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# LATEX MODIFIED BITUMEN

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**ABSTRACT:**

Flexible pavements with bituminous surfacing are widely used in India. Exponential increase in traffic, overloading of commercial vehicles and variations in temperatures have shown some limitations of conventional bitumen performance. Flexible pavements can be defined as the one consisting of a mixture of asphaltic or bituminous material and aggregates placed on a bed of compacted granular material of appropriate quality in layers over sub-grade. Bituminous surfacing develops distress symptoms like cracking, rutting, raveling, undulations, shoving etc, are been reported in flexible pavements. Bitumen modified with Styrene Butadiene Rubber (SBR) which is one of the most effective polymer additive offers a combination performance related to physical properties of the bitumen. SBR is an elastomer which is an important sort of synthetic rubber whose molecule structure primarily consists of organic compound Styrene and Butadiene chain. It plays an active role in improving the visco-elastic properties bitumen and also changes rheological behavior of bitumen by increasing the resistance of mixture against permanent deformations. This paper presents the experimental study on modification of Bitumen by the replacement of bitumen by SBR latex at 0, 3, 5, 7, 9% by the weight of bitumen. Various tests on bitumen like penetration test, softening point, viscosity test and ductility test are conducted on addition of SBR latex with bitumen and results are compared. Marshall Stability test is the one of the important test conducted to decide the performance of the bituminous mix. So, Marshall Stability test is conducted for various percentages of SBR latex and optimum % is determined. The properties of the mix evaluated by Marshall test are stability, flow, air voids (Va), volume of mineral aggregates (VMA) and void filled with bitumen (VFB). From this test optimum content of SBR to be added to bitumen is obtained. SBR latex is an easily available product and also economical.

**Keywords: Sub grade, Soil, Lime stone, Natural soil, Base grade, waste plastic, gravels, Fly ash.**

## 1. INTRODUCTION:

In India Bitumen is widely used for construction of flexible pavements since long time. But their actual duration of working is 5-10 years only instead of their

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design period, because they undergo repairs and rehabilitation of pavements needs additional cost which will directly increases the construction cost of pavements. The main reasons of this quick deterioration of Pavements are the conditions of adverse climatic factors and heavy traffic loads. These leads to development of distress symptoms like cracking, rutting, undulations, ravelling of bituminous surfacing. Bitumen as a visco-elastic material plays a prominent role in determining many aspects of road performance. Various types of crude sources and refining process lead to extreme complexity in bitumen chemistry and rheology. This rheological behaviour of bitumen varies depending on the loading time and temperature. A Bituminous mixture needs to be flexible enough at low service temperatures to prevent pavement cracking and to be stiff enough at high service temperatures to prevent rutting. Flexible pavements containing conventional bitumen do not always perform as expected. In improving the properties of bitumen several types of modifications are done by addition of polymers, synthetic rubber, natural rubber and some chemicals. From the previous studies it has been revealed that properties of bitumen mix can be improved to meet the growing requirements of pavement with incorporation of certain polymers. Bitumen modified with polymer offers a combination of performance related benefits as they improve the physical properties of bitumen without changing the chemical nature of it. Two types of polymers are generally used in bitumen for road construction: Plastomers and Elastomers. Basically, plastomers increase the viscosity and stiffness of bitumen and elastomers also improve the elastic behaviour of bitumen. Plastomers like Polyethylene, Polypropylene etc., Elastomers like Styrene Butadiene Rubber, Styrene Butadiene Styrene are generally used. These polymers usually influence bitumen by creating an Inter-connecting matrix of polymer through bitumen. It is this matrix of long chain molecules of added polymer that modifies the physical properties of bitumen. This additive increase the elasticity, decrease the brittle point and increases the softening point of bitumen. This results in greater stiffness of bitumen mix at higher temperatures and high flexibility at low temperatures. In this case, study on the properties of bitumen on addition of SBR latex is made. In general SBR latex is used as an abrasion resistant replacement for natural rubber. It can be produced by free-radical solution polymerization or by emulsion polymerization either warm at 300C to 600C (hot rubber) or at cold temperatures near 00C (cold rubber). SBR is comprised of 75% butadiene ($CH_2=CH-CH=CH_2$) and 25% of styrene ($CH_2=CHC_6H_5$). On polymerization process the styrene and butadiene repeating units are arranged in a random manner along a polymer chain. A large amount of SBR is produced in latex form as a rubbery adhesive for use in applications such as carpet backing, water proofing, flooring, cable insulation etc,. SBR is one of the cheaper synthetic elastomers

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that sometimes used as a substitute for Natural Rubber. The addition of styrene lowers the price contributes to good wear and bonding properties. The addition of SBR also improves the strength, abrasion resistance and blend properties of poly-butadiene. The fatigue resistance and low temperature properties of SBR are inferior to Natural Rubber but its heat-aging and abrasion resistance are better.

## 2. RELATED STUDY:

Mix layout is the technique of selecting the most notable stabilized content material of several elements of the pavement. The favoured principle of blend design is that the aggregate have to provide outstanding overall performance whilst built inside the preferred function inside the pavement form of sub-grade. Design proportions of the materials are usually based on an evaluation of the effect of several proportions on decided on engineering homes of the aggregate. Numerous studies guides and technical publications are available to useful aid the engineer within the desire requirements to determine the quantity of every aspect. A significant form of take a look at techniques have been proposed inclusive of- California way, Eades and Grim technique, Illinois system, Louisina manner, Oklahoma method, South dekota technique, Texas method, Thompson way, Virginia technique and lots of others. Engineering houses which are considered, relying at the goal are- Attenberg limits California Bearing Ratio (CBR), swell capacity, unconfined compression electricity (UCS) of cured or uncured combinations, Freeze-thaw and wet-dry check and lots of others. The combination layout way includes the checking out for electricity and for durability. Most researchers mentioned that at the least three percentage lime is important to supply suitable sufficient reaction in the discipline. The National Lime Association recommends three, five and 7 percentage lime in the trial mixes. Industrial wastes or through-products, regionally to be had materials may be used to in part replace the natural aggregates in base or sub-base software, which aren't used for other creation functions but available in huge portions at a nominal fee. These substances won't suit the desired requirements or specs however offer a prospect for their premiere utilization in road creation. Use of the above substances may additionally result in a lower within the construction price of roads, fine the first-class necessities and can also assist in enhancing the energy and sturdiness of the pavement. In the existing paintings slag from metallic plant industries and locally available hard moorum are used as non-traditional materials in street base and sub-bases.

## 3. METHODOLOGY AND TASTING:

This chapter describes the materials used, the preparation of the test specimens and the test procedures. MATERIALS REQUIRED

**COARSE AGGREGATE:** Coarse aggregate shall be crushed material retained on 2.36 mm sieve and shall be crushed stone, crushed slag. It shall be clean, strong,

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durable, fairly cubical shape & free from disintegrated pieces, organic or other deleterious material. The aggregate shall be hygroscopic and low porosity. Aggregate most of which is retained on 4.75-mm IS Sieve and containing only so much finer material as permitted.

**FINE AGGREGATE:** Fine aggregate shall be the fraction passing through 2.36 mm sieve and retained on 0.075 mm sieve consisting of crusher run screenings, natural sand or mixture of both. It shall be clean, hard, durable, uncoated, dry & free from any flaky pieces and organic matter. Aggregate most of which passes 4.75-mm IS Sieve and contains only so much coarser material as permitted.

**FILLER MATERIAL:** The filler material chosen in this project is stone dust. The main function of filler is to fill the voids between coarse aggregate and fine aggregate and increases the density of the mix. Stone dust is by- product of crushing stone. It has ability to form strong, non-porous surfaces. Now a day's stone dust is used as replacement to fine aggregate and showing better results. The requirement of filler in bituminous concrete shall normally be met by the material passing through 75µm sieve in fine aggregate, if any. In case the fine aggregate is deficient in material passing through 75µm sieve, extra filler shall be added. The filler shall be a inert material, the whole of which passes 600µm sieve, at least 90% passing 150µm sieve & not less than 70% passing 75µm sieve. The filler used in this paper is stone dust.

**BITUMEN:** Bitumen acts as a binder which binds coarse aggregate, fine aggregate & filler material and imparts strength. Bitumen of 80/100 grade is used in this study. 5% of total mix is added. Bituminous materials or asphalts are extensively used for roadway construction, primarily because of their excellent binding characteristics and water proofing properties and relatively low cost. Bituminous materials consists of bitumen which is a black or dark coloured solid or viscous cementitious substances consists chiefly high molecular weight

**TESTING:**

The compressive power of cement stabilized cube specimens (15 cm ×15 cm ×15 cm) became determined as in step with IS: 4332 (Part V) -1970. Specimens have been prepared to the predetermined most dry density taking substances as plenty as a most length of 37.Five mm compacted on the quality moisture content material. The compaction end up executed via a vibratory hammer equipped to three tampers with special heights (as established in fig.Three.2.) for compaction in three layers (every of five cm) of the dice.

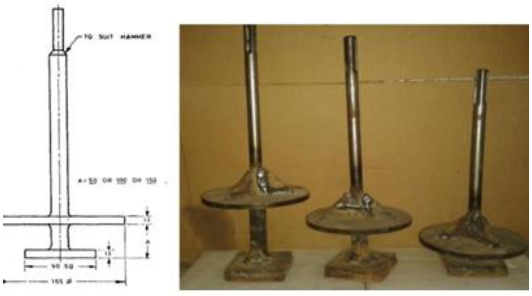

**Fig.3.1. Tampers.**

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The distinction in weight before garage and after elimination (7 days from the time of compaction) was determined to be within 2 g (which is lots less than the allowable restrict of 10 g) for all of the specimens. The specimens after elimination from the tin were then without delay tested in the Compression Testing Machine at a steady charge of loading (35 kgf/cm2/min) until failure.

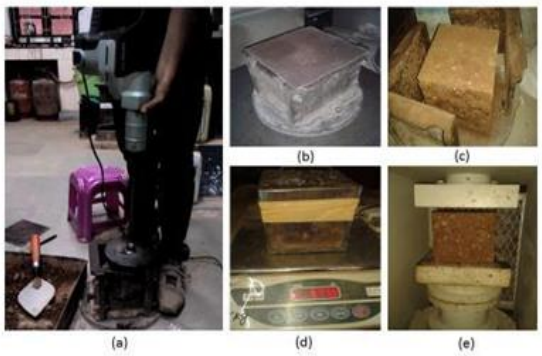


**Fig.3.2. Compressive models.**

## 4. CONCLUSION:

From the Marshall Stability test results, on comparison between conventional and SBR latex modified bitumen, it can concluded that there is a considerable increase in the stability value in the modified bitumen.

• Marshall Stability value at 5% SBR is 15.7 kN which is maximum and least at 0% SBR as 8.9 kN.

• Flow value increases on addition of SBR content, this indicate flexibility of the mix. Air voids in a mix must be minimum and in this study minimum air void of 3.43% is observed at 5% of SBR content and maximum is observed at 0% SBR as 4.8.

• VMA value of 15.2% is observed as least at 5% of SBR and 16.87% at 0% SBR.

• VFB value of 77.5% is observed as maximum at 5% of SBR and minimum is observed at 0% of SBR as 70.3%.

• From these results it is concluded that optimum SBR content to replace bitumen by weight is 5%.

• Therefore usage of SBR latex as modifier fetched better results and is even economical.

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