Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

COMPARATIVE ANALYSIS OF CONVENTIONAL AND LDPE COATED CHIPSEAL INTERLAYERED BITUMINOUS BRIQUETTES

Mahalakshmi M[1], Muthu Ganesh K[2], Prakash P[3], Praveen A[4], KerenKana J[5]

[1]*Department of Civil Engineering,Visvesvaraya Technological University, Karnataka, India*
[2,3,4,5]*Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India*

Abstract— *In this paper, a comparison of Marshall Valuesbetween conventional briquette and Low Density Poly Ethylene (LDPE) coated chip seal interlayered briquettes were done. The interlayers are formed in various thicknesses like 14, 16 and 18 mm in the overall depth of 64mm briquettes. The tests are conducted in Marshall Stability apparatus. It is found from this study that the interlayered briquettes perform more than the conventional briquette. While using LDPE coated chip seal as interlayer we achieve less bitumen consumption and durability has been increased. Thepenetration of water into sublayers is also being arrested due to the usage of polymer.*

Keywords - *Chip seal; LDPE; Marshall Stability; Flow; Interlayer; Bitumen*

I.INTRODUCTION

Bitumen is used in road construction, mainly because of its excellent binding property and relatively low cost. Physical properties and temperature susceptibility characteristics of the bitumen influence pavement stiffness at both high and low field operating conditions and therefore affect the final performance of the mixture.

Researchers used High density poly ethylene for coating aggregates and found that there is a sound improvement in the abrasion resistance and impact resistance properties thus improving strength of aggregates Also modification using polymers always have been given better durability compared to the conventional bitumen.

Adding polymers like LDPE increases the properties of bitumen. Similarly, LDPE is added in the form of waste plastic covers which act as eco-friendly initiative movement.

II. OBJECTIVES

- To prepare conventional bituminous briquette and LDPE coated chip seal interlayered bituminous briquette
- To analyse the stability and flow value of conventional bituminous briquette and chip seal interlayered briquette, using Marshall Stability test and compare it.

III. MATERIALS

1. Bitumen 60/70 grade
2. Coarse aggregate (6 mm, 13.2 mm, 19 mm)
3. Fine aggregate (2.36mm, 1.18mm, 600µ)
4. Dust (300µ, 150µ,75µ)
5. Low Density Poly Ethylene (Waste plastic covers)

Figure 1. Bitumen Figure 2. Coarse AggregateFigure 3. Chip seal

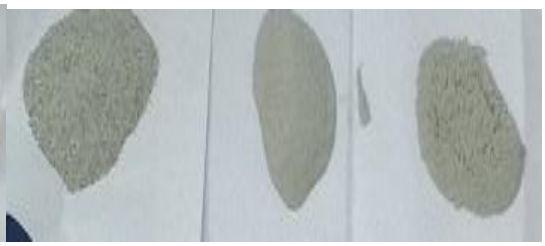


Figure 4. Fine Aggregate ***Figure 5.Dust***

Figure. 6 Shredded LDPE

IV. BASIC TESTS ON BITUMEN

A. Specific gravity

It is defined as the ratio of weight of bituminous material to the weight of equal volume of water at 27˚C.

SPECIFIC GRAVITY = (c-a) / [(b-a)-(d-c)]

Where, a- Empty weight of specific gravity bottle
b-Weight of bottle + water
c- Weight of bottle +1/3rd filled bitumen
d-Weight of bottle + 1/3rdfilled bitumen + water

B. Penetration test

The penetration value of bitumen is determined by the penetration of a standard needle vertically under conditions of standard load (100 gm), standard time of 5 seconds and standard temperature of 25˚C.

C. Softening point test

It is the temperature at which the substance maintains a particular degree of softening under the weight of a 3.5 gm steel ball.

D. Viscosity test

Viscosity denotes the fluid property of bituminous material and it is a measure of resistance to flow

E.Ductility test

Ductility is the property of bitumen that permits it to undergo elongation.

F. Flash and Fire point test

The flash point of bitumen is the lowest temperature at which the vapour of bitumen suddenly takes fire in the form of flash and the fire point is the lowest temperature at which the bitumen gets ignited and burns.

Table 1. Basictest results for Bitumen

S.No	Name of test conducted	Obtained values	Standard values	
1	Specific gravity	0.98	0.97 to1.02(IS:1202-1978)	
2	Penetration	65mm	60mm to 70mm (IS:73-1992)	
3	Softening Point	53.3˚C	45˚C to 55˚C(IS:73-1992)	
4	Viscosity	63 sec	Min50sec(IS:1206-1978)	
5	Ductility	88 cm	Min 78cm(IS 1208 -1978)	
6	Flash Point	187 ˚C	Min 175 ˚C	(IS:1209-1978)
	Fire Point	226 ˚C	Min 202 ˚C	

V. TESTS ON AGGREGATES AND CHIPSEAL

A. Specific gravity test
It is defined as the ratio of a unit weight of aggregate, to the unit weight of water.

B. Impact test
The impact value is defined as a measure of resistance to sudden impact.

C.Crushing test
The crushing value of aggregates is a relative measure ofresistance to crushing under a gradually applied load

D. Water absorption test
The water absorption value of aggregate is the percentage of moisture content absorbed by the aggregate when soaked for 24 hours.

Table 2. Test results of chips andaggregates

S.No.	Name of test conducted	Chips	Aggregate	Standard values (is2386-1963)
1.	Specific Gravity	2.72	2.79	2.40-2.88 PART III
2	Impact value	35.3%	27.6%	Max 40% PART V
3	Crushing value	36.3%	26.3%	Max 40% PART IV
4	Water Absorption	0.52%	0.31%	Max 2% Part III

VI. PREPARATION OF BRIQUETTES

A. Waste Plastic Shredding
Shredding of plastic is the process of cutting the plastic into small sizes between 2.36 mm to 4.75 mm. The waste plastic bags were collected from kitchen waste. Once the required quantity of Low Density Polyethylene bags were collected, all

those bags were cleaned, washed and dried. The cleaned, washed and dried LDPE bags were shredded. The shredded LDPE were then sieved and collected.

B. Preparation of Conventional Briquettes

Total weight of aggregates taken is 1200gm (coarse aggregates, fine aggregates and dust). It is heated to a temperature of 175°c to 190°c. The percentage of bitumen taken for Marshall Stability briquettes preparation is 5.5% by weight of aggregates. Bitumen is heated to a temperature of 121°c to 125°c. Those heated aggregates are thoroughly mixed with bitumen at a temperature of 154°c to 160°c. The mix is placed in a preheated mould and compacted by a rammer with 50 blows on either side at a temperature of 138°c to 149°c with a free fall of 45cm. The weight of mixed aggregates taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/-3 mm. and finally the mould is kept undisturbed for 24 hours.

The four types of samples are given below

- Conventional bituminous briquette
- 14mm thick interlayer bituminous briquette
- 16mm thick interlayer bituminous briquette
- 18mm thick interlayer bituminous briquette

Table 3. Thickness of Layers

S. No.	Bottom Layer thickness in mm	Interlayer thickness in mm	Top Layer thickness in mm
1	25	14	25
2	24	16	24
3	23	18	23

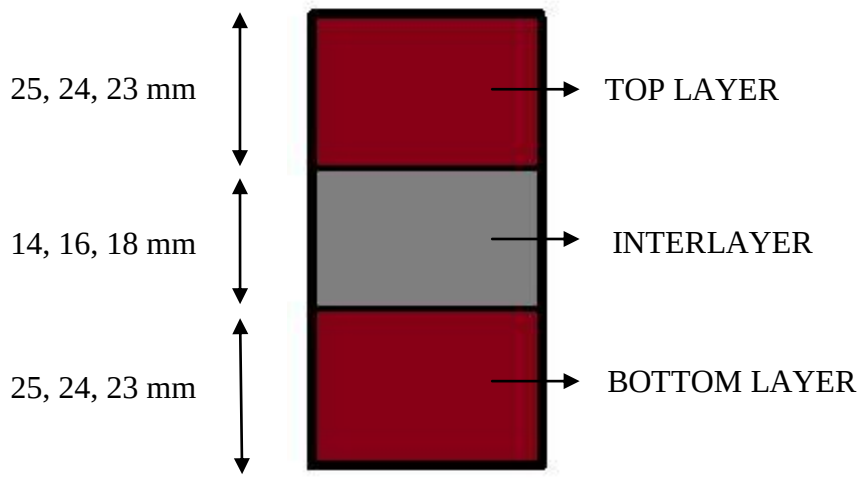


Figure 7. Model Briquettes' layer thicknesses

C. Preparation of Interlayered Briquettes

The inter layer aggregates are coated with shredded and heated Low Density Poly Ethylene. The weight of LDPE taken is 6% by weight of interlayered aggregates.

64 mm thick specimen is considered, the order is first bottom 25mm is put in mould, then interlayer of thickness 14mm is put and finally top 25mm is put, and then the final obtained briquette specimen is kept undisturbed for 24hours.

The same procedure is repeated for other interlayer thickness.

D. 14 mm Interlayered Thick Bituminous Briquettes
Mix ratio: 1:1:1.5
Quantity of Dust: 342.84 gm
Quantity of Fine Aggregate: 342.84gm
Quantity of coarse aggregate: 514.26 gm

Table4. Proportion of bottom and top layer of 14 mm interlayer bituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µm	59.52
1.5	150µm	89.28
2.0	300µm	119.04
Fine aggregate proportion		
1	600µm	59.52
1.5	1.18mm	89.28
2.0	2.36mm	119.04
Coarse aggregate proportion		
1	6mm	89.28
1.5	13.2mm	133.92
2.0	19mm	178.56

Table 5.Proportion of interlayer of 14 mm interlayer bituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µ	16.67
1.5	150µ	25
2.0	300µ	33.33
Fine aggregate proportion		
1	600µ	16.67
1.5	1.18mm	25
2.0	2.36mm	33.33
Coarse aggregate proportion		
1	6mm	25
1.5	13.2mm	37.5
2.0	19mm	50

E. 16 mm Interlayered Thick BituminousBriquettes,

Mix ratio: 1:1:1.5
Quantity of Dust: 342.28 gm
Quantity of Fine Aggregate: 342.28 gm
Quantity of coarse aggregate: 513.42 gm

Table6.Proportion of bottom and top layer of 16mm interlayerbituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µ	56.9
1.5	150µ	85.35
2.0	300µ	113.8
Fine aggregate proportion		
1	600µ	56.9
1.5	1.18mm	85.35
2.0	2.36mm	113.8
Coarse aggregate proportion		
1	6mm	85.35
1.5	13.2mm	128.03
2.0	19mm	170.7

Table7.Proportion of interlayer of 16mminterlayer bituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µ	19.17
1.5	150µ	28.75
2.0	300µ	38.34
Fine aggregate proportion		
1	600µ	19.17
1.5	1.18mm	28.75
2.0	2.36mm	38.34
Coarse aggregate proportion		
1	6mm	28.74
1.5	13.2mm	43.11
2.0	19mm	57.48

E. 18mm Thick Interlayer Bituminous Briquette
Mix ratio: 1:1:1.5
Quantity of Dust: 342.14 gm
Quantity of Fine Aggregate: 342.14 gm
Quantity of coarse aggregate: 513.21 gm

Table 8.Proportion of bottom and top layer of 18mm interlayer bituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µ	54.4
1.5	150µ	81.6
2.0	300µ	108.8
Fine aggregate proportion		
1	600µ	54.4
1.5	1.18mm	81.6
2.0	2.36mm	108.8
Coarse aggregate proportion		
1	6mm	81.6
1.5	13.2mm	122.4
2.0	19mm	163.2

Table 9. Proportion of interlayerof 18mm interlayer bituminous briquette

Proportion	Sieve size	Weigtht retained (gm)
Dust proportion		
1	75µ	21.58
1.5	150µ	32.37
2.0	300µ	43.16
Fine aggregate proportion		
1	600µ	21.58
1.5	1.18mm	32.37
2.0	2.36mm	43.16
Coarse aggregate proportion		
1	6mm	32.37
1.5	13.2mm	48.56
2.0	19mm	64.74

F. Extraction of Specimen

The process of removing the specimen from the mould is done by sample extractor. After fixing the mould in the extractor the plate is rotated so that the briquette specimen comes out.

G. Prepared Specimens

Figure 8. Conventional briquettes

Figure 9. Interlayered briquettes 14 mm

Figure 10.Interlayered briquettes 16 mm

Figure 11. Interlayered briquettes 18 mm

VII. TESTING OF BRIQUETTES

A. Marshall Stability Test procedure

The Marshall Stability and flow test provided the performance prediction measure. The stability portion of the test measured the maximum load supported by the test specimen at a loading rate of 50.8 mm/minute. Load is applied to the specimen till failure, and the maximum load is designated as stability. During the loading, an attached dial gauge measured the specimen's flow as a result of the loading. The flow value is recorded in 0.25 mm increments at the same time when the maximum load is recorded.

VIII. DATA ANALYSISAND RESULTS

Chart 1. Bitumen briquette Vs Stability Value

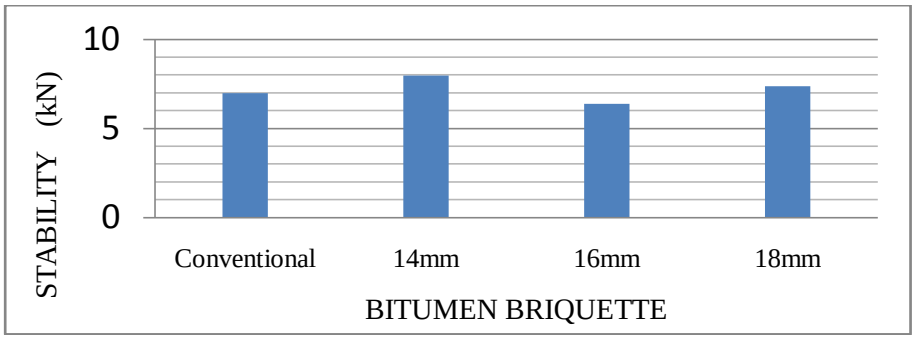
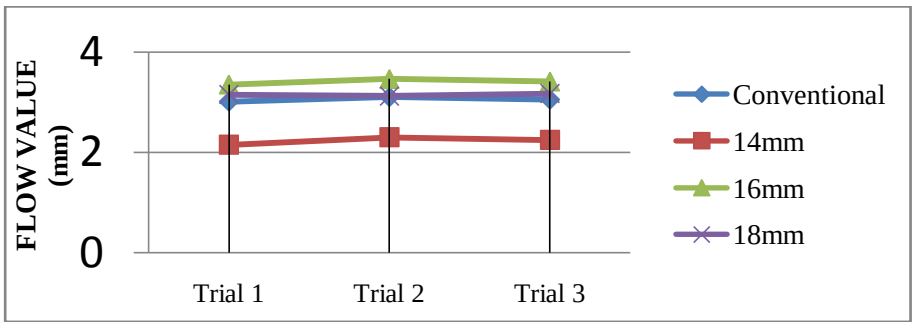


Chart 2. Bitumen briquette Vs Flow value



- By dry process the aggregate is modified by coating with LDPE and a new modified interlayer briquette is produced and thus tested.
- As per IRC29 it has been specified that the minimum stability value must be at least 6.5kN and the corresponding flow value must be in the range of 2mm – 4mm.
- From the test results, it is found that compared to the conventional bituminous briquette, the interlayered ones perform better in certain thickness.
- The stability value of the conventional and 18 mm thick interlayered briquettes is nearly the same, wherein the stability of 16 mm thickness decreases than the conventional bitumen.
- The 14 mm interlayered briquette has a higher stability value compared to the 18 mm interlayered briquette.
- Also, the flow value is less in 14 mm interlayered briquette compared to all other interlayered briquettes and the conventional briquette

Table 10.Marshall Stability Test Data

Briquette Details	Bitumen content (%)	Stability value (kn)	Flow Value (mm)
Conventional	5.5	7.0	3.0
Interlayer 14 mm thick	5.5	8.0	2.2
Interlayer 16 mm thick	5.5	6.4	3.5
Interlayer 18 mm thick	5.5	7.1	3.2

IX. CONCLUSION

- From marshal stability results, it is found that 14mm thick interlayer briquette shows better results when compared to other interlayer briquettes and the conventional briquettes.
- The use of polymers helps to reduce the quantity of bitumen, thus reducing the cost of the road laying.
- The waste plastics are used in the effective and ecofriendly way instead of unsafe disposal.
- LDPE is used to reduce the percolation of water to the subgrade of soil.
- Chip seal is beneficial in current demand for aggregates
- The interlayer concept is tried to establish like intermediate layers does not require bitumen and thus saving the economy.

REFERENCES

[1] Ajim.S.Sutaret al., (2012) "Experimental investigation on use of low density polyethylene in bituminous road construction", Journal on Information Knowledge and Research in Civil Engineering.
[2] Patil.S .Bet al.,(2016) "Effect of crumb rubber in bitumen using marshal stability test", International Journal of Research in Applied Science and technology.
[3] Prakash Somanyet al., (2013) "Strengthen of flexible pavement by using waste plastic and rubber", SSRG International Journal of Civil Engineering.
[4] Rajasekaran.Set al.,(2015) "Reuse of waste plastics coated aggregates bitumen mix composite for road application-green method", American Journal of Engineering Research.
[5] Rajesh Kumar.Ket al.,(2016) "Experimental studies on modified bituminous mixes using waste HDPE and Crumb Rubber", International Research of Emerging Technology and Advanced Engineering.
[6] Shiva Prasad .K et al., (2014) "Study on marshal stability properties of BC Mix Used in road construction", IOSR Journal of Mechanical and Civil Engineering.

