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Laboratory Evaluation of Modified Mixture for BC Grade 1

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ABSTRACT: Bitumen got from Indian refineries meets the current particulars, however the writing thinks about have demonstrated that the untimely disappointment of adaptable bitumen pavement in India is primarily happening because of failure of customary black-top blends to maintain rehashed use of wheel load and significant variation in day by day and occasional temperature of the bitumen in India. The nature of bitumen can be enhanced by adding added substances to the bitumen. The present paper plans to feature this fluctuation associated with the polymer altered mix configuration process and build up a system to discover ideal bitumen content by Marshall Mix outline strategy which accomplishes most stability. It was observed for with SBS modified specimens that the Marshall Stability values increased and most noticeable fruitful values recorded is at 5.2% optimum bitumen content with 1 % SBS. The change of the properties of bituminous mixture shows the constructive outcome of SBS. In this manner, it is presumed that the utilization of 1% SBS changes the attributes of VG30 bituminous mixtures in an exceptionally helpful manner.

KEYWORDS: Marshall Mix design, SBS, Optimum bitumen content, Percentage air voids

I. INTRODUCTION

Roads indirectly add to the monetary development of the nation it is greatly fundamental that the roads are well laid out and strong. India is home to a few terrible roads be it the metropolitans, the urban communities or the towns. This is because of increment in very loaded business vehicles in constrained road space with noteworthy changes in day by day, regular temperature and extraordinary ecological conditions posturing weight on roads along these lines which needs inventive material to oppose the worries with no trade off with quality and execution. Durability is the key parameter of satisfactory serviceability. At first in the undertaking, an endeavour has been made to recognize the building properties of materials and concentrate the effects of SBS on VG 30 bituminous blends for BC grade 1 with and without it, as indicated by the standards as determined in MoRTH (area 500 conditions 507).

II. LITERATURE REVIEW

Ping and Xiao (2011) assessed the SBS changed folio impact on versatile modulus properties of Florida black-top blends. They found that the SBS polymer modifier made the HMA blend milder at mid to low test temperatures and kept up solidness level at high temperatures. A powerful SBS polymer content seemed to exist in the vicinity of 3.0% and 6.0% relying upon the genuine states of blend generation.

U.Arun Kumar, P.V.V Satyanarayana (2015) uncovered in their work that impact of Styrene-Butadiene-Styrene is entangled opposite against the right bitumen concerning their designing properties by fractional supplanting of regular bitumen with the previously mentioned polymer modifiers. Discoveries from this investigation uncover that the polymer altered bitumen's offer better designing properties there by expanding the force of the street.

Mohammed Abbas Hasan Al-Jumaili (2015) explore in his work that the impact of Styrene – Butadiene - Styrene (SBS) on the dampness affectability of altered black-top blends. The seven SBS rates were chosen (0.5, 1.0, 1.5, 2.0, 2.5, 3.0 and 3.5) % by the heaviness of black-top. The preparatory tests incorporate: Marshall Test, circuitous elasticity result, and the list of held quality test.

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Awanti et al. (2008) demonstrated that the static circuitous quality qualities for SBS adjusted black-top cement were higher arranged by 49-101% when contrasted with regular black-top blends in the temperature scope of 15-40°C. The suitability of utilizing SBS as an added substance in stone mastic black-top (SMA) was researched in another examination. The blend adjusted with 5% SBS demonstrated higher steadiness and rigidity; bring down dampness vulnerability and around 40% expansion in versatile modulus esteems at 26.5°C.

Baha Vural Kok and Mehmet Yilmaz (2009) present that Penetration, softening point; consistency tests have demonstrated that the SBS content expanded the firmness. Marshall Stability test, Marshall Stability esteems expanded with the SBS content when molding. As indicated by held Marshall Stability, it was reasoned that the expansion of just 2% lime had around same impact with expansion of 6% SBS concerning dampness harm. In the aberrant elasticity test, it was gotten that the reduction in TSR estimations of the main SBS altered blends with the expansion of freeze–defrost cycles was consistent, however the lessening in TSR estimations of the lime treated blends with the expansion of freeze–defrost cycles was not relentless.

III. MATERIALS AND METHODOLOGY:

MATERIAL:

- **Aggregates:**

Coarse and fine aggregates are for the most part taken from quarry of Chikhli. Mechanical crushing is done to lessened extricated shake into the usable sizes. The aggregate gradation chose is of BC grade 1 as per MoRTH.

- **VG-30 (50/70 review):**

It has amazing holding and cement properties with totals, superb property of waterproofing, protection from acids and antacid as well. It is utilized to develop extraordinary load conveying black-top asphalts that need to experience extensive movement loads.

- **SBS as Modifier for VG 30 review Bitumen:**

This is a thermoplastic polymer implied for alteration of bitumen to enhance the general execution of black-top asphalt by expanding the stability, elasticity, and stiffness of black-top fasteners. SBS mollifies under high temperature; can be effortlessly included and blended with black-top cover. The impact of SBS-changed pavements on dampness affectability stays undetermined.

METHODOLOGY:

In this work bituminous concrete (BC) mix is designed for 26.5 mm nominal size of aggregate obtained from crushing plant Chikhli. The bitumen was taken from unique construction plant, Kamrej, Surat Gujarat. SBS modifier from Tiki Tar Industries is collected. Initially, to find the physical properties of aggregate, laboratory test are done by performing tests as per the MoRTH specification for BC grade 1 section 500 clause 507. In the same way, the Bitumen tests for VG30 with & without SBS are perform which includes the Penetration test, Viscosity test, Softening Point test, Ductility test, which are as per IS standard and all results satisfied the IS specification.

Furthermore, for Marshall Mix design samples are prepared and the Optimum bitumen content is conclude for mix using modifier. After determining the Optimum bitumen content, samples are prepared at different dose of modifiers (0.5 %, 1.0 %, and 1.5 %) and at 4.8%, 5.2% and 5.6% bitumen contain. Depend on this the Optimum contain and Optimum dose of modifier has been determined.

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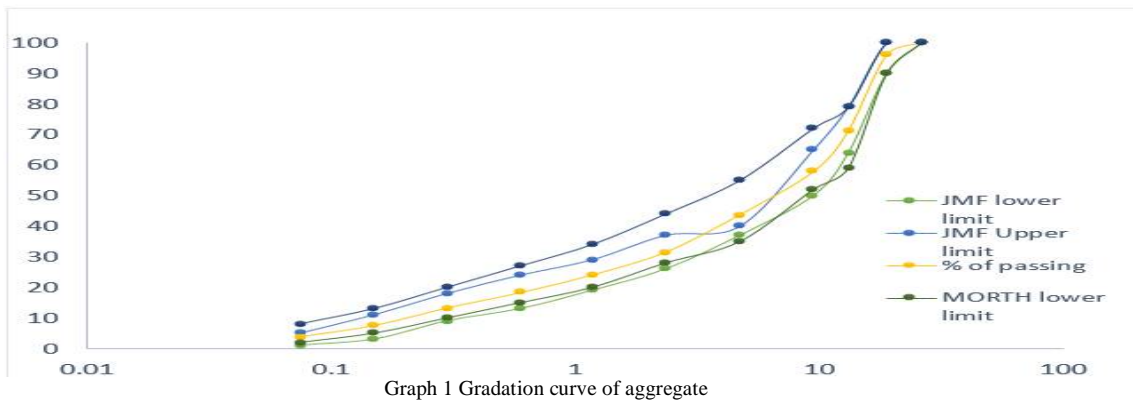
IV. LABORATORY INVESTIGATIONS

A. Physical properties of Materials

Table 1: Physical properties of Aggregate

Sr. No.	Name of Test	Test result	Requirements as per MORT&H Table-500-16
1	Combines F.I & E.I Agg.	24.70%	Max 35%
2	Agg. Impact Value	16.91%	Max 24%
3	Los Angeles Abrasion Value	14.36%	Max 30%
4	Specific Gravity	2.840 2.817 2.636 2.427	Not Specified
5	Water Absorption	1.0	Max 2%
6	Stripping of bitumen Agg. Mixture	More than 95%	Min retained coating 95%

Gradation of aggregate meeting MoRTH section 507



It is clear from the above graph that the limits are within the Upper and Lower limits satisfying JMF & MoRTH section 500 table 500-17.

Table 2: Physical property of VG30 with and without SBS

Characteristics of tests	VG-30	VG30+0.5% SBS	VG30+1.0% SBS	VG30+1.5% SBS	Min. limit	IS Code
Penetration (mm)	57	59	55	48	45	IS 1203
Softening point (C°)	52	56	58	61	47	IS 1205
Ductility (cm)	94	95	98	100	40	IS 1208
Absolute Viscosity at 60 (C°)	2497	2542.2	2590.6	2650.5	2400 - 3600	IS 1206 (part 2)

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B. Marshall Mix design for optimum binder content using VG30

For deciding the Optimum Bitumen Content, 3 specimens are arranged of bitumen substance at 4.8, 5.2 and 5.6 % of degree blend weight at blending temperature 160° C according to the system and prerequisites of MoRTH segment 507. The volumetric properties obtained are as shown in table 3.

Table 3: Properties of Marshall Mix Design for BC Grade I as per MoRTH

Bitumen %	Bulk Sp. Gr. (Gmm)	stability (KN)	flow (mm)	air voids %	VMA%	VFB%
4.8	2.363	1282	2.2	6.03	17.59	65.7
5.2	2.377	1448	3	5.45	17.45	68.83
5.6	2.368	1343	3.9	5.35	18.12	68.17
Limit (MoRTH-507)	-----	Min 9 KN	2 to 4 mm	Min 3 -5%	Min 14%	65 to 75%

Optimum bitumen content: 5.2%

The ideal cover substance 5.2% fulfils the point of confinement set down in MoRTH segment 507 regarding greatest stability, Marshall Flow value, percentage air voids in compacted mix and voids filled with bitumen and Bulk specific gravity.

C. Marshall Mix Design for VG30 (5.2 % OBC) plus SBS for optimum dosage and optimum Percentage

Different dosages of SBS are taken i.e. 0.5 %, 1.0%, and 1.5 % of SBS. All properties of the Marshall Mix design test is as shown in Table 4 and Figure 1 to 6

Table 4 Marshal Mix properties of bitumen with different dosage of SBS

BITUMEN %	0.5 % SBS			1.0 % SBS			1.5 % SBS		
	4.8	5.2	5.6	4.8	5.2	5.6	4.8	5.2	5.6
DENSITY	2.426	2.445	2.428	2.444	2.456	2.41	2.432	2.436	2.434
STABILITY	1431	1526	1444	1443	1532	1426	1434	1504	1404
FLOW	3.39	3.42	3.43	3.13	3.2	3.23	2.73	2.93	2.9
AIR VOIDS	4.85	4.5	4.41	5.62	4.82	4.73	4.64	4.46	4.18
VMA %	15.39	15.1	16.04	14.76	14.73	16.65	15.2	15.4	15.84
VFB %	68.51	70.4	72.78	62.08	67.64	71.62	69.51	68.62	73.63

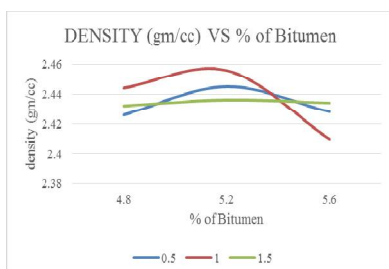


Figure 1: Density (gm/cc) VS % of Bitumen

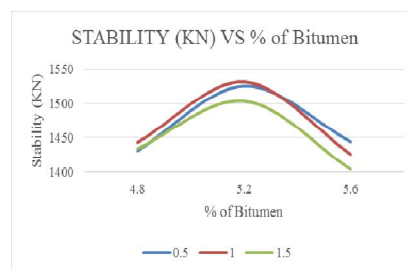


Figure 2: Stability (KN) VS % of Bitumen

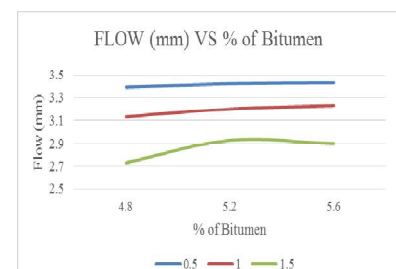


Figure 3: Flow (mm) VS % of Bitumen

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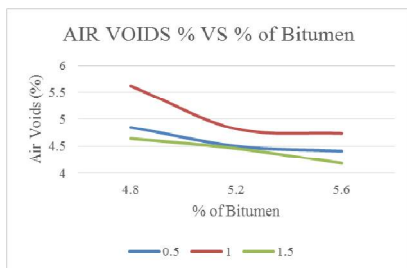


Figure 4: Air Voids % VS % of Bitumen

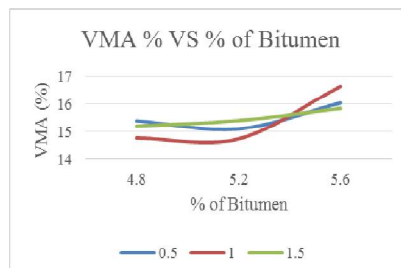


Figure 5: VMA % VS % of Bitumen

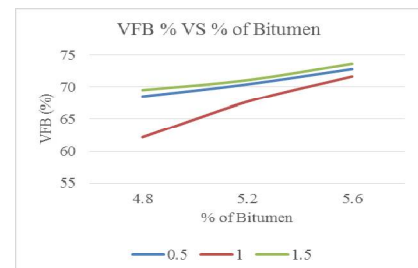


Figure 6: VFB % VS % of Bitumen

V. CONCLUSION

From the different examinations completed in the laboratory taking after, conclusions are indicates that the engineering properties of VG30 grade with and without SBS is investigated like penetration test, viscosity test, softening test, and Ductility test fulfilling the criteria as laid down in codal provisions for bituminous surface. The test of Marshall Mix design VG 30 as 5.2 % by weight of bitumen with 0.5 %, 1.0 % and 1.5% SBS as Modifier added substance demonstrates that VG 30 with 1.0 % SBS fulfils the criteria's set down in codal MoRTH procurement at 160°C, likewise it is seen that at this rate huge change in flow values, stability, and unit weight are watched for improving the compaction and increasing the workability conditions. Mixture of VG 30 grade bitumen with 1 % SBS shows good performance properties leading to enhance stability.

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