Experimental Analysis of Plastic Waste & Zeolite in Bitumen Road Construction

Gautam Talreja[1] Kaushik Majumdar[2] Mayank Gupta[3]
[1,2,3]Department of Civil Engineering
[1,2,3]SIRTE, Bhopal, M.P, India

Abstract— In this present era the biggest problem which is to be dealt with is non – biodegradable waste i.e polythene. This non bio – degradable waste can enhance and stabilize the properties of bitumen when mixed in optimum proportions. In this study tensile strength, marshall's stability value and ductility of bitumen by adding different proportions of HDPE (high density polythene) in order to find the optimum proportion of HDPE. Also zycotherm (hydrated aluminium silicate) is added in order to reduce the temperature of the mix which in turn reduces the carbon emission .In this study four specimen's are prepared named 1, 2, 3 and 4 having HDPE percentages of 2, 3, 4 and 5 respectively. All the specimen are tested in Marshall's stability test, penetration test and ductility test. Results show that the specimen 3 with HDPE percentage 4 has highest Marshall Stability value. So, by the use of plastic waste in the bitumen road construction we can resolve the problem of non – biodegradable waste in feasible manner.

Key words: Bitumen, HMA, HDPE, LDPE

I. Introduction

Construction of highway involves huge outlay of investment. A precise engineering design may save considerable investment as well a reliable performance of the in-service highway can be achieved. Two things are of major considerations in flexible pavement engineering, pavement design and the mix design. The present study is related to the mix design considerations. A good design of bituminous mix is expected to be result of a mix which is adequately;

1) Strong
2) Durable
3) Resistive to fatigue and permanent deformation
4) Environment friendly Economical and so on.

A mix designer tries to achieve these requirements through a number of tests on the mix with varied proportions and finalizes with the best one. The present research work tries to identify some of the issues involved in this art of bituminous mix design and the direction of current research. The use of waste polythene carry bags in (bitumen) flexible pavement construction. Reclaimed plastic waste derived from low density polyethylene (disposals and carry beg) 4%by weight as well as from high density polythene (HDPE) plastic bottles and toys in variation of 2%, 3%, 4% & 5 by weight have been used as additive in flexible pavements. In this study we will also add a 2.5% of Zycotherm (Zycotherm is an odor free additive that increases moisture resistance while lowering mixing and compaction temperature up to 65° F).Purposes of using above materials is to utilize environmentally unacceptable waste material

II. Objectives

The objectives of our work are as follows

1) To study the effect of adding LPDE, HPDE and a mix of both in a hot mix asphalt.
2) To identify which sample (LPDE, HPDE and mix) is more stable and performing well.
3) To find out the best mechanism of adding the polythene to the asphalt mixture to achieve better mixture properties.
4) To determine the optimum percentage of polythene in a HMA.
5) To justify the use of waste non-degradable waste in road construction.

A. Coarse Aggregates

The aggregates retained on 4.75 mm sieve are called as coarse aggregates. Coarse aggregate should be screened crushed rock, angular in shape, free from dust particles, clay, vegetation sand organic matters which offer compressive and shear strength and shows good interlocking properties. In present study, stone chips are used as coarse aggregate with specific gravity2.75.

B. Fine Aggregates

Fine aggregate should be clean screened quarry dusts and should be free from clay, loam, vegetation or organic matter. Fine aggregates, consisting of stone crusher dusts were collected from a local crusher with fractions passing 4.75 mm and retained on 0.075 mm IS sieve. It fills the voids in the coarse aggregate and stiffens the binder. In this study, fine stones and slag are used as fine aggregate whose specific gravity has been found to be 2.6 and2.45.

III. Results & Discussion

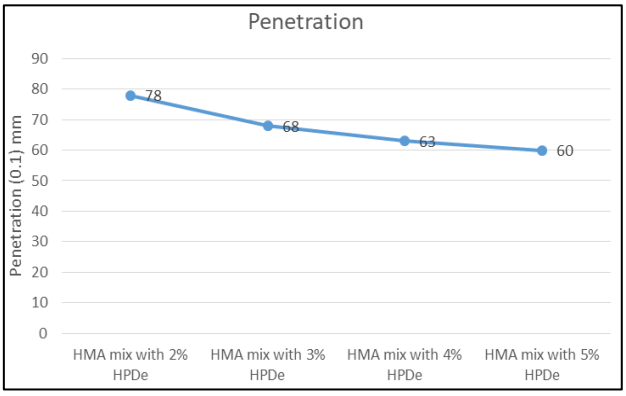

Fig. 1: Comparison of Weight of Different Sample

PENETRATION TEST		
S.No.	Standard value	Test result
HMA mix with 2 % HPDe	60-70 (0.1) mm	78
HMA mix with 3 % HPDe		68

HMA mix with 4 % HPDe		63
HMA mix with 5 % HPDe		60

Table 1: HMA with Various Mix

Sr. No.	Type of Mix	Flow Value	Ductility test	PENETRATION TEST	Marshall Stability value (kg)
1.	HMA mix with 2 % HPDe	3.5	100	78	1560
2.	HMA mix with 3 % HPDe	3.8	101.5	68	1640
3.	HMA mix with 4 % HPDe.	4.1	103.43	63	1700
4.	HMA mix with 5 % HPDe	4.0	104.3	60	1686

Table 2:

IV. CONCLUSION

1) Marshall Test conducted on bituminous mix with combination 4% HPDe plastic and 2.5% Zycotherm have higher value of stability 1700 kg correspondingly the values of flow is 4.1, percentage air voids is3.0 %, VMA is 9.48% & VFB is 68.30%.
2) It is observed that by addition of polyethylene HPDe to the mixture, the resistance to moisture susceptibility of mix also increases. BC with polyethylene results in highest tensile strength ratio in HMA mix

REFERENCES

[1] Brown E.R. (1992), "Experience with Stone Matrix Asphalt in the United States", NCAT Publication, Auburn University, Alabama.
[2] Jones David R. ,Kennedy Thomas W (1994) , THE ASPHALT MODEL: The Results of SHRP Asphalt Research Program, A-001 Contract SHRP, Transportation Research Center, University of Texas, Austin, USA.
[3] National Asphalt Pavement Association (1994), Guidelines for materials, productions, and placement of SMA, Technical Working Group, Publication No. IS118.
[4] Brown E.R., Haddock J.E. and Crawford C. (1996), "Investigation of Stone Matrix Asphalt Mortars", TRR 1530, National Research Council, TRB, USA, pp 95 – 102.
[5] Pawan Kumar, P. K. Sikdar, Sunil Bose &Satish Chandra (2004), Use of Jute Fiber in SMA for Road Materials and for Pavement Design, vol.5(2), pp. 239-249.
[6] Kamraj C., Sood V.K. ,Jain P.K. and Sikdar P.K.(2006), "Design of Stone Matrix Asphalt by using Different Stabilizing Additives", Journal of the IRC, Volume 67-1, April-June, pp 107-114.
[7] Ibrahim M. Asi (2006), "Laboratory Comparison Study for the Use of Stone Matrix Asphalt in Hot Weather Climates", Construction and Building Materials, Volume 20, Issue 10, pp. 982-989.
[8] Bose S. , Kamaraj C. and Nanda P.K. (2006), "Stone Mastic Asphalt (SMA),A Long Life Pavement Surface" , International Seminar on Innovations in Construction and in Maintenance of Flexible Pavements, Agra, 2-4 September, Technical Papers, Volume 1, pp. 169-17.
[9] Kumar Pawan, Bose Sunil and Chandra Satish(2007), "Laboratory investigations on SMA mixes with Different Additives", International Journal of Pavement Engineering, Volume 8, Issue 1, pp. 11-18.
[10] 10. IRC: SP: 79-2008, tentative specifications of stone matrix asphalt, Published by IRC (Indian Roads Congress).

