

Experimental Study of Bituminous Mix by Adding Waste Polythene

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Abstract— Bituminous mixes are most commonly used all over the world in flexible pavement construction. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together, laid down in layers and then compacted. Under normal circumstances, conventional bituminous pavements if designed and executed properly perform quite satisfactorily but the performance of bituminous mixes is very poor under various situations. Today's asphaltic concrete pavements are expected to perform better as they are experiencing increased volume of traffic, increased loads and increased variations in daily or seasonal temperature over what has been experienced in the past. In addition, the performance of bituminous pavements is found to be very poor in moisture induced situations. In the present study waste polyethylene which has been easily obtained are used, in dry form with the aggregates like a fiber in a bituminous mix. A comparative study is carried out between standard bitumen concrete and polyethylene modified bitumen concrete with varying polyethylene contents 0%, 2%, 4%, 6%, and 8% with bitumen binder 80/100 grade bitumen. Fly ash is used as mineral filler material. Waste polyethylene used as a modifier for the bituminous mixes for sustainable management of plastic waste as well as for improvement of bituminous mix. Using Marshall Method of mix design the optimum polyethylene content have been determine of the different type of the mix. **Keywords:** Bituminous Concrete (BC), Stone Mix Asphalt (SMA), Waste Polyethylene, Marshall Properties

I. INTRODUCTION

The performance of road pavement can be improved by addition of polymer to asphalt binder and these polymers give greater resistance to rutting and thermal cracking. After this study, it was found that it decreased fatigue damage, stripping value and improved temperature susceptibility. Polyethylene was extensively used plastic material and it was found to one of the most effective polymer additives. Thin plastic bags were mainly composed of low density polyethylene (LDPE) and it was used for packaging. The waste plastic (WPB) is non-biodegradable materials has been a problems. Various studies have been made of use of waste plastic bags added in asphalt mix. Depending upon their physical state and chemical composition, they have been employed as a binder modified or as an aggregate coat as well as they can be used as elements which partially substitute portion of aggregate in asphalt mix. Results were encouraging and exhibit an improvement in performance of the modified asphalt.

The waste polyethylene add in bitumen mix in construction of road pavement from their study and research it was found the addition of low density polyethylene such as plastic bags as a modifier in convention bitumen improved the physical properties and increase service life of bitumen pavement, reduce the thermal cracking as well as environment pollution.

II. REVIEW OF LITERATURE

BHARGAVA & SINGH, 2018 in this study waste polyethylene in bitumen mix would be important to find an alternative solution for increasing the service life of bitumen pavement, reducing the thermal cracking and rutting in pavement as well as environment pollution. From their study it was conducted that addition of Low Density Polyethylene such as plastic bags as a modifier in conventional bitumen (80/100) improved the physical properties of bitumen.

KUMAR & GARG, 2017 studied the behavior of bitumen concrete mixture with use of waste polyethylene (Amul milk packets) as additive. They concluded that addition of polyethylene in bitumen concrete mixture gave a more durable and stable mix for pavement. The size of used polyethylene is maximum 2mm. This small technique not only utilized the non-degradable plastic but also improved pavement strength and increase its life reduced the cracking and pot hole formation. The Marshall Stability value was increased up to 4% replacement and after that it was decreased rapidly. This also helped in decreasing the amount of plastic waste which is considered to be a threat to the hygiene of the environment.

Yakub and Prof F.I. Chaven 2017 studied behavior of the polyethylene as modifying additive in asphalt mixture. They added the polyethylene as additive to hot mineral aggregate for few minutes, after it asphalt mix was added which reduced the cost of construction and simplify the construction process. From their work, it was concluded that there was improvement on low temperature cracking resistance and water resistance after modification and high temperature stability. It evaluated polyethylene as additive in the aspect of technical view, economic and environment aspect.

III. MATERIAL FOR MIX

The bituminous concrete mix is generally composed of aggregate and bitumen. On the basis of particle size of aggregate, the aggregate are divided into coarse aggregate and fine aggregate and filler fraction. Required amount of bitumen is add in the mix to make it impervious and will have acceptable elastic properties. The aim of bitumen mix design is to determine the proportion of bitumen, coarse aggregate, fine aggregate and filler to produce a stable mix which is strong, durable, workable and economical.

The basic materials:

- 1) Aggregate
- 2) Bitumen binder
- 3) Mineral Filler
- 4) Polyethylene

IV. TEST RESULT

A. Result of Penetration value

Trial	Sample [A]			Sample [B]		
	1	2	3	1	2	3
Initial [0.1mm]	0	0	0	0	0	0
Final [0.1mm]	91	93	95	95	94	93
Penetration value	91	93	95	95	94	93
Average	93			94		

Penetration value = 93.5

So grade of the bitumen =80/100

B. Ductility Test Result

Sample	Ductility (cm)
1	107
2	108
3	106
Average	107

Ductility of the bitumen =107 cm

C. Softening Point Test Result

Sample	Softening point (°C)
1	50
2	51
3	49
Average	50

The average value of Softening point =50°C

V. ANALYSIS OF THE RESULTS

A. Data for plotting curve

1) Mean values of the result

PE (%)	Unit weight (G _{mean})	Mean Void in mineral aggregate (%)	Mean of air void (%)	Mean VFB (%)	Mean S (KN)	Mean f (mm)
0	2.238	47.75	4.180	91.25	14.59	4.23
2	2.315	47.56	1.49	96.87	14.32	3.23
4	2.252	41.72	1.22	97.07	17.68	2.87
6	2.210	38.31	0.23	99.39	15.32	2.77
8	2.181	38.16	0.04	99.39	12.83	2.48

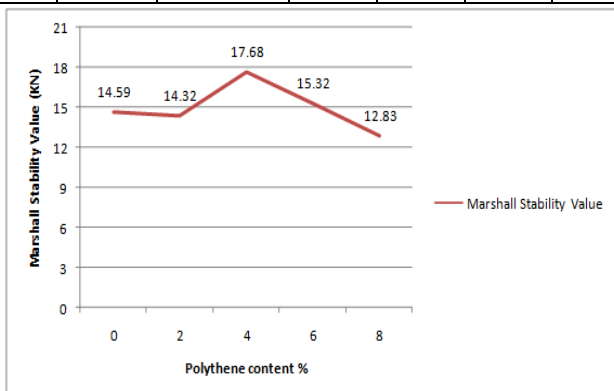


Fig. 1: Marshall Stability Value vs. polyethylene content

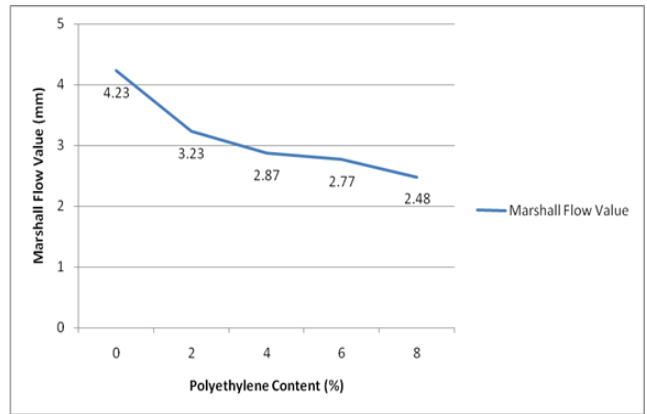


Fig. 2: Marshall Flow Value Vs Polyethylene Content

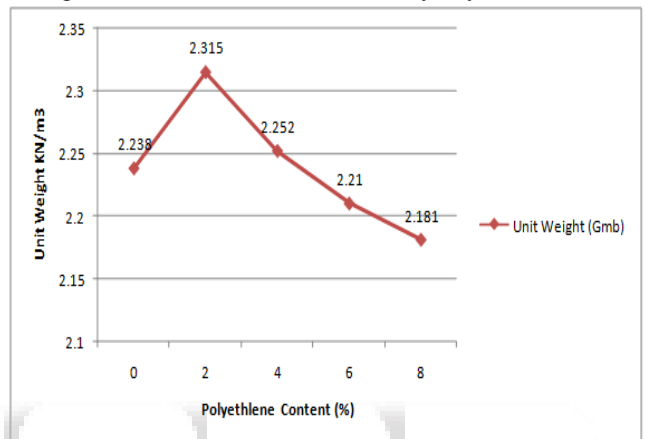


Fig. 3: Bulk Unit Weight Vs Polyethylene Content

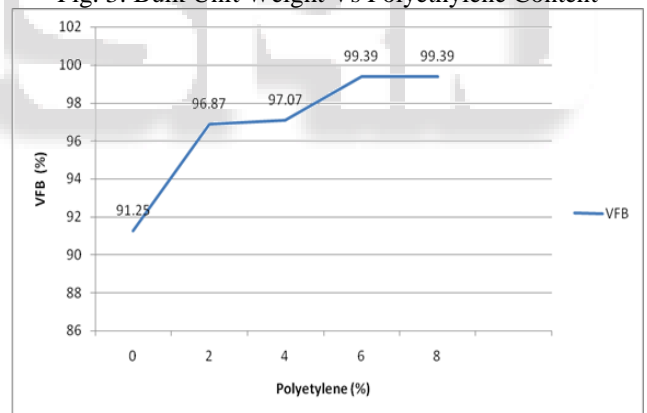


Fig. 4: VFB vs. Polyethylene Content

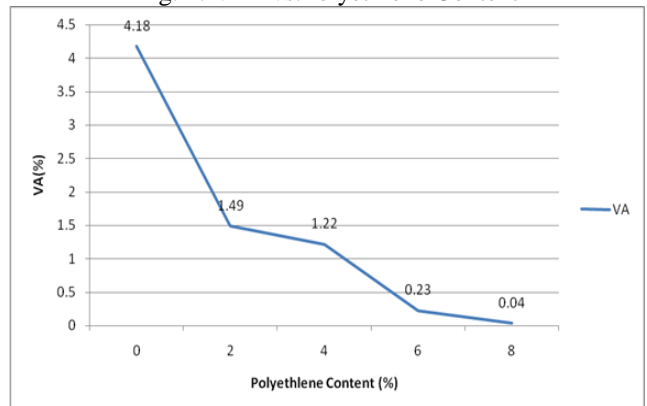


Fig. 5: V.A. Vs Polyethylene Content

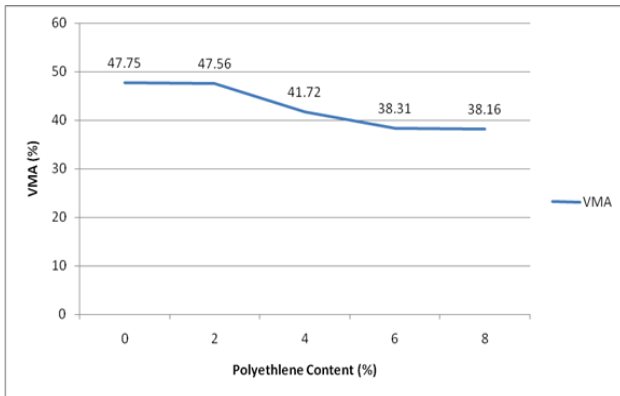


Fig. 6: VMA Vs Polyethylene Content

VI. CONCLUSION

In this investigation the bituminous mix are prepared with 80/100 grade of bitumen used as a binder. The effect of addition of waste polyethylene that are in locally available in the bituminous mixes has been the studied by varying proportionation of PE of polyethylene from 0%, 2%, 4%, 6% and 8%. From this investigation various results are described.

- 1) Waste polyethylene used as a modifier for the bituminous mixes for sustainable management of plastic waste as well as for improvement of bituminous mix.
- 2) Using Marshall Method of mix design the optimum polyethylene content (OPC) have been determine of the different type of the mix. From the present study it will be observer that after addition of 4% polyethylene in the bituminous gives optimum Marshall Properties where fly ash used as filler.
- 3) The Marshall Stability Value increases up to 4% of PE Contents and after addition of more PE Contents its Value decreases. This Value shows the strength of the pavement. Strength increases up to 4% of PE content.

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