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Examination of regular VG-30 Bitumen Mix and Gilsonite Changed Bitumen Mix

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ABSTRACT- Because bitumen is such an important and crucial component of road building, it attracts a lot of attention. Bitumen is used to hold coarse aggregates, fine aggregates, and filler together in a mix. Because of its remarkable binding and water proofing characteristics as well as its inexpensive cost, bitumen is employed in road construction. The penetration, ductility, softening point, and viscosity of the bitumen used in this project are all evaluated. Modifiers are increasingly being used to improve the performance of hot asphalt mixtures, and a large variety of binders have been developed to improve the properties of asphalt binders and extend their service life. The main goal of this research is to use Gilsonite as a modifier to improve the properties of the mix, with a particular focus on the impact of properties such as Bulk Specific Gravity (Gm), Voids in Air (Va), Voids in Mineral Aggregates (VMA), Voids filled by Bitumen (VFB), Marshall Stability, and Flow value. The bitumen used in this experiment was VG 30 grade. Gilsonite was added to Bitumen at rates of 0%, 3%, 6%, 9%, and 12% in this study, with results showing a rise in Marshall stability, VMA, and a decrease in Bulk Specific Gravity, VFB, and Flow Value.

KEYWORDS- Flexible Pavement, Flow value, Gilsonite, Ideal Bitumen content, Marshall stability, VG-30 Bitumen.

I. INTRODUCTION

Adaptable asphalts when contrasted with the inflexible asphalts are the most widely used asphalt type all over the planet since they give serious riding solace and need less beginning venture. The disappointment of adaptable asphalt as weariness, potholes, rutting, warm breaking and lifting are the essential drivers of rising auto collisions. These breaks show up for an assortment of causes, remembering addition for traffic loads and the inferior quality of materials utilized in the creation of adaptable asphalts. The visco-versatile element of the asphalt makes it weaken. Since it conveys most of the applied burden, the exhibition of the bituminous layer of adaptable asphalt will essentially affect the primary limit of the asphalt.

Current life has brought about amazingly high traffic volumes and unusual burdens, the asphalts developed utilizing ordinary hot blend black-top are inclined to genuine misery subsequently lessening the asphalts life expectancy. The utilization of the modifiers to work on the exhibition, security and solidness of the hot black-top blends keep on provoking curiosity around the around the world, and an enormous number of black-top fastener modifiers have been created to work on the attributes of black-top covers and to make them last longer. Out of various modifiers, Gilsonite is a less extensive modifier.

Gilsonite, otherwise called the normal black-top is a lustrous dim and contains little sulphur of debris. Gilsonite can be quickly ground into powdered structure. Gilsonite otherwise called the normal black-top has high strength, is weariness safe, brings down the temperature defencelessness and expands security from water stripping[2]. It is dissolvable in sweet-smelling and aliphatic dissolvable similarly as petroleum black-tops. Because of its exceptional properties Gilsonite is used to solidify delicate oil-based wares.

II. LITERATURE REVIEW

Aliasghar A. M,et. al Use of Gilsonite for enhancing stiffness of Asphalt [1]

Baha, V.K. et.al. Use of Gilsonite at various percentages (0% to 10%) to modify the properties of bitumen [3]-[4].

Hugo A. R. Quintana et.al.The goal of this study was to benchmark the performance of Gilsonite added mixtures. They included 6%, 8% and 10% ratios by weight. They observed the following increase in viscosity and stiffness of the base aggregate [5].

Houshmandi S. K et.al. Evaluated the effect of Gilsonite modified bitumen on the blend's volumetric characteristics. Gilsonite expansion has been discovered to increase the Marshall mix consistency [6].

Johannian H. Shafabaksh GH et.al. Carried an experimental study on Bitumen properties by using medical plastic waste and discovered that the obtained OBC was 6% of total mass by weight. It was discovered during the research that the amount of bitumen used might be reduced to a degree without impacting the quality of product. Bitumen's tensile strength and malleability [7].

Kök, Mehmet Yilmaz, Baha V et.al. Using two sort of totals, for instance siliceous aggregates and lime totals, they found that broadening Gilsonite further fosters the sogginess affectability of blends containing siliceous aggregates, as they are having TSR regards than blends in with lime totals, which are having lower TSR regards [8]

III. OBJECTIVES

The various objectives of this research study are as:

- To find assuming that Gilsonite can be utilized as a modifier in VG 30 Bitumen.

- Checks out what Gilsonite means for Bitumen substantial blend dependability measurements including Marshall Stability and Flow esteem.
- To explore the effect of Gilsonite on volumetric boundaries of bitumen substantial blends, for example, VA that is voids in totals, VMA that is voids in mineral totals, VFB that are the voids filled by bitumen.

IV. MATERIALS USED

The following are the various materials that are utilized in the manufacturing of bituminous mix concrete:

- Aggregates
- Fillers
- Bitumen
- Gilsonite

A. Aggregates

One of the most common materials used in pavement construction is aggregates. They form major portion of the pavement structure. Aggregates are granular materials made up of different types of rocks, squashed stones, or sand. They are expected to withstand stresses caused by wheel loads on the pavement as well as wear caused by traffic's abrasive action on the surface course. By volume aggregates make up about 70 percent of bituminous mix. These aggregates come from a variety of neighboring sources. Before utilizing them in the mix, they are thoroughly examined according to protocols to establish their chemical and physical properties, as well as their suitability for use in versatile pavements.

- **Types of Aggregates**

The various types of aggregates are as under;

- **Coarse Aggregates**

Aggregates which have size more prominent than 4.75 mm size fall in the classification. Coarse totals are held on 4.75 mm strainer and are acquired from rock and squashed stones.

- **Fine Aggregates**

Aggregates comprises of cruciferous substances gathered from a 4.75 mm which are put away at 0.075 mm. Fine scorpion is a 2.36 mm sifter and comprises of 75 micron of mineral material that is clayed, divided or normally happening or can be blends of two.Table 1 shows tests performed results details and test methods.

Table 1: Indicates tests performed, results, details and test methods

S. No	Tests performed	Results (%)	Details	Test Method
1	Abrasion Value	24.42	Max 30%	IS: 2386 Part 5
2	Crushing Value	19.22	Max 30%	IS: 2386 Part 4
3	Impact Value	15.29	Max 24%	IS: 2386 Part 4
4	Elongation and Flakiness Index		Max 25%	IS: 2386 Part 1
5	Water Absorption of Coarse aggregate	0.75	2%	IS: 2386 Part 3
6	Specific Gravity of Coarse aggregate	2.66	2.5-3%	IS: 2386 Part 3
7	Water absorption of Fine aggregate	1.26	2%	IS: 2386 Part 3
8	Specific Gravity of Fine aggregate	2.38	2.5-3%	IS: 2386 Part 3

B. Fillers

A pan material is called filler or the aggregate which pass through 75-micron sieve. Filler is useful in filling the voids between the fine aggregates and the coarse aggregate. Dust material and sand usually come into this category.

C. Bitumen

Bitumen is a blackish color by product obtained by the distillation of petroleum crude oil. Bitumen is used to bind the different constituents of a mix such as coarse aggregates, fine aggregates and filler. Bitumen is used in the road construction because of its outstanding binding and water proofing capabilities as well as its low cost. The bitumen grade VG 30 is used in this project for the preparation of mix. The bitumen utilized in this venture is tried for penetration value, ductility value, softening point and viscosity.*Fig 1 shows Depicts VG 30 Bitumen*

Figure 1: Depicts VG 30 Bitumen

D. Gilsonite

Gilsonite is dark black, brittle mineral with minor ash. Gilsonite forms a genuine, stable solution with bitumen, which is mixed with the bitumen either directly with the aggregates during heating (dry process) or by combining it with bitumen at a temperature of 160c to 180 c and stirring the solution continuously for 20 minutes to ensure proper Gilsonite –bitumen mixing (wet process). Gilsonite creates a more durable and well bounded asphalt that can last up to 25 years. As compared to other admixtures Gilsonite is cheap which leads to economical design of the pavement. The addition of Gilsonite to bitumen lowers the penetration value, increasing the stiffness, viscosity, softening point of bitumen. It also improves the mix's Marshall stability. The addition of Gilsonite to bitumen has great efficiency at high temperatures.Fig 2 shows Depicts Gilsonite.

Figure 2: Depicts Gilsonite

V. METHODOLOGY

The approach to be used in the research project is both the most difficult and critical aspect of the research. The approach used determines all of the work done and findings that will be collected during the study. The part of the research work that gives one an idea of different methods and techniques to use during the research is called research methodology.

A. Tests on Aggregates

- Los Angeles Abrasion Test
- Impact test of aggregates.
- Shape test of aggregates.
- Specific gravity and Water absorption test

B. Tests on Bitumen

- Ductility Test
- Penetration Test
- Softening Point Test
- Specific Gravity of Bitumen
- Marshall Test

C. Marshall Test

For paving jobs Marshall method is the most famous method. The mix design determines the optimum bitumen content for the evaluation of performance of bituminous mixed flow test and the stability test are performed. The flow value and the Marshall stability provides the performance prediction measure for Marshall mix design method

Flow is measured as deformation in units of 0.25 mm between as load and maximum load during carried by the specimen and with the loading rate of 50.8 mm / minute. It is expressed in kg. The different steps that must be taken in order to complete the mix design are

D. Prepration of Gilsonite Modified Bitumenmix

There are two methods by which Gilsonite can be added to bitumen

- Dry Process: In this method while heated Gilsonite is directly added to the aggregates in the heating pan when we prepare the mix. According to the previous studies this method does not provide the accurate results.
- Wet Process: In this method Gilsonite is not directly added. Gilsonite is added before mixing the mix. At the temperature of 1600 c Gilsonite is added to the bitumen and stirred properly to get proper mix.
- In this research work Gilsonite is added to bitumen at a percentage of 0%, 3%, 6%, 9%, 12% by weight of total optimum Amount of bitumen

E. Apparatus Required

The apparatus required are cylindrical moulds (having radius 5 cm and 7.5 height) along with collar and base plate, sample extractor with the help of which the sample is extractor and the loading machine.

F. Procedure

In the Marshall test, the sample is fitted in the Marshall Test stacking machine. Load is applied to the specimen and the most extreme load it can carry along with the flow value.

In this research Marshall test was conducted using Wet Process.Fig.3 shows depicts marshal samples and fig 4 shows the depics marshal sample in the extractor

G. Volumetric Properties of Marshall Blend

Theoretical specific gravity of blend

$$GT = \frac{□1+□2+□3+□□}{\frac{□1}{□1}+\frac{□2}{□2}+\frac{□3}{□3}+\frac{□□}{□□}}$$

Bulk specific gravity of blend

$$Gm = \frac{□□□□h□\ □□\ □□□□□□\ □□\ □□□}{□□□□h□\ □□\ □□□□□□\ □□\ □□□-□□□□h□\ □□\ □□□□□□\ □□\ □□□□□}$$

Air void percent (Vv)

$$Vv = \frac{□□-□□}{□□}$$

Percent volume of bitumen (Vb)

$$Vb = \frac{□□/□□}{□1+□2+□3+□□\ □□}$$

Voids in mineral aggregates (VMA)

$$VMA = Vv + Vb$$

Voids filled by bitumen (VFB)

$$VFB = \frac{□□*100}{□□□}$$

Figure 3: depicts Marshal samples

Figure 4: depicts Marshal sample in the extractor

VI. RESULTS

Calculation of optimum bitumen content
Bitumen content is equivalent to greatest Marshall stability achieved = 5.6
Bitumen content comparable to most extreme worth of bulk specific gravity = 4.8
Bitumen content is equivalent to 4 % air voids =6
OBC=

$$= \frac{5.6+4.8+6}{3}$$

$$= 5.466 = 5.5$$

Table 1I shows the marshal test results of regular bitumen without gilsonite and table III shows the result with gilsonite and Table III, figure5, figure6, figure 7, figure8 and figure 9 shows the Result of Gilsonite mix with presence of Gilsonite.

Table 2: Marshall Test Results of Regular VG-30Bitumen Blend Samples (without Gilsonite)

Bitumen content %	Vv %	Vb %	VMA %	VFB %	Marshall Stability. KN	Flow value Mm
4.8	5.08	10.18	15.26	66.71	13	2.26
5.2	4.46	10.98	15.4	71.4	13.26	2.68
5.6	4.423	11.76	15.99	73.54	15.21	2.92
6	4.00	12.51	16.51	74.3	18.11	3.14
6.4			16.92	67.5	13.38	3.52
	3.61	13.306				

Table 3: Result of Gilsonite mix with presence of Gilsonite

Gilsonite content by weight of OBC %	Optimum Amount of Bitumen %	Bulk specific Gravity Gm
0	5.5	2.379
3	5.5	2.347
6	5.5	2.359
9	5.5	2.355
12	5.5	2.374

Fig 5 shows the Variation of Bulk Specific Gravity in presence of Gilsonite.

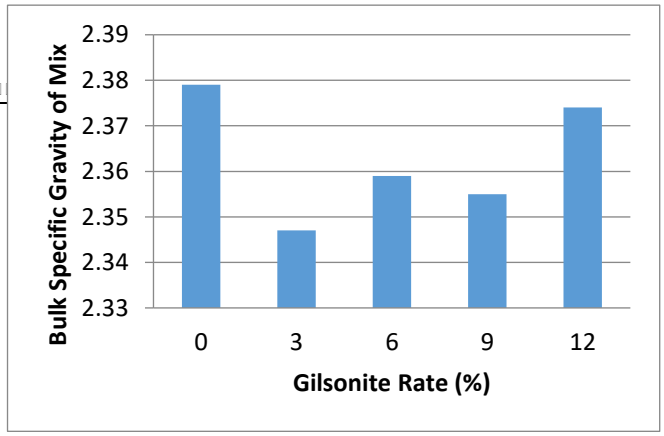

Figure 5: Variation of Bulk Specific Gravity in presence of Gilsonite

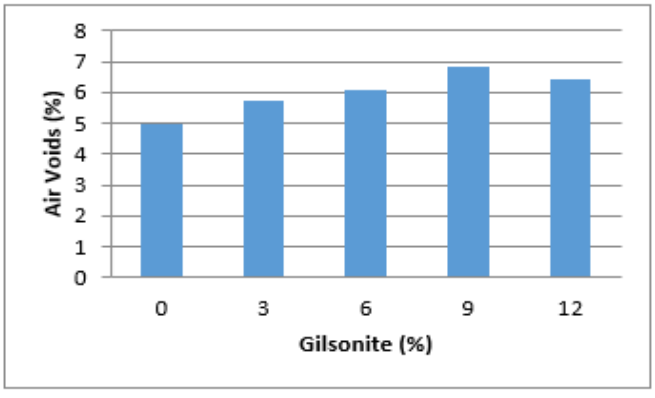

Figure 6: depicts percent air void in presence of Gilsonite

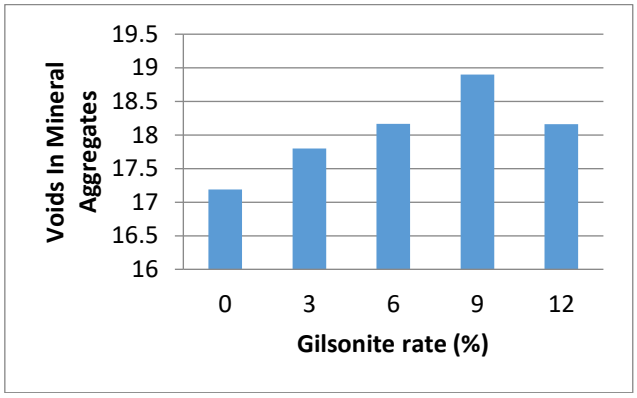

Figure 7: Depicts Voids in Mineral Aggregates in presence of Gilsonite

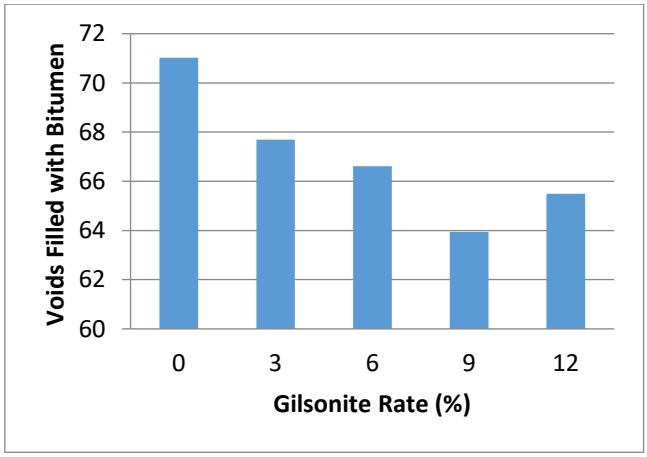

Figure 8: Variation of voids filled with bitumen in presence of Gilsonite

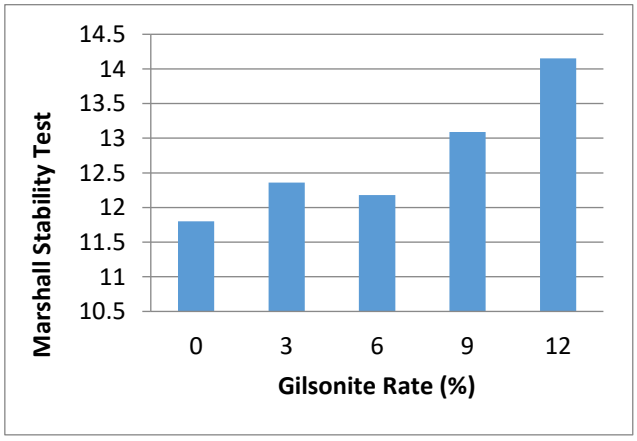

Figure 9: Variation of Marshall Stability in presence of Gilsonite

VI. CONCLUSION

- The Marshall stability value increases on increasing the Gilsonite content. 14.15 KN is the maximum stability achieved at 12% of the Gilsonite content while as the Flow value decreases on the increment of the Gilsonite content. The minimum value of 3.11 mm is obtained at 12 %.
- On increasing the Gilsonite content to the blend, the values from the bulk specific Gravity of the mix kept on fluctuating. The minimum value of Bulk Specific Gravity is observed at 3%.
- It's also been discovered that as the amount of Gilsonite in the bitumen increases so does the value of voids filled by the bitumen. At 12% Gilsonite content, a value of 65% VFB was discovered.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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