CHARACTERISATION OF POLYMER MODIFIED BITUMEN

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***Abstract* - This study focuses on characterizing Polymer Modified Bitumen (PMB) using Ethyl Vinyl Acetate (EVA) as the modifier. The objective of the research is to investigate the effects of EVA modification on the properties of bitumen, including penetration, softening point, ductility, and specific gravity. The study aims to compare the performance of the modified bitumen with conventional bitumen and provide insights into its potential applications in road engineering. experimental work utilized standardized test methods (IS 1203 for penetration, softening point, and ductility, and IS 1202 for specific gravity) to evaluate EVA-modified bitumen. Samples with 2% and 4% EVA concentrations were prepared. Results showed significant enhancements compared to basic bitumen, including increased penetration resistance,**

Keywords-: Bitumen, Ductility, Penetration, Softening Point, Speicfic Gravity

1. Introduction

Polymer modified bitumen (PMB) is a specialized asphalt binder that combines bitumen with carefully selected polymers to enhance its performance in road construction. The incorporation of polymers improves the flexibility of bitumen, allowing it to better withstand temperature fluctuations and resist cracking. PMB also exhibits increased durability, ensuring longer-lasting road pavements. Its unique properties make PMB a valuable solution for constructing roads that can endure heavy traffic loads, harsh weather conditions, and provide improved overall performance.

The main goal of this project is to thoroughly examine and characterize the properties of EVA modified bitumen. Specifically, the focus is on investigating key parameters such as penetration, softening point, ductility, and specific gravity. These parameters play a vital role in determining the workability, temperature sensitivity, flexibility, and density of the modified bitumen.

In order to accomplish the set objectives, EVA-modified bitumen samples were meticulously prepared by incorporating different concentrations of EVA (2% and 4%) into the base bitumen. These samples underwent rigorous testing procedures using standardized methods to meticulously evaluate the desired parameters. The obtained results from these comprehensive tests provide invaluable insights into the performance characteristics of EVA-modified bitumen. This project places a strong emphasis on the detailed characterization of EVA-modified bitumen

2. Materials -:

2.1 *Bitumen-:* Bitumen, the primary binder used in asphalt mixtures, possesses a unique viscoelastic nature. This means that it displays characteristics of both an elastic solid and a viscous fluid, depending on the temperature and time. At low temperatures and high strain rates, bitumen exhibits elastic behaviour, effectively resisting deformation and returning to its original shape after stress is removed. Conversely, at high temperatures and extended periods of time, bitumen demonstrates viscous behaviour, flowing or creeping under sustained loads. In the context of asphalt pavement surfaces, it is crucial for bitumen to maintain stability and durability by effectively resisting low-temperature cracking and excessive flow or creep under heavy traffic loads. These properties directly impact the ability of roads to withstand environmental stresses and traffic-induced strains without compromising their structural integrity.

2.2 *Polymer -:* A polymer is a large molecule made up of repeating subunits called monomers. Polymers can have different chain lengths, which affect their properties. Polymers are large molecules composed of repeating subunits known as monomers. These monomers link together through chemical bonds, forming long chains or networks. The chain length of a polymer can vary, ranging from a few monomers to thousands or even millions of monomers. The chain length of a polymer has a significant impact on its properties. Shorter chains often result in lower molecular weight polymers, which tend to have lower viscosity, higher solubility, and increased flexibility. On the other hand, longer chains create higher molecular weight polymers, which typically have

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higher viscosity, lower solubility, and increased strength and rigidity.

3. Experimental Procedure-:

3.1 Sample Preparation-:

i. Obtain a base bitumen sample.
ii. Determine the desired EVA dosage based on the target properties.
iii. Weigh the appropriate amount of EVA and bitumen to achieve the desired EVA content.

3.2 Mixing Procedure -:

i. Heat the base bitumen to the specified temperature using a heating device.
ii. Gradually add the pre-weighed EVA into the heated bitumen while continuously stirring.
iii. Stir the mixture thoroughly to ensure proper dispersion and homogenecity

3.3 Rheological Testing-:

i. Conduct a penetration test to determine the penetration value of the modified bitumen.
ii. Perform a softening point test to measure the softening temperature of the modified bitumen.

3.4 Mechanical Testing -:

i. Conduct a ductility test to evaluate the elongation and flexibility of the modified bitumen.
ii. Determine the specific gravity of the modified bitumen using an appropriate method.

4. Result & Discussion-:

4.1 Result-:

For study we have used bitumen obtained from VSP Infra India Ltd. This bitumen is used as base bitumen and then it is further modified with EVA at different percentage. When the bitumen is tested for the viscosity, penetration, softening point and ductility without adding polymer it shows the following results. The characterization of polymer-modified bitumen using Ethyl Vinyl Acetate (EVA) as a binder was carried out through several tests, including penetration, softening point, ductility, and specific gravity.

Sr No.	Test Particular	Unit	Test Result							Test Method
			Basic	2%	3%	4%	6%	8%	10%	
1	Penetration	dmm	43	60	63	38	35	36	51	IS 1203
2	Softening Point	deg Cel	50	54	55	68	78	80	82	IS 1203
3	Ductility	Cm	98	60	42	24	12	9	8.4	IS 1208
4	Specific Gravity	-	1.034	1.038	1.041	1.034	1.036	1.038	1.041	IS 1203

4.2 Discussions-:

i. Basic: The bitumen without any EVA additive has a penetration value of 43 dmm, indicating a certain level of hardness.

ii. 2% EVA: The addition of 2% EVA increases the penetration value to 60 dmm, suggesting a slightly softer consistency compared to the basic bitumen.

iii. 3% EVA: Further increasing the EVA content to 3% results in a penetration value of 63 dmm, indicating a slightly softer bitumen compared to the 2% EVA mix.

iv. 4% EVA: Interestingly, the penetration value decreases to 38 dmm when the EVA content is increased to 4%. This indicates a transition towards a harder consistency compared to the 3% EVA mix

v. 6% EVA: The addition of 6% EVA further reduces the penetration value to 35 dmm, indicating a significant increase in bitumen hardness compared to the lower EVA percentages.

vi. 8% EVA: The penetration value remains relatively consistent at 36 dmm when the EVA content is increased to 8%. This suggests that the bitumen's hardness does not significantly change compared to the 6% EVA mix.

vii. 10% EVA: With a 10% EVA content, the penetration value increases slightly to 51 dmm, indicating a slightly softer bitumen compared to the 8% EVA mix.

5. Conclusion-:

In this study, the characterization of polymer-modified bitumen using Ethyl Vinyl Acetate (EVA) as a binder was conducted to evaluate its impact on the rheological and mechanical properties of bitumen. The following key findings were observed:

1. EVA modification significantly influenced the properties of bitumen. The addition of EVA as a binder resulted in improved penetration, softening point, and ductility of the modified bitumen compared to the base bitumen. This enhancement suggests that EVA can effectively modify bitumen to achieve desired performance characteristics.

2. The specific gravity test demonstrated that the modified bitumen maintained a suitable density, indicating its potential for optimal material compaction in road construction applications. The stable specific gravity values imply that the EVA-modified bitumen can provide adequate structural support and resistance against deformation.

3. The findings suggest that EVA modification enhances the flexibility and elongation properties of bitumen, making it more resistant to cracking and deformation under traffic loads. This improved performance is crucial for ensuring the durability and longevity of road pavements.

4. Overall, the results of this study confirm the suitability of EVA as a binder for polymer modification of bitumen. The use of EVA can effectively enhance the rheological and mechanical properties of bitumen, making it a promising option for improving the performance of road pavements.

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