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Improving the performance of flexible pavements by using bituminous binder

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ABSTRACT: The interest on bituminous adaptable asphalt, because of development in substantial heavy traffic loads and their tire contact pressure with inappropriate climatic conditions, weariness and rutting execution has brought about an interest towards the changed bituminous covers. There are different well-known altered folios currently accessible around the world. These modifiers fundamentally adjust the rheological and morphological properties of the cover, as portrayed by rheological testing strategies alongside the morphological instead of the traditional techniques, to improve the exhibition of the folio. This work is expected towards the alteration of the customary thickness grade VG 30 bitumen and uses of business sulfur accessible in nearby market to alter the VG 30 bitumen and to assess the rheological attributes of unaged and matured examples of these two fasteners utilizing a Dynamic Shear Rheometer (DSR).

KEYWORDS: Asphalt, Bituminous, Rheology, Traffic, Pavement, Dynamic Shear Rheometer.

I. INTRODUCTION

In India, roadways are essential methods of transportation. Roadways built with adaptable asphalts consistently given more significance because of its smooth riding quality and less development costs than in the event of unbending asphalts. Bituminous materials alongside totals are used for the development of adaptable asphalt streets. Asphalt materials and aggregates are used to build flexible roads. India's road transport infrastructure is a major challenge for the development of the National Highway Development Plan, Pradhan Mantri Gram Sadak Yojana and the National Highway Improvement Plan to improve road performance.

Bitumen is a building material for the construction of highways in terms of flexible Pavements. One of the advantages of bitumen as an engineering building material is its versatility. Bitumen is a highly adhesive material with very high adhesion and high water resistance and durability, which makes it very useful in road construction. It is also very resistant to most acids, bases and salts.

The objective of this study is to explore the use of modified binder to improve the performance of flexible pavements.

II. MATERIALS AND METHOD

It is known from studies in which the modification level is based on the type of bitumen type and a type of modifier. Different studies have been carried out in the field of sulfur modification and there are some descriptions for the need to use the switch within the bituminous industry. There are several explanations behind the use of the bitumen modifier within the bituminous industry began with the expansion of the sidewalk's useful life, it has improved its performance, it complies with the strange traffic needs and, finally, saving the Maintenance expenditure. In this test project, a VG30 bitumen viscosity project was used. The physical properties of the vg30 bitumen were provided in the table 1.

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Table1 Physical properties of VG -30 bitumen

Properties	Result
Absolute viscosity 60°C (Cp)	2460
Kinematic Viscosity 135°C (cst)	364
Softening point °C	46
Penetration (dmm) 25 °C	55
Ductility (cm) 25°C	>100
Elastic Recovery (%)	27

III. RESULTS AND DISCUSSION

Rheological properties of unaged and aged binder test results

SHRP test results for appropriate mixing/blending temperature for modification of bitumen by sulfur under Standard Conditions of SHRP test

Test results are analyzed on the basis of phase angle and complex shear modulus and their behavior with variations in blending temperature and are presented in diagrams[figure 1 (a) & (b)].

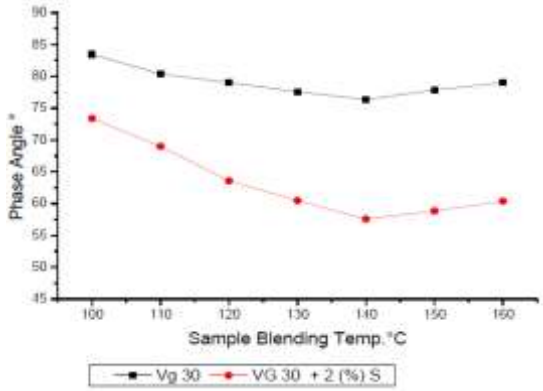

Figure 1 (a): Variations of phase angle with different blending temperature

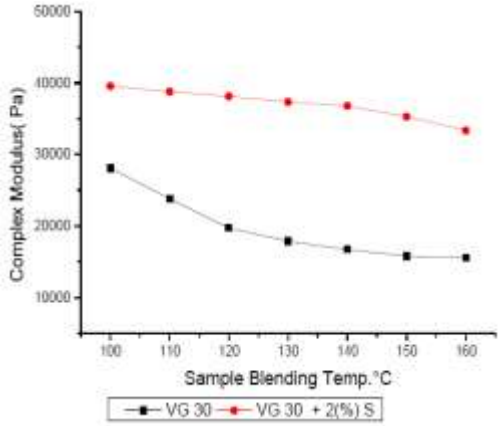

Figure 1 (b): Variations of complex modulus with different blending temperatures

Strategic Highway Research Program(SHRP) test results for appropriate mixing/blending time for modification of bitumen by sulfur under Standard Conditions of SHRP test

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These test results are mulled over regarding phase angle and complex modulus for proper time needed for mixing/blending of sulfur andbitumen. Theirrelationshipswithdifferentblendingtemperaturearepresented ingraphs[Figure2(a) &(b)].

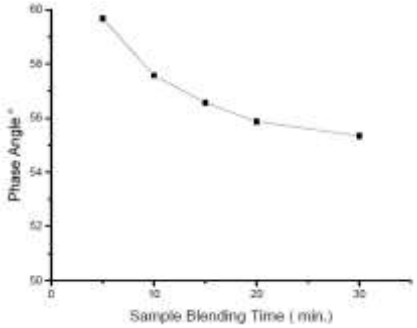

Figure 2 (a): Behaviour of phase angle with change in blending time for 2% sulfur modified bitumen

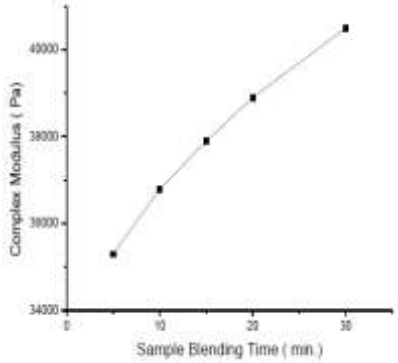

Figure 2 (b): Behaviour of complex modulus with change in blending time for 2% sulfur modified bitumen

Table 2 SHRP grade determination test results

Sample type	Test Temp. °C	Angular Frequency rad/s	Phase Angle °(δ)	Complex Modulus Pa (G*)	G*/Sin(δ) Pa	G*x Sin(δ) Pa	Specification pa
VG 30	60	10	77.37	1.77E+04	1.81E+04		>1000
VG 30 - RTFOT	60	10	68.37	3.18E+04	3.42E+04		>2200
VG30 - PAV	60	10	65.03	3.59E+04		3.25E+04	< 5000
VG 30 + 2% S	60	10	55.34	3.65E+04	4.44E+04		>2200
VG 30 + 2% S RTFOT	60	10	51.17	3.88E+04	4.98E+04		>2200
VG 30 + 2% S PAV	60	10	48.58	4.11E+04		5.48E+04	< 5000

Storage stability Test results

The test results are shown in tabular form in Table 3 for VG 30 and 2% of sulfur VG 30 bitumen. It is clearly displayed that the difference of the softening point for GG 30 is 5.2 C, while in the case of modified bitumen binder, the reduced difference at 2.6 ^{o}C can be seen that the vg 30 bitumen storage populations have improved with the Adding sulfur. .

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Table 3: Storage stability test results of bituminous binder

Type of binder	Difference in softening point value ^{o}C
VG30	5.2
VG30 +2% S	2.6

IV. CONCLUSION

Several modifiers have been tempted to improve bituminous properties in terms of engineering properties and performance criteria for the highest advantages to support modern loads of road wheels that cause heavy stress. Sulfur is an additive that is located to improve the performance of the bitumen binder. In this research work, sulfur was added to VG 30 bitumen which maintains the at 140^{O}C temperature through mechanical agitation for about 30 minutes to introduce a homogeneous modified binder

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS

a) Taking into account the criteria of the complex module and the phase angle, the addition of 2% sulfur by weight of VG 30 bitumen mixed at 140^{0}C temperature for about 30 minutes of time is translated into the condition of mixing / optimal mixture.
b) As regards the situation of the briefcase of the brief, the addition of sulfur to the measure of 2% with the conventional VG 30 improves the viscoelastic behaviour in terms of fatigue and rutting resistance with respect to the undamaged binder.
c) It is observed that the modified collector has a higher viscoelastic characteristic and other rheological characteristics in elderly binders.

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