International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Study on Percentage Replacement of Bitumen with Molasses in Stone Matrix Asphalt

G.MOUNIKA[1], B.H.S Sai prasanth[2], K.Lakshmi prasanna[3]

[1]*M.Tech Student in Civil Engineering Department, Andhra University*
[2]*Assistant Professor in Sitam College of Engineering, Vizianagaram*
[3]*M.Tech, Student in Civil Engineering Department, Andhra University, Visakhapatnam*

Abstract - *Bitumen the residue left over from petroleum distillation is the most significant bonding agent used for road way construction. Increasing energy costs and the demand for petroleum has encouraged the development of alternative binders to modify or replace asphalt binders. such sustainable and environmental friendly materials like sugar cane waste molasses are used. There are three major types of asphalt surfacing characterized by a mixture of bitumen and stone aggregate. They are Dense Graded asphalt (DGA), Stone Mastic Asphalt (SMA), and Open Graded Asphalt (OGA). For this investigation SMA has selected. In the present study, an attempt has been made to evaluate the basic properties of Bitumen and coarse aggregate. SMA samples were prepared using Marshall compaction pedestal by varying the binder content as 5.5, 6.0, 6.5 and 7.0 per cent by weight of aggregates and to find the optimum percentage of molasses content by replacing 5 to 15 % with 1 % increment by weight of OBC (from Marshall stability test results). Volumetric Properties are improved for Molasses modified SMA mix* but drain down increases.

Key Words: **Bitumen, Aggregate, Stone Mastic Asphalt, molasses,Marshal stability test**

1. INTRODUCTION

Majority of the roads all over the world are made up of flexible pavements. Flexible pavements consist of a bituminous layer on the surface course and sometimes in base course followed by granular layers in base and sub base courses over the subgrade. The bituminous pavements play a vital role in Indian pavements at present. Bituminous pavement allows stage construction and may use a wide range of construction materials, often leading to substantial savings through the use of locally available materials.

1.1 Stone Matrix Asphalt

Stone Matrix Asphalt is a gap graded, dense, hot mixture Asphalt containing 70-80% coarse aggregate, 6-7% of binder, 8-12% of filler and 0.3-0.5% of fiber or Modifier. The SMA mixtures is different from other mixtures because of its skeleton type structure providing better stone-to-stone contact between the coarse aggregates which provides good internal friction and high resistance to rutting. Mineral filler plays an important role in the properties of SMA mixture in terms of air voids, voids in mineral aggregate and optimum binder content in the mix. The durability of SMA mixtures improved by slow rate of deterioration obtained due to low permeability of binder mastic content and aggregates. The high binder content increases the fatigue resistance, provides flexibility to the pavement and lowers the air voids content.

1.2 Molasses

A by-product of sugar factories in countries growing sugar cane and/or sugar refineries processing raw sugar cane. A dark brown syrupy liquid with earthly caramel-like, non-pungent smell. Molasses is the dark, sweet, syrupy byproduct made during the extraction of sugars from sugarcane and sugar beets. Molasses can vary in color, sweetness, and nutritional content depending on the variety or how much sugar has been extracted. By spraying this molasses over the aggregates increases binding characteristics. The molasses modified bituminous mix reduces the void present in the mix and this prevents the moisture absorption and oxidation of bitumen entrapped air.

2. Results and Discussions

2.1 Results for Aggregate

Aggregate tests such as Specific Gravity Test, Aggregate Impact Value test, Los Angeles Abrasion Value Test, Aggregate Crushing Value tests, Water absorption test were conducted according to IS Standards. Results are shown in following table.

Table -1: Aggregate test results

Test	Test method	Results(%)
Aggregate Impact Value	IS:2386 (IV)	22.59
Los Angeles Abrasion Value	IS:2386 (IV)	19.10
Crushing Value	IS-2386 (IV)	23.47
Water Absorption	IS:2386 (III)	0.54

Specific Gravity Test	IS:2386 (III)	2.68
Flakiness and Elongation Index	IS:2386 (I)	25.47 %

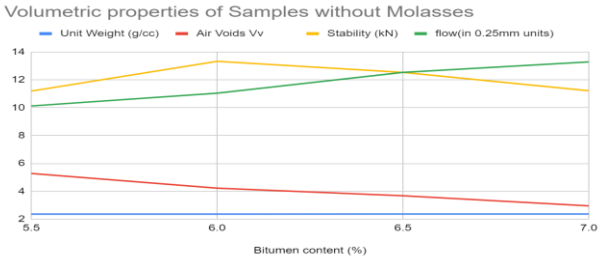
2.2 Results for bitumen

Bitumen tests such as softening point, penetration, ductility tests were conducted on bitumen. According to IS, the specific gravity of pure bitumen should be of range 0.97 to 1.02.Penetration Test(in 1/10th) is 66, Ductility Test value 86 cm, Softening Point Test value is 48.5ºC

Table -2 :

Bitumen content (%)	Unit Weight (g/cc)	Air Voids Vv (%)	Stability (kN)	flow (mm
5.5	2.359	5.28	11.19	10.12
6.0	2.363	4.22	13.32	11.04
6.5	2.364	3.68	12.53	12.53
7.0	2.365	2.95	111.21	13.28

Chart -1:



Stability value initially increases up to 13.32 KN (at 6% bitumen content) and then decreases. Flow value (in units of 0.25mm) increases from 10.38 to 13.12 with increasing the Bitumen content.

Table -3 :

Bitumen content (%)	Molasses Content (%)	Unit Weight (g/cc)	Air Voids Vv (%)	stability (kN)	flow (mm)
95	5	2.359	3.364	13.15	11.08
94	6	2.363	3.211	13.46	11.24
93	7	2.364	3.162	13.67	11.56
92	8	2.365	3.107	13.84	11.76
91	9	2.368	3.002	14.13	12.04
90	10	2.369	2.933	14.52	12.88
89	11	2.372	2.819	14.93	13.48
88	12	2.377	2.617	15.18	13.84
87	13	2.385	2.280	15.24	14.16
86	14	2.390	2.096	14.98	14.32
85	15	2.392	2.019	14.94	14.52

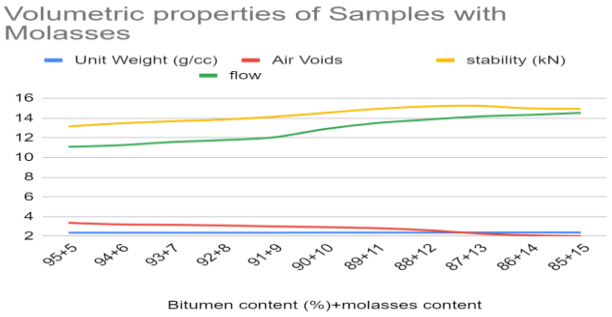


Chart -2

Stability value initially increases up to 15.24 KN (corresponding to 13% Molasses content OBC) and then decreases. Flow value is increases from 11.08 to 14.52 with increasing the Molasses content at OBC.

2.3 Binder Drain down Test:

Binder drain down test was conducted as per ASTM D 6390 on mixtures at the OBC of 13mm SMA mix to ensure that the binder draining property was within acceptable levels. It also provided an evaluation of the SMA mixture drain down potential produced in the field. The important aspects of the test were to place the samples of the SMA loose mixtures in a wire basket fabricated using standard 6.3mm sieve cloth.

$$\text{Drain down, (\%)} = \frac{100 \times (D-C)}{(B-A)}$$

Where,

A= mass of empty wire basket

B= mass of wire basket plus sample

C= mass of the empty catch plate

D= mass of the catch plate plus drained mate

Drain down test results

For unmodified SMA sample	0.71%
For Molasses modified SMA sample	0.76%

3. CONCLUSIONS

1) From the Study of Volumetric properties of unmodified SMA samples such as

- VFB Value increased from 73.31 to 87.9 % with increasing the Bitumen content
- Stability value initially increases up to 13.32 KN (at 6% bitumen content) and then decreases.
- Flow value (in units of 0.25mm) increases from 10.38 to 13.12 with increasing the Bitumen content

- The optimum bitumen content is corresponding to 4% Air voids i.e., 6.07%.

2) From the Study of Volumetric properties of Molasses modified SMA samples such as

- VFB Value increased from 79.24 to 86.58 % with increasing the Molasses content at OBC.
- Stability value initially increases up to 15.24 KN (corresponding to 13% Molasses content OBC) and then decreases.
- Flow value (in units of 0.25mm) increases from 11.08 to 14.52 with increasing the Molasses content at OBC.

3) Drain downed content for Molasses modified SMA mix increased by 7% compared to unmodified SMA sample.

REFERENCES

1) K. Shyam Prakash, M. Phanindra, S. Ram Surya and J. Naresh "Percentage replacement of bitumen with sugarcane waste molasses" International Journal of Civil Engineering & Technology (IJCIET), Volume 5, Issue 7, 2014, pp. 188- 197.
2) Rosli Hainin, Wasid Farooq Reshi and Hamed Niroumand "The Importance of Stone Mastic Asphalt in Construction" Vol. 17, 2012.
3) R.Sathishkumar and Dr.S.P.Jeyapriya, "Comparison of Strength Properties of Bitumen Mixed with Waste Materials as Modifier", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 4, 2013, pp. 219 - 224, ISSN Print: 0976 – 6308, ISSN Online: 0976 – 6316.
4) Bose, S., Kamaraj, C., Nanda, P.K. (2006). "Stone Mastic Asphalt (SMA) – A Long Life Pavement Surface." International Seminar on Innovations in Construction and Maintenance of Flexible Pavements, Agra, 169-17.