International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 4, June 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Modification 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 which binds mineral aggregate to make a homogeneous mix, laid down in layers and then compacted. In normal condition, conventional flexible pavements if designed and constructed properly as per the specifications, perform quite satisfactorily but the performance of bituminous mixes is very poor under temperature variation. 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. Also these flexible pavements made up of bituminous materials are prone to deterioration by moisture.

In the current investigation a fibrous and more moisture resistant bituminous mix is formed with the incorporation of waste polyethylene: a locally available waste and non-biodegradable compound. A comparison is drawn between conventional 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. Marshall Method of proportioning mix design is to find the best percentage of polyethylene content to prepare mixes of different concentration.

KEYWORDS: *Bituminous concrete (BC), Stone mix asphalt (SMA), Waste polyethylene, Marshall Properties*

How to cite this paper: Yogesh Duddi | Er. V. S. Sagu "Modification of Bituminous Mix by Adding Waste Polythene" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-4, June 2020, pp.1389-1393, URL: www.ijtsrd.com/papers/ijtsrd31591.pdf

IJTSRD31591

I. INTRODUCTION

The performance of road pavement can be improved by addition of polymer to asphalt binder and these polymers give superior rutting resistance and less thermal cracking. After this study, inference revealed that this modification reduced the extent of damage from fatigue, a lesser stripping value and par 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 comprises low density polyethylene (LDPE) and used extensively for packaging. The waste plastic bags (WPB) are non – biodegradable materials pose a serious 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 a 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 it 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 2017studied 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 aggregate and bitumen are mixed thoroughly to form bituminous concrete mix. On the basis of particle size of aggregate, the aggregate are categorized 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:

A. Aggregate
B. Bitumen binder
C. Mineral Filler
D. Polyethylene

IV. TEST RESULT

Result of Penetration value

	Sample [A]			Sample [B]		
Trial	1	2	3	1	2	3
Initial [0.1mm]	0	0	0	0	0	0
Final [0.1mm]	92	95	92	96	93	96
Penetration value	92	95	92	96	93	96
Average	93	95				

Penetration value = 94
So grade of the bitumen =80/100

Ductility Test Result

Sample	Ductility (cm)
1	108
2	107
3	109
Average	108

Ductility of the bitumen =108 cm

Softening point test Result

Sample	Softening point (°C)
1	51
2	52
3	50
Average	51

The average value of Softening point =51°C

Analysis of the results

Data for plotting curve

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

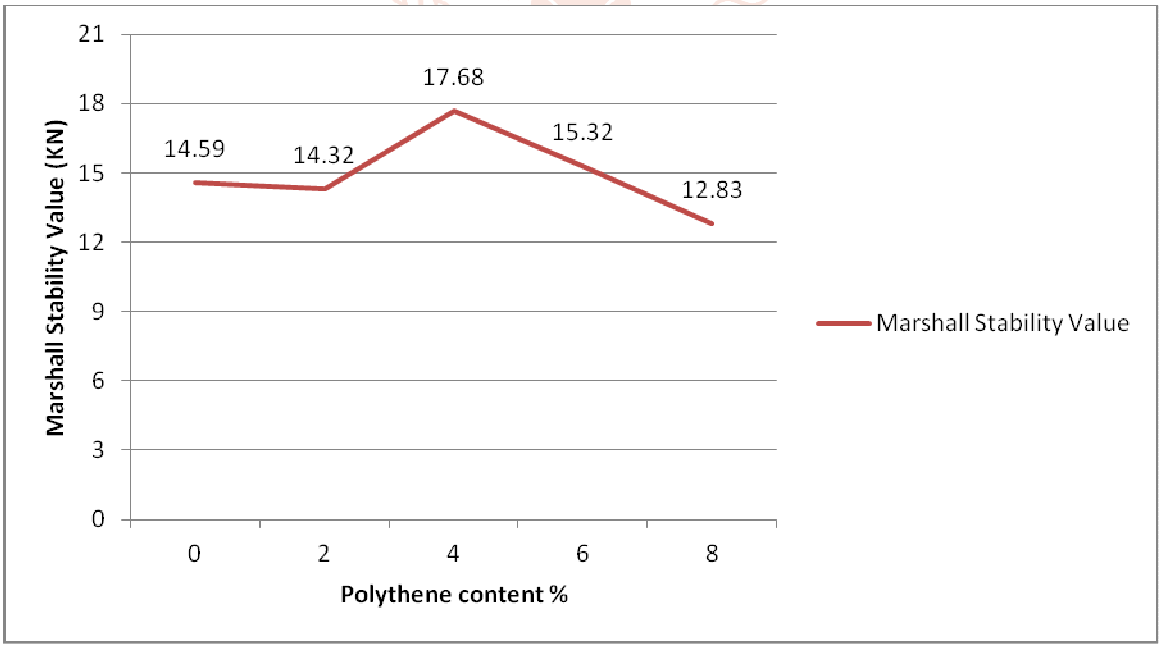

Fig. Marshall Stability Value vs. polyethylene content

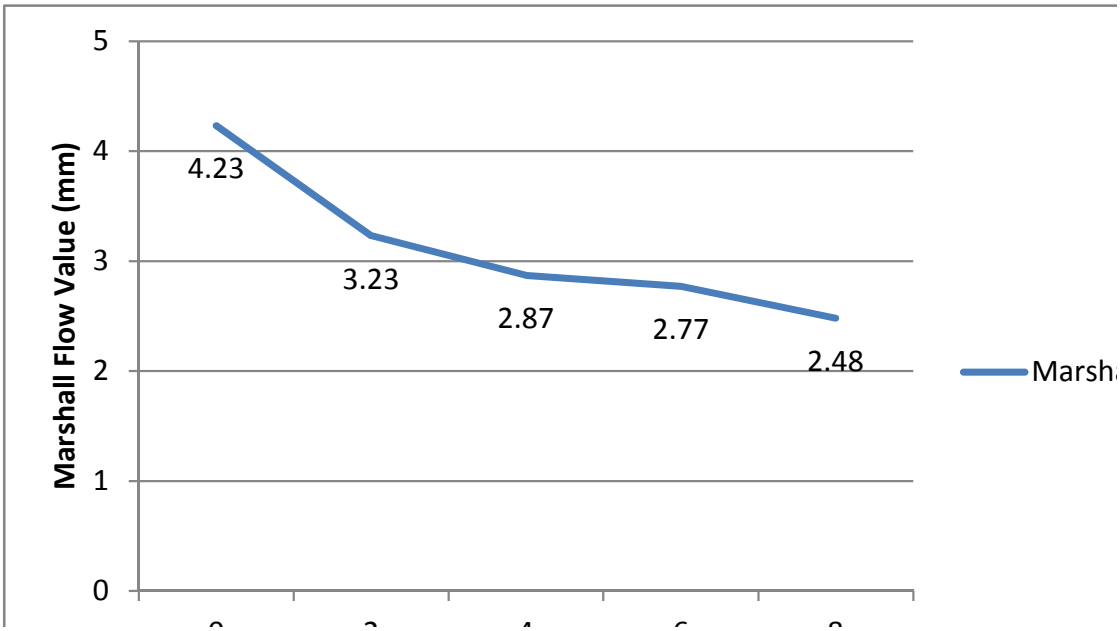

Fig.- Marshall Flow Value Vs Polyethylene Content

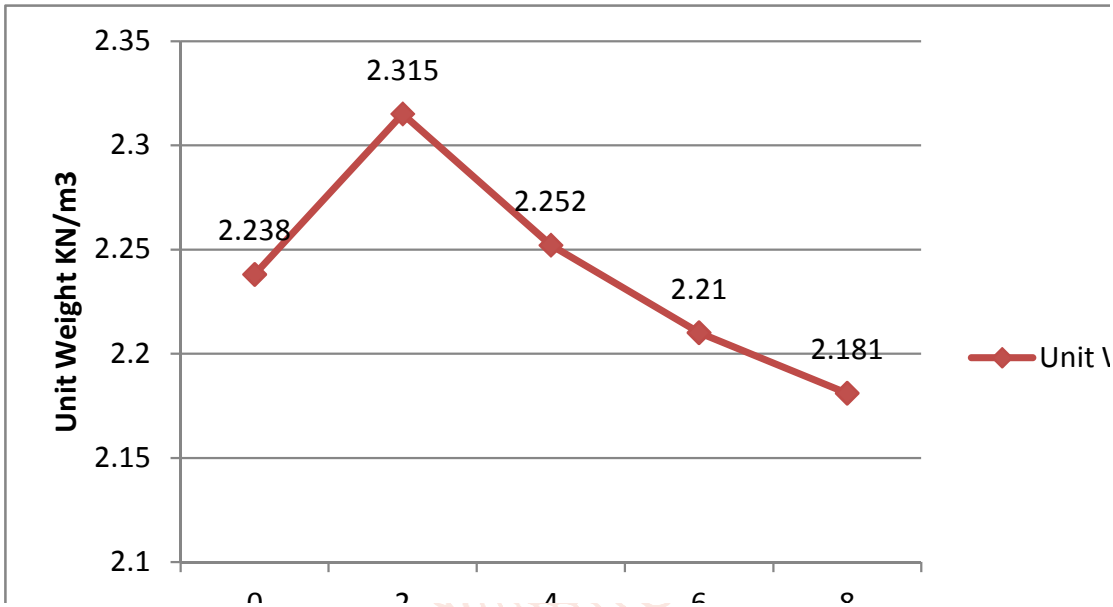

Fig. - Bulk Unit Weight Vs Polyethylene Content

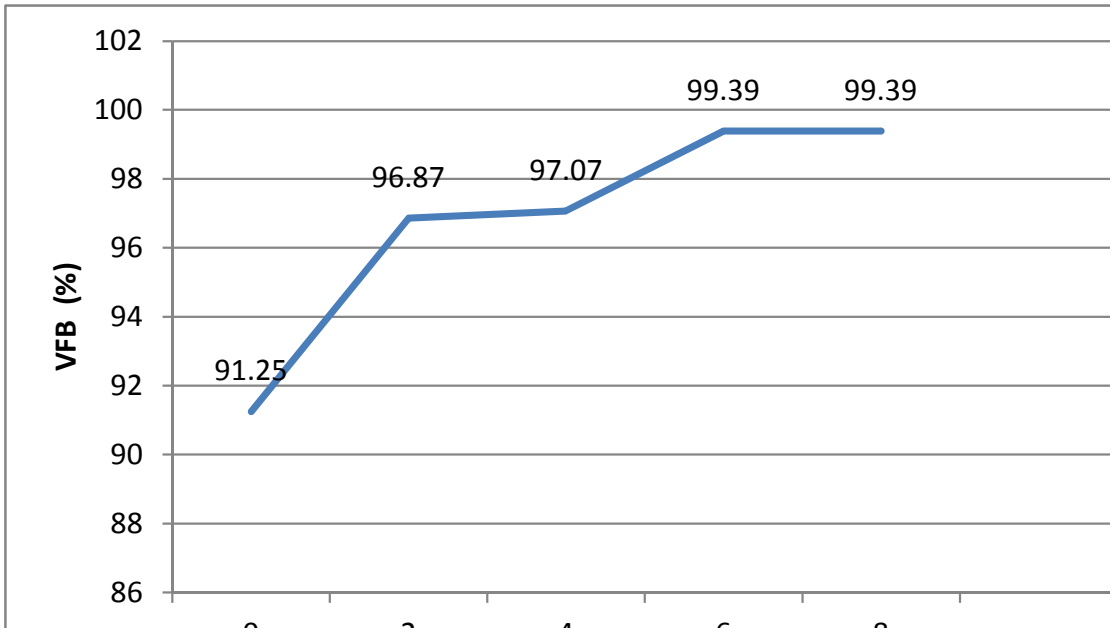

Fig. VFB vs. Polyethlene Content

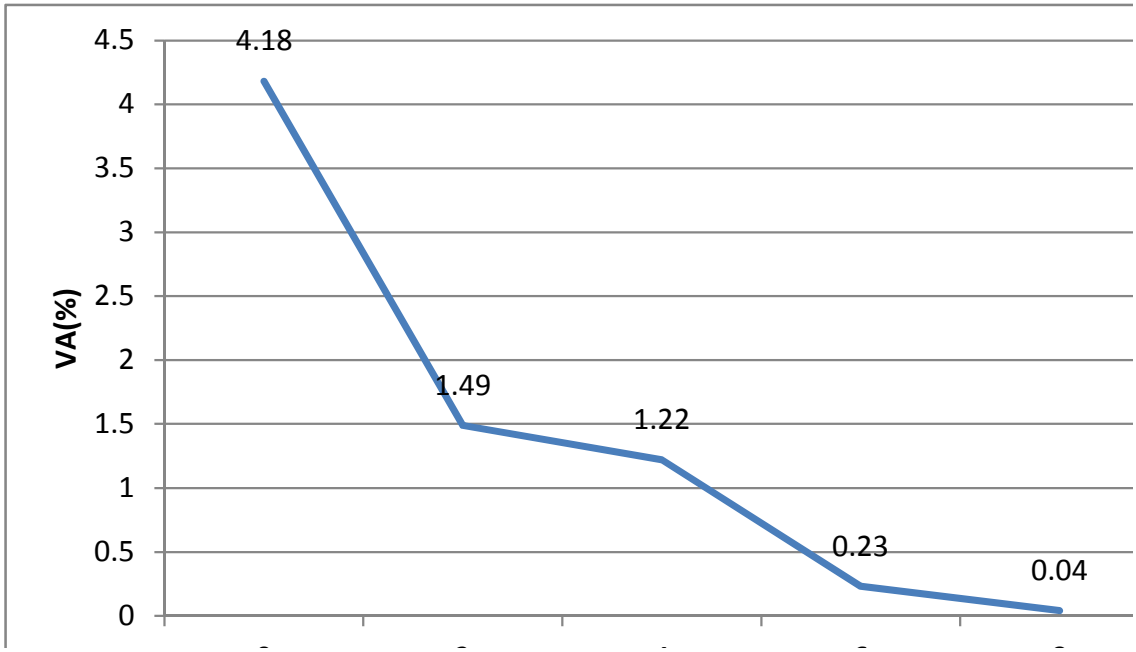

Fig.- V.A. Vs Polyethlene Content

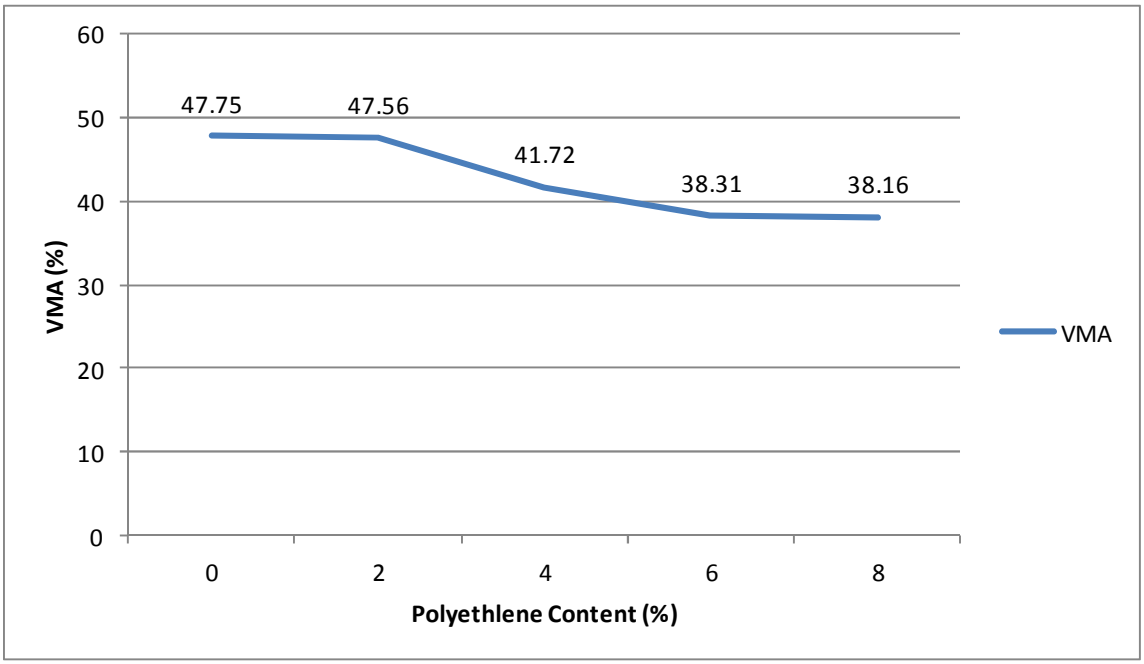

Fig.- VMA Vs Polyethlene Content

V. Conclusion

The current study under subject work "waste plastic as modifier of bituminous mix" the bitumen used for making the bituminous mix was 80/100 grade. The effect of addition of waste polyethylene that are in locally available in the bituminous mixes has been the studied by varying proportion of polyethylene from 0%, 2%, 4%, 6% and 8%. From this investigation the results obtained are summarized below.

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 addition of 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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