the temperature or the load.
5) Exposure to ultraviolet (UV) rays and the evaporation of volatile compounds can cause bitumen to harden.

1.2.1.2 BITUMEN CONTENT
BINDER – 54%
MINERAL MATTER – 36%,
ORGANIC MATTER – 10%.

1.2.1.3 GRADES IN BITUMEN
VG-10 BITUMEN:
VG-10 is widely used in spraying applications such as surface-dressing and paving in very cold climate in lieu of old 80/100 Penetration grade. It is also used to manufacture Bitumen Emulsion and Modified Bitumen products.

EMULSION TYPES
RS-1 : Rapid Setting – 1
RS-2 : Rapid Setting – 2
MS : Medium Setting
SS-1 : Slow Setting – 1
SS-2 : Slow Setting – 2

VG-20 BITUMEN
VG-20 is used for paving in cold climate & high altituderegions and this is the general form of an normal using bitumen in road pavement construction.

VG-30 BITUMEN
VG-30 is primarily used to construct extra heavy duty Bitumen pavements that need to endure substantial traffic loads. It can be used in lie of 60/70 gradepenetration.

VG-40 BITUMEN
VG-40 is used in highly stressed areas such as intersections, Due to its higher viscosity, stiffer Bitumen mixes can be produced to improve resistance to shoving and other problems associated with higher temperature and heavy traffic loads.

1.2.1.4 MANUFACTURING PROCESS OF BITUMEN
Tar is Obtained from Coal.People can be exposed to coal tar pitch volatiles is hazardous to Health. Crude Oil is heated about 300˚c to 350˚c .further the crude oil subdivided into Gas,Propane,butane,Naphtha,Kerosene,Gas oil
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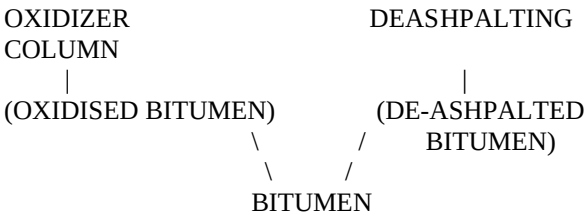
Then the Second Process are Atmospheric Residue is heated about 350˚c to 425˚c then from the Vacuum Gas oil is further divided into oxidizer and deasphalting Column(Propane/butane Solvent) by 1st distillation,2nd distillation and 3rd distillation



OXIDISED BITUMEN& DE-ASHPALTED BITUMEN

Oxidized Bitumen are Produced from passing the air through the residue.This Process gives the bitumen more rubber properties than its original content. De-Ashpalted bitumen are Separates the Ashpalt from the Bitumen or Crude Oil.this is the form of deashpalted bitumen

1.2.2 QUARRY DUST
Quarry dust is obtained from Crushing units of rocks, It is the waste residue materials used for the purpose of filler of our Bituminous sample. filler consists of, very fine, inert mineral matter that is added to the hot mix asphalt, to increase the density and enhance strength of the mixture.

1.2.3 PLASTIC CONCERN IN A ROAD PAVEMENT
Bottle caps and closures, detergents covers, biscuit covers,water pouches and microwave trays are the plastics consists of polypropylene chemical content, usage of more carrying materials through the plastic bags contains more hazardous to the world as well as environmental degradation and also soil fertility. Partial replace of plastics gives more stability,water resistant,Apart from that due to rapid increase in wheel loads and change in climatic conditions. Plastic modification can be considered as one of the pavement to improve the road pavement construction. Higher resistance to deformation.Higher resistance to water induced damages. Increased durability and improved fatigue life.Improved stability and strength. Disposal of waste plastic and thereby environment

MATERIALS AND METHODS

3.1 INTRODUCTION
The threat of disposal of plastic will not solve until the practical steps are not initiated at the ground level. It is possible to improve the Performance of bituminous mixed and used in the surfacing course that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems. Plastic is a very versatile material. Due to the industrial revolution ,and its large scale production plastic seemed to be a cheaper and effective raw material.

3.2 Basic materials
The materials used are as follows.
i. Coarse Aggreagates
ii. Bituminous Binder
iii. Mineral Filler
iv. Polypropylene

3.2.1 Coarse Aggregate (CA)

Coarse aggregate should be screened crushed rock, angular in shape, free from dustparticles, clay, vegetations and organic matters.Coarse aggregates are of sizwe 6mm,12.5mm,20mm and fillers are main use in binding process of the bituminous mixes while mixing the plastics it should be the most compacting material in the mixes.Coarse aggregates are of size 6mm,12.5mm,20mm and fillers are main use in binding process of the bituminous mixes while mixing the plastics it should be the most compacting material in the mixes.

3.2.2 Bitumen

Asphalt binder RS-1 and VG grade are used in this research. The bitumen are of various percentage for RS-1 from 5%,5.25%,5.5%,5.75%,6%,6.25% and VG grade of 4.5%,5%,5.5%,6%,6.5%

3.2.3 Mineral Filler

Mineral filler consists of, very fine, inert mineral matter that is added to the hot mix asphalt, to increase the density and enhance strength of the mixture. These fillers should pass through 75µm IS Sieve and it may be cement or fly ash.

3.2.4 Polypropylene

Due to the waste of more and more plastic waste. The one of the main commercial waste is water packet pouches it consists of more wastage problems, it should be cleaned and dried after shredding process to be taken, then for the more bituminous mixing properties are available in plastics.so it should be used for the binding content for the bitumen.

Water Packets are the more commercial waste the various sources from theatres, drinking shops and bus stands,Railway stations more dangerous to the environment, So Polypropylene(PP) is to utilize by the bitumen.

3.3 DESIGN OF MIX:-

According to IRC-SP-98-2013

Requirements for Waste Plastic Modified Dense Graded Bituminous

Pavement Layers

Minimum stability (kN at 60°C) – 12kN

Minimum flow -2mm

Maximum flow -4mm

RS-1 GRADE TABLE 1: RS-1 GRADE BY PP CONTENTOF 0%

BITUMEN (%)	BITUMEN (gms)	AGGREGATES(mm)				Total
		20	12.5	6	Fillers	100 % (gms)
		12% (gms)	23% (gms)	35% (gms)	30% (gms)	
5%	60	136.8	262.2	399	342	1200
5.25%	63	136.4	261.5	398	341.1	1200
5.5%	66	136.1	260.8	396.9	340.2	1200
5.75%	69	135.7	260.1	395.9	339.3	1200
6%	72	135.4	269.4	394.8	338.4	1200
6.25%	75	135.0	258.8	393.8	337.5	1200

TABLE 2: RS-1 GRADE BY PP CONTENT OF 5%

BITUMEN (%)	BITUMEN (gms)	PP 5% REPLACEMENT (gms)	AGGREGATES(mm)				Total
			20	12.5	6	Fillers	100 % (gms)
			12% (gms)	23% (gms)	35% (gms)	30% (gms)	
5%	57	3	136.8	262.2	399	342	1200
5.25 %	59.85	3.15	136.4	261.5	398	341.1	1200
5.5 %	62.7	3.3	136.1	260.8	396.9	340.2	1200
5.75 %	65.55	3.45	135.7	260.1	395.9	339.3	1200
6%	68.4	3.6	135.4	269.4	394.8	338.4	1200
6.25 %	71.25	3.75	135.0	258.8	393.8	337.5	1200

TABLE 3: RS-1 GRADE BY PP CONTENTOF 15%

BITUMEN (%)	BITUMEN (gms)	PP 10% REPLACEMENT (gms)	AGGREGATES(mm)				Total 100% (gms)
			20	12.5	6	Fillers	
			12% (gms)	23% (gms)	35% (gms)	30% (gms)	
5%	54	6	136.8	262.2	399	342	1200
5.25%	56.7	6.3	136.4	261.5	398	341.1	1200
5.5%	59.4	6.6	136.1	260.8	396.9	340.2	1200
5.75%	62.1	6.9	135.7	260.1	395.9	339.3	1200
6%	64.8	7.2	135.4	269.4	394.8	338.4	1200
6.25%	67.5	7.5	135.0	258.8	393.8	337.5	1200

VG GRADE

TABLE 4: VG GRADE BY PP CONTENTOF 0%

BITUMEN (%)	BITUMEN (gms)	PP 15% REPLACEMENT (gms)	AGGREGATES(mm)				Total 100% (gms)
			20	12.5	6	Fillers	
			12% (gms)	23% (gms)	35% (gms)	30% (gms)	
5%	51	9	136.8	262.2	399	342	1200
5.25%	53.55	9.45	136.4	261.5	398	341.1	1200
5.5%	56.1	9.9	136.1	260.8	396.9	340.2	1200
5.75%	58.65	10.35	135.7	260.1	395.9	339.3	1200
6%	61.2	10.8	135.4	269.4	394.8	338.4	1200
6.25%	63.75	11.25	135.0	258.8	393.8	337.5	1200

TABLE 5: VG GRADE BY PP CONTENTOF 0%

BITUMEN (%)	BITUMEN (gms)	AGGREGATES(mm)				Total 100% (gms)
		20	12.5	6	Fillers	
		12% (gms)	23% (gms)	35% (gms)	30% (gms)	
4%	48	136.8	262.2	399	342	1200
4.5%	54	136.4	261.5	398	341.1	1200
5%	60	136.1	260.8	396.9	340.2	1200
5.5%	66	135.7	260.1	395.9	339.3	1200
6%	72	135.4	269.4	394.8	338.4	1200
6.5%	78	135.0	258.8	393.8	337.5	1200

TABLE 6: VG GRADE BY PP CONTENTOF 5%

BITUMEN (%)	BITUMEN (gms)	PP 5% REPLACEMENT (gms)	AGGREGATES(mm)				Total 100% (gms)
			20	12.5	6	Fillers	
			12% (gms)	23% (gms)	35% (gms)	30% (gms)	
4%	45.6	2.4	136.8	262.2	399	342	1200
4.5%	51.3	2.7	136.4	261.5	398	341.1	1200
5%	57	3	136.1	260.8	396.9	340.2	1200
5.5%	62.7	3.3	135.7	260.1	395.9	339.3	1200
6%	68.4	3.6	135.4	269.4	394.8	338.4	1200
6.5%	74.1	3.9	135.0	258.8	393.8	337.5	1200

TABLE 7: VG GRADE BY PP CONTENTOF 10%

BITUMEN %	BITUMEN (gms)	PP 15% REPLACEMENT (gms)	AGGREGATES			Total	
			20	12.5	6	Fillers	100 % (gms)
			12% (gms)	23% (gms)	35 % (gms)	30 % (gms)	

TABLE 8: VG GRADE BY PP CONTENTOF 15%

4%	40.8	7.2	136.8	262.2	399	342	1200
4.5%	45.9	8.1	136.4	261.5	398	341.1	1200
5%	51	9	136.1	260.8	396.9	340.2	1200
5.5%	56.1	9.9	135.7	260.1	395.9	339.3	1200
6%	61.2	10.8	135.4	269.4	394.8	338.4	1200
6.5%	66.3	11.7	135.0	258.8	393.8	337.5	1200

3.4 Initial Testss

The initial test for the bitumen and tar should have proper Standards on methods of tests was first published in 1958. However, during the course of this period a number of improvements have since been made in carrying out of these methods of tests.

TABLE 9: CODE BOOK FOR INITIAL TESTS

SL.NO	TEST	GRADE	IS CODE
1	SOFTENING POINT	RS-1	IS 887-2004
		VG	IS:1205-1978
2	PENETRATION	RS-1	IS 887-2004
		VG	IS:1203-1978
3	SPECIFIC GRAVITY	RS-1	IS 887-2004
		VG	IS:1202-1978

3.4.1 SOFTENING POINT TEST

Softening Point - The temperature at which the substance attains a particular degree of softening under specified condition of test.

Bitumen (%)	Bitumen (gms)	PP 15% Replacement (gms)	Aggregates				Total
			20	12.5	6	filters	
			12%(gms)	23%(gms)	35%(gms)	30%(gms)	100 %(gms)
4	40.8	7.2	136.8	262.2	399	342	1200
4.5	45.9	8.1	136.4	261.5	398	341.1	1200
5	51	9	136.1	260.8	396.9	340.2	1200
5.5	56.1	9.9	135.7	260.1	395.9	339.3	1200
6	61.2	10.8	135.4	269.4	394.8	338.4	1200
6.5	66.3	11.7	135.0	258.8	393.8	337.5	1200

PROCEDURE

Preparation of Test Sample - Heat the material to a temperature between 75°C and 100°C above its softening point. Stir until it is completely fluid and free from air bubbles and water, and filter. Place the rings, previously heated to a temperature approximating to that of the molten material, on a metal plate which has been coated with a mixture of equal parts of glycerine and dextrine, and fill with sufficient melt to give an excess above the level of the ring when cooled. Aftercooling for 30 minutes in air, level the material in the ring by removingthe excess with a warmed, sharp knife.

TABLE 10: SOFTENING POINT TEST FOR BITUMEN

SL.NO	GRADE	SOFTENING POINT(˚C)		
		TRIAL-1	TRIAL-2	TRIAL-3
1	RS-1	45 ˚C	45 ˚C	46 ˚C
2	VG	51 ˚C	52 ˚C	51 ˚C

3.4.2 PENETRATION TEST

Penetration - The penetration of a bituminous material is the distance in tenths of a millimetre that a standard needle will penetrate vertically into a sample of the material under standard conditions of temperature, load and time.

PROCEDURE

Preparation of Test Sample

Soften the material to a pouring consistency at a temperature not more than 60°C for tars and pitches and not more than 90°C for bitumens above the respective approximate softening point and stir it thoroughly until it is homogeneous and is free from air bubbles and water. Pour the melt into the container to a depth at least 10 mm in excess of the expected penetration. Protect the sample from dust and allow it to cool in an atmosphere at a temperature between 15 to 30°C for1

l/2 to 2 h for 45 mm deep container and 1 to1 l/2 h when the container of 35 mm depth is used. Then place it along with the transfer dish in the water bath at 25.0 ± 0.1°C and allow it to remain for 11/2 to2 hand 1 to 11/2 h for 45 mm and 35 mm deep container respectively.

TABLE 11: PENETRATION TEST FOR BITUMEN

SL.NO	GRADE	INITIAL	FINAL	PENETRATION VALUE
1	RS-1	80	161	81
	VG	121	166	45
2	RS-1	142	228	86
	VG	202	247	45
3	RS-1	231	313	82
	VG	302	349	47

3.4.3 SPECIFIC GRAVITY

Specific Gravity - The ratio of the mass of a given volume of the substance to the mass of an equal volume of water, the temperature of both being specified.

PROCEDURE PYCNOMETER METHOD

Clean, dry and weigh the specific gravity bottle together with the stopper . Fill it with freshly boiled and cooled distilled water and insert the stopper firmly.

A)Keep the bottle up to its neck for not less than half an hour in a beaker of wipe all surplus moisture from the surfacewith a clean, dry cloth and weigh again B)After weighing the bottleand water together the bottle shall be dried again. Fill the specific gravity bottle containing the asphalt with freshly boiled distilled water placing the stopper loosely in the specific gravity bottle. Do not allow any air bubble to remain in the specific gravity bottle. Place the specific gravity bottle in the water bath and press the stopper firmly in place. Allow the specific gravity bottle to remain in the water bath for a period of not less than 30 minutes. Remove the specific gravity bottle from the water bath, wipe all surplus moisture from the surface with a clean dry cloth and weigh it along with the stopper. In the case of liquids such as creosote and anthracene oil, fill the bottle up to the brim and insert the stopper firmly. Keep the filled bottle for not less than halfan hour in a beaker of distilled water maintained at a temperature of 27.0 ± 0.1°C, remove the bottle from the beaker, wipe all surplus water from the surface with a clean, dry cloth and weigh again

Specific gravity (solids and Semisolids)=(c-a)÷(b-a)-(d-c) where a = mass of the specific gravity bottle, b = mass ofthe specific gravity bottle filled with distilled water c =mass of the specific gravity bottle about half filled with the material, d = mass of the specific gravity bottle about half filled with the material and the rest with distilled water, and e = mass of the specific gravity bottle completely filled with the material
Specific gravity of bitumen(RS-1)=0.99
Specific gravity of bitumen(VG)=0.99

3.5 GRADATION OF AGGREGATES

Grading of aggregates consists of Bituminous Concrete(BC) and Dense Bituminous Macadam(DBM)according to MORT(Ministry of Road
Transport)

TABLE 12: DENSE BITUMINOUS MACADAM

Grading	1	2
Nominal a size	37.5mm	26.5mm
Layer thickness	75-100mm	30-75mm
IS Sieve(mm)	Cumulative % by weight of total aggregate	Cumulative % by weight of total aggregate
45	100	-
37.5	95-100	100
26.5	68-93	90-100
19	-	71-95
13.2	35-75	36-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8

Sieving of aggregates as per gradation of 20mm size, 12.5mm and 6mm aggragates are retained and sieved the correct size of bituminous mix aggregates are taken to the sample Preparation.

3.7 MARSHALL STABITY TESTING
3.7.1 TEST PROCEDURE

Procedure to determine Marshall stability of bituminous mixture

i)Heat the weighed aggregates and the bitumen separately upto 170°C respectively. Mix them thoroughly. ii),transfer the mixed material to the compaction mould arranged on the compaction pedestal.

iii)Give 75 blows on the top side of the specimen mix with a standard hammer (45cm, 4.86kg). Reverse the specimen and give 75 blows again. Take the mould with the specimen and cool it for a few minutes.

The standard mould size for the Marshall Stability is 100mm by 63.5mm depth of total height it consists of one collar and holding the mould one screws are there for placing and removal of an mould.

Pouring the aggregates and bituminous mixes of sample should be poured at the mould after mould normal compact should done before the compaction process.

75 Blows Should done both top and bottom side from the drop in height.

iv) Remove the specimen from the mould by pushing. Mark the specimen and cure it at room temperature, overnight.

v) A series of specimens are prepared by a similar method with varying quantities of bitumen content, with an increment of 0.5% (3 specimens) or 1 bitumen content.

vi) Before testing of the mould, keep the mould in the water bath having a temperature of 60ºC for half an hour.

vii) Check the stability of the mould and flow value on the Marshall stability apparatus.

3.7.2 WATER BATH PROCEDURE

When over of specimen tamping process leave for 4 hours after attain a normal temperature, place the specimen in a weight and note down the grams of specimens, after the specimen should be heated about 60˚c and take a weight.

TABLE 13: RS-1 GRADE BITUMEN BY PP CONTENTOF 0%

SL. NO	PERC ENTA GE	TRIAL-1		TRIAL-2		TRIAL-3	
	(%)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)
1	5	1192	1212	1194	1212	1192	1218
2	5.25	1195	1216	1197	1221	1197	1226
3	5.5	1200	1226	1195	1229	1192	1233
4	5.75	1194	1214	1192	1216	1193	1218
5	6	1198	1224	1199	1228	1197	1230
6	6.25	1295	1220	1196	1225	1200	1228

TABLE 14: RS-1 GRADE BITUMEN BY PP CONTENT OF 5%

SL. NO	PERCENTAGE (%)	TRIAL-1		TRIAL-2		TRIAL-3	
		SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)
1	5	1197	1215	1198	1217	1193	1221
2	5.25	1194	1219	1197	1225	1194	1228
3	5.5	1200	1223	1193	1229	1196	1231
4	5.75	1197	1217	1197	1224	1195	1229
5	6	1195	1226	1200	1228	1195	1234
6	6.25	1200	1219	1196	1225	1200	1226

TABLE 15: RS-1 GRADE BITUMEN BY PP CONTENT OF 10%

SL. NO	PERCENTAGE (%)	TRIAL-1		TRIAL-2		TRIAL-3	
		SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)
1	5	1193	1219	1195	1216	1193	1227
2	5.25	1194	1215	1194	1220	1197	1220
3	5.5	1194	1224	1190	1227	1190	1215
4	5.75	1197	1213	1198	1229	1200	1220
5	6	1192	1220	1197	1224	1195	1218
6	6.25	1189	1221	1193	1227	1198	1223

TABLE 16: RS-1 GRADE BITUMEN BY PP CONTENT OF 15%

SL.NO	PERCENTAGE (%)	TRIAL-1		TRIAL-2		TRIAL-3	
		SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)
1	5	1190	1213	1197	1215	1193	1223
2	5.25	1192	1215	1195	1223	1199	1227
3	5.5	1194	1222	1199	1229	1192	1216
4	5.75	1196	1218	1198	1222	1195	1227
5	6	1199	1224	1192	1227	1198	1212
6	6.25	1196	1223	1197	1218	1200	1228

TABLE 17: VG GRADE BITUME BY PP CONTENT OF 0%

SL.NO	PERCENTAGE	TRIAL-1		TRIAL-2		TRIAL-3	
	(%)	SAMPLE (w.t)	W.B 60° C (w.t)	SAMPLE (w.t)	W.B 60° C (w.t)	SAMPL E (w.t)	W.B 60° C (w.t)
1	4	1197	1202	1194	1201	1191	1209
2	4.5	1196	1206	1193	1209	1197	1201
3	5	1193	1208	1194	1203	1192	1205
4	5.5	1199	1208	1195	1204	1190	1207
5	6	1195	1203	1197	1208	1200	1209
6	6.5	1197	1201	1200	1206	1191	1208

TABLE 18: VG GRADE BITUME BY PP CONTENT OF 5%

SL.NO	PERCENTAGE	TRIAL-1		TRIAL-2		TRIAL-3	
	(%)	SAMPLE (w.t)	W.B 60° C (w.t)	SAMPLE (w.t)	W.B 60° C (w.t)	SAMPL E (w.t)	W.B 60° C (w.t)
1	4	1193	1210	1191	1202	1191	1206
2	4.5	1198	1209	1199	1204	1198	1209
3	5	1191	1203	1194	1201	1193	1207
4	5.5	1197	1205	1198	1206	1197	1203
5	6	1200	1205	1197	1204	1195	1201
6	6.5	1194	1200	1198	1208	1198	1202

TABLE 19: VG GRADE BITUME BY PP CONTENT OF 10%

SL. NO	PERCENTAGE	TRIAL-1		TRIAL-2		TRIAL-3	
	(%)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPLE (w.t)	W.B 60°C (w.t)	SAMPL E (w.t)	W.B 60°C (w.t)
1	4	1195	1206	1192	1202	1200	1205
2	4.5	1195	1209	1197	1204	1197	1205
3	5	1200	1204	1193	1204	1193	1203
4	5.5	1197	1202	1196	1209	1191	1207
5	6	1200	1212	1195	1201	1200	1202
6	6.5	1195	1207	1198	1209	1198	1208

TABLE 20: VG GRADE BITUME BY PP CONTENT OF15%

SL. NO	PERCENTAGE	TRIAL-1		TRIAL-2		TRIAL-3	
	(%)	SAMPLE (w.t)	W. B 60° C (w.t)	SAMPL E (w.t)	W. B 60° C (w.t)	SAMP LE (w.t)	W. B 60° C (w.t)
1	4	1192	1207	1192	1201	1193	1202
2	4.5	1198	1206	1199	1202	1198	1207
3	5	1195	1208	1193	1207	1197	1203
4	5.5	1194	1205	1200	1206	1195	1209
5	6	1200	1203	1194	1208	1195	1204
6	6.5	1193	1201	1193	1202	1193	1201

CHAPTER 4
RESULT AND DISCUSSION

As the result of effects of plastic waste(Polypropylene) in Bitumen is done by the Marshall Stability Apparatus at NIT,Trichy and Some Specimens are of casted at Periyar Maniammai University,Thanjavur are being tested and attains the maximum load.

4.1 Marshall Stability Value

It is defined as the maximum load at which the specimen fails under the application of the vertical load. It is the maximum load supported by the test specimen at a loading rate of 50.8 mm/minute (2 inches/minute). Generally, the load was increased until it reached the maximum & then when the load just began to reduce, the loading was stopped and the maximum load was recorded by the proving ring.

4.2 Marshall Flow Value

It is defined as the deformation undergone by the specimen at the maximum load where the failure occurs. During the loading, an attached dial gauge measures the specimen's plastic flow as a result of the loading. The flow value was recorded in 0.25 mm (0.01 inch) increments at the same time when the maximum load was recorded.

TABLE 21-RESULT OF RS-1 GRADE

SL.NO	BITUMEN %	PP %	TRIAL-1		TRIAL-2		TRIAL-3	
			STABILITY VALUE (kN)	FLOW VALUE (mm)	STABILITY VALUE (kN)	FLOW VALUE(mm)	STABILITY VALUE(kN)	FLOW VALUE (mm)
1	4	0	61	3.1	63	3.3	63	3.2
		5	63	3.1	65	3.3	66	3.1
		10	65	3.2	69	3.2	69	3.1
		15	68	3.1	70	3.2	71	3.2
2	4.5	0	72	3.2	76	3.1	78	3.3
		5	75	3.0	78	3.1	82	3.2
		10	76	3.1	77	3.1	80	3.9
		15	78	3.6	81	3.4	79	3.8
3	5	0	75	3.1	79	3.3	81	3.3
		5	77	3.3	81	3.6	80	3.6
		10	78	3.3	82	3.6	79	3.6
		15	81	3.2	83	3.5	87	3.3
4	5.5	0	82	2.9	87	2.9	87	3.1
		5	91	3.2	94	3.0	96	3.3
		10	102	3.5	101	2.6	100	2.8
		15	95	3.0	97	3.1	99	3.2
5	6	0	84	2.8	90	2.7	93	2.9
		5	85	2.9	87	2.9	90	3.9
		10	86	3.3	87	3.0	89	3.3
		15	89	3.2	90	3.1	93	3.1
6	6.5	0	92	2.8	96	2.9	94	2.6
		5	94	2.7	93	3.2	95	3.1
		10	96	2.9	95	3.2	97	3.2
		15	100	3.0	98	3.5	98	3.2

TABLE 22- RESULT OF VG GRADE

SL.NO	BITUMEN%	PP %	TRIAL-1		TRIAL-2		TRIAL-3	
			STABILITY VALUE (kN)	FLOW VALUE (mm)	STABILITY VALUE (kN)	FLOW VALUE (mm)	STABILITY VALUE (kN)	FLOW VALUE (mm)
1	5	0	30	3.4	32	3.3	34	3.3
		5	32	3.9	33	3.2	34	3.5
		10	35	3.7	37	3.6	36	3.6
		15	39	3.6	41	3.3	41	3.3
2	5.25	0	58	3.4	61	3.1	62	3.3
		5	61	3.3	63	3.1	61	3.5
		10	62	3.5	63	3.6	62	3.4
		15	65	3.2	66	3.4	66	3.1
3	5.5	0	68	3.3	72	3.1	74	3.1
		5	71	3.3	71	3.7	72	3.6
		10	73	3.3	74	3.5	74	3.6
		15	75	3.4	74	3.5	76	3.5
4	5.75	0	79	3.4	79	3.3	81	3.4
		5	81	3.2	82	3.6	81	3.5
		10	92	3.2	91	3.2	93	3.6
		15	95	3.6	96	3.5	95	3.4
5	6	0	82	3.2	83	3.2	86	3.2
		5	85	3.3	86	3.1	86	3.0
		10	87	2.9	88	2.8	88	2.9
		15	92	2.8	92	3.0	92	2.9
6	6.25	0	84	3.1	85	3.2	89	3.2
		5	86	3.1	87	3.1	84	3.3
		10	89	3.2	89	3.1	87	3.2
		15	91	3.1	90	3.2	91	3.2

CHAPTER 5 CONCLUSION

- The result shows that with increase of waste plastic in bitumen increases the properties of aggregate and bitumen.
- Using of waste plastic in flexible pavements shows good result when compared with conventional flexible pavements.
- The optimum use of plastic can be 5.75% for RS-1 grade and 5.5% of VG grade bitumen based on Marshal Stability test.
- This has added more value in minimizing the disposal of plastic waste is the eco-friendly technique
- Utilization of waste polypropylene in bituminous concrete mixtures shows improved property of the mixtures thus formed.
- The waste polypropylene plastics utilized in the mix will get coated over Aggregate of the mixture and reduces porosity, absorption of moisture and improves binding property.
- The bitumen modified with 15% Polypropylene for RS-1 grade and 10% Polypropylene for VG grade Waste is showing better Performance as compared to other mixes.
- The Marshall Stability which is a strength parameter has shown increasing trend based on the graph.

- From the study of the behaviour of Polypropylene modified DBM it was found that the modified mix possesses improved Marshall
  - Characteristics
- It is observed that Marshall stability value increases with Polypropylene content upto 5.6% gradually and thereafter decreases.
- we observe that the marshall flow value decreases upon addition of polypropylene i.e the resistance to deformations under heavy wheel loads increases.
- Softening Point of bitumen lies optimum value of 45˚c for RS-1 grade and 51˚c for VG grade.
- Penetration of bitumen forms on 83˚c for RS-1 grade and 45˚c for VG grade.
- Marshall Stability Value of Maximum attains Strength are 96 Kn for RS-1 AND 102 FOR VG grade.