BEHAVIOUR CHANGE IN MARSHALL PROPERTIES OF SDBC MIX USING ZEOLITE WITH LIME AS FILLER

Prof R.K. Yadav[1], prashant sukhija[2]

[1] Associate Professor, Jabalpur Engineering College, Jabalpur (M.P.)
[2] ME Scholar , Jabalpur Engineering College, Jabalpur (M.P.)

Abstract - *An experimental investigation carried out on SDBC mix using Zeolite with lime as a filler. Addition of lime with zeolite to the asphalt is more beneficial due to its antistripping property. A number of additives to reduce moisture sensitivity and stripping are used in the United States. The most widely used antistrip additive is hydrated lime .The beneficial properties of zeolite include a controlled release of moisture that aids mixture workability and the ability of asphalt to effectively coat the aggregate particles. The mixture of zeolite and hydrated lime is easier to handle and intergrate into a process than use of either compound alone, and it offers a number of other benefits.*

In this study the mix is prepared with different percentage of zeolite 0.3, 0.6, 0.9, 1.2% by weight of total aggregate with lime as a filler (2% by total weight of aggregate) obtained from Job mix formula. It has been found that the Marshall stability, Void Ratio, density and other property has improved with optimum mix of zeolite and lime (0.6% of zeolite and 2% of lime by total mass of aggregate).

Keywords: *Zeolite, Lime, Bitumen, Aggregate.*

I. INTRODUCTION

The flexible pavement design is based on the load distributing characteristics of a layered system. It consists of Sub grade; Sub base, Base Course and wearing course. Wearing course carry the maximum load as vehicle wheel is directly in contact with the wearing course. Wearing course transfer the vehicular load to the adjacent layer of Base course and load is ultimately transferred to the compacted soil sub grade through sub base layer. It is the topmost layer of the pavement which should be structurally sound & functionally adequate to ensure a smooth & durable riding surface.

Properties of Zeolite and Lime promote the potential to distribute a composite blend of Zeolite and lime in the asphalt mix so that a more even distribution of both can be achieved. This uniformity of distribution enhances the mixture's benefits as a filler. The addition of Zeolite allows the asphalt production plant to reduce its operating temperature from an average of 150° C. to 120° C. because of the effect of the release of micro water steam bubbles from the Zeolite structure when heated at this temperature along with improving the Marshall Properties.

Literature Review

1. **Lee et al.,(2008)**,(18) prepared three types of CIR-foam specimens: (a) CIR-foam with 1.5% of Sasobit® (wax), (b) CIR-foam with 0.3% Aspha-min® (synthetic zeolite),and (c) CIR-foam without any additive. They reported that WMA additives have improved the CIR-foam mixtures compactibility resulting in reduction of air void. The indirect tensile strength of CIR-foam mixtures with Sasobit®(wax) was the highest. Flow number of CIR-foam mixtures with Sasobit® was the highest followed by ones with Aspha-min®(synthetic zeolite), and the specimens without any additive.

2. **Hodo et al.,2009** (7) stated that the foamed asphalt mixture spresented better workability at lower temperatures which showed greater ease in placingand compacting it and the moisture susceptibility tests showed marginal results and they suggested that if anti-stripping agents were added to theWMA mixture, the moisture damage resistance would be improved.

3. **Wielinski et al.,2009** (22) conducted a study based on laboratory tests and field evaluations of foamed WMA. They found that the Hveem and Marshall properties of HMA and WMA were almost similar, and all met the Hveemdesign requirements and the mixture property requirements. The in-situ densities were also almost similar.

II. MATERIALS USED AND METHODOLOGY

In this study mix is prepared using zeolite (Clinoptilolite type structure) and lime (75microne). Coarse aggregate 10mm, 6mm and fine aggregate(dust) is used in different proportion to satisfy the MORTH specification. The apperent specific gravity are found to be.

SPECIFIC GRAVITY					
Bitumen	Coarse Aggregate(10mm)	Coarse Aggregate (6mm)	Fine Aggregate (DUST)	LIME	ZEOLITE
1	2.92	2.87	2.74	2.61	2.33

To Study the effect of modifier following methodology was adopted.

The normal mix specimens was prepared with bitumen contents of 4.5, 5, 5.5, 6% by weight of total aggregate and 2% of lime as a filler. The optimum bitumen content and different Marshall Properties was found out using Marshall test. Modifide specimens using zeolite at different percentage (0.3, 0.6, 0.9, 1.2%) by weight of total aggregate are prepared with fix percentage of bitumen (4.5, 5, 5.5, 6%).

III. LABORATORY EXPERIMENTS CONDUCTED

Marshall Modified Mix is prepared using zeolite with lime as a filler, the property of mix at different percentage of bitumen with different percentage of mix is find out as

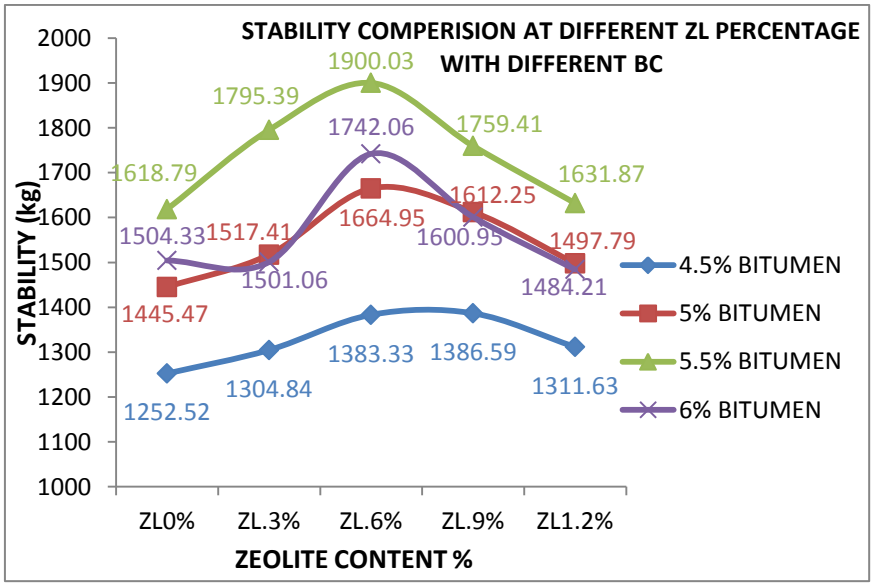
4.5% by weight of aggregate with ZL0%, ZL0.3%, ZL0.6%, ZL0.9%, ZL1.2%

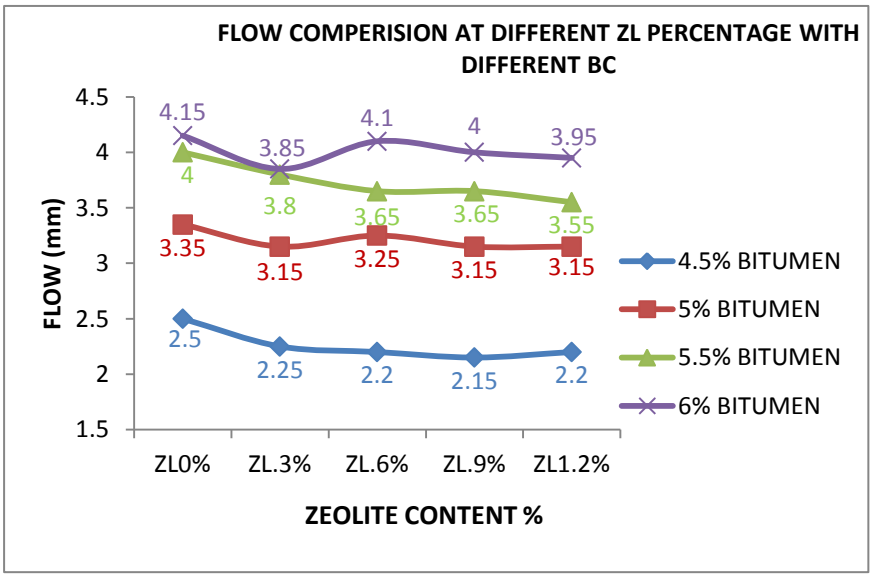
5.0% by weight of aggregate with ZL0%, ZL0.3%, ZL0.6%, ZL0.9%, ZL1.2%

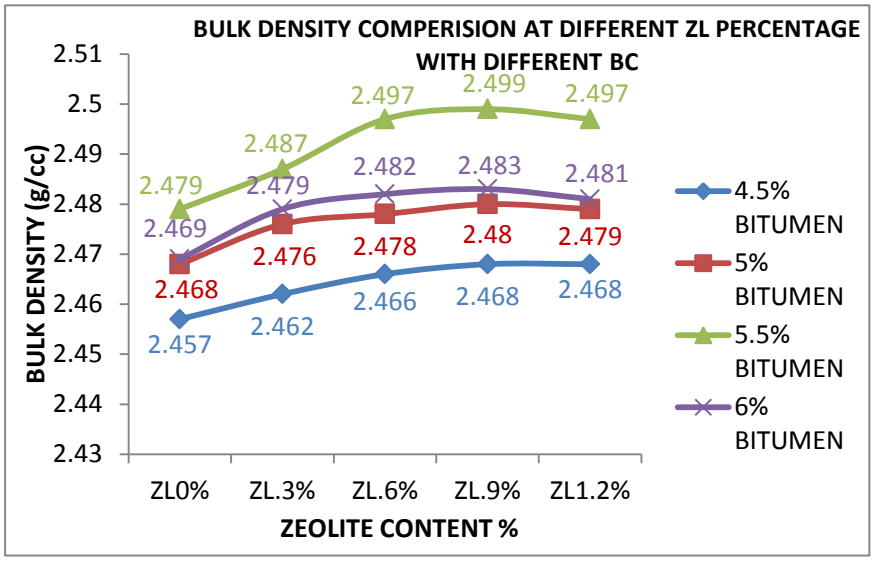
5.5% by weight of aggregate with ZL0%, ZL0.3%, ZL0.6%, ZL0.9%, ZL1.2%

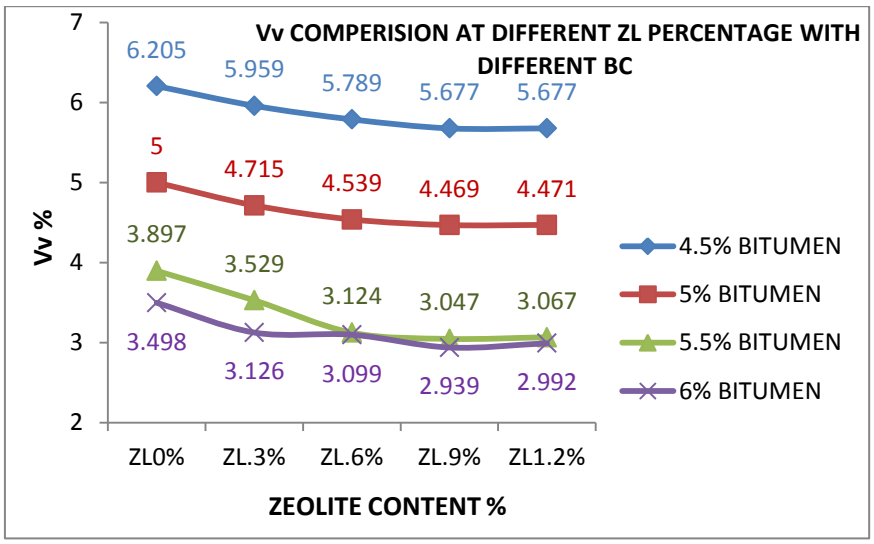
6.0% by weight of aggregate with ZL0%, ZL0.3%, ZL0.6%, ZL0.9%, ZL1.2%

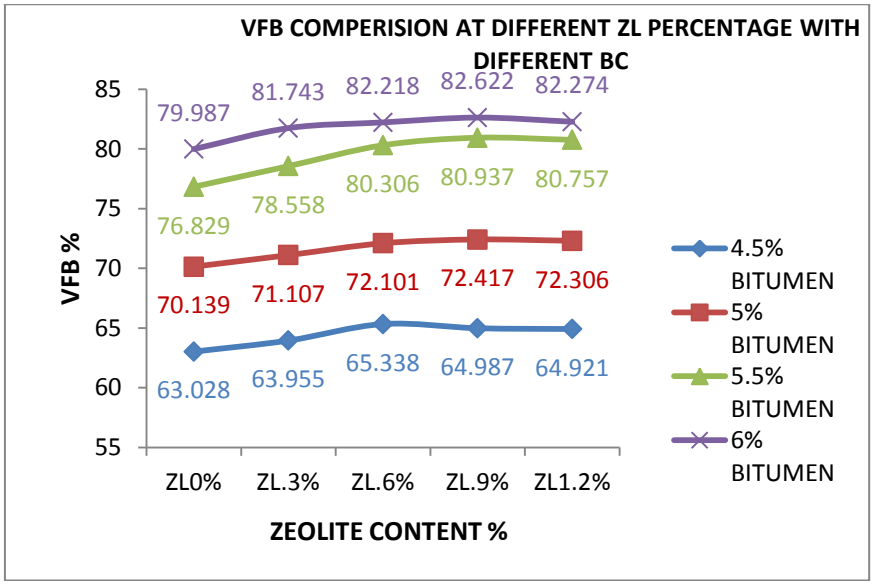
- Marshall Stability value increases at different percentage of bitumen with increasing the zeolite content up to 0.6% by weight of total aggregate.
- Flow Value decrease for different percentage of bitumen with increasing the zeolite content.
- Bulk density increases at different percentage of bitumen with increasing the zeolite content.




FLOW COMPERISION AT DIFFERENT ZL PERCENTAGE WITH DIFFERENT BC
FLOW (mm)
4.5
4
3.5
3
2.5
2
1.5
4.15
3.85
4.1
4
3.95
4
3.8
3.65
3.65
3.55
3.35
3.15
3.25
3.15
3.15
2.5
2.25
2.2
2.15
2.2
ZL0%
ZL.3%
ZL.6%
ZL.9%
ZL1.2%
ZEOLITE CONTENT %
4.5% BITUMEN
5% BITUMEN
5.5% BITUMEN
6% BITUMEN


BULK DENSITY COMPERISION AT DIFFERENT ZL PERCENTAGE WITH DIFFERENT BC
BULK DENSITY (g/cc)
2.51
2.5
2.49
2.48
2.47
2.46
2.45
2.44
2.43
2.497
2.499
2.497
2.487
2.482
2.483
2.481
2.479
2.479
2.469
2.476
2.478
2.48
2.479
2.468
2.462
2.466
2.468
2.468
2.457
ZL0%
ZL.3%
ZL.6%
ZL.9%
ZL1.2%
ZEOLITE CONTENT %
4.5% BITUMEN
5% BITUMEN
5.5% BITUMEN
6% BITUMEN


Vv COMPERISION AT DIFFERENT ZL PERCENTAGE WITH DIFFERENT BC
Vv %
7
6
5
4
3
2
6.205
5.959
5.789
5.677
5.677
5
4.715
4.539
4.469
4.471
3.897
3.529
3.124
3.047
3.067
3.498
3.126
3.099
2.939
2.992
ZL0%
ZL.3%
ZL.6%
ZL.9%
ZL1.2%
ZEOLITE CONTENT %
4.5% BITUMEN
5% BITUMEN
5.5% BITUMEN
6% BITUMEN



CONCLUSIONS

Based on Result obtained from laboratory on SDBC containing different proportion of zeolite the following conclusion are drawn.

At different percentage of bitumen content (4.5, 5.0, 5.5, 6.0% by weight of aggregate) with increase in zeolite content (0.3, 0.6, 0.9, 1.2% by weight of total aggregate) at each bitumen content,

1. Stability increases upto 0.6% zeolite for each bitumen content then start decreasing.
2. Flow value decreases upto 0.6% zeolite for each bitumen content then almost constant beyond 0.6% zeolite
3. Bulk density increase upto 0.9% zeolite for each bitumen content then remain constant beyond that limit.
4. Air voids continuously decreases upto 0.6% zeolite then remain contant with further increase in zeolite contant.
5. Void filled with bitumen (VFB) increases upto 0.9% zeolite then decreases with increase in zeolite contant. 0.6% zeolite by weight of total aggregate is the limit which satisfy all the criteria of MORTH and improves the Marshall Properties of mix.

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