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Stabilization of Bituminous Roads using Parapro Polypropylene and Sodium Silicate

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Abstract: This paper presents a part of research on the rheological properties of bitumen modified by Parapro polypropylene polymer with sodium silicate used as a binder. Parapro polypropylene polymer obtained as a waste ropes, whose disposal is a matter of concern can be used successfully to modify the bitumen, these waste polymers are added in 5%, 10%, 15% and 20% percentages in S65 grade bitumen with 2%, 4%, 6%, 8% of sodium silicate and its effect on different properties of bitumen are evaluated. The obtained bitumen content with polypropylene fibers are used to assess the volumetric properties of Marshall Mix design to evaluate the stability of flexible pavement. The rheological study of polymer modified bitumen (PMB) was done by using penetration, ring & ball, softening point and viscosity test. The results are related to the changes in the rheological properties of polymer modified bitumen. It was observed for polymer specimens that the Engineering properties are increased and flow values reduced in a recognizable way, which shows that the modified bitumen is preferred for national highways and high temperature zones. The change of the properties of bituminous mixture shows the constructive outcome of polypropylene fibers.

Keywords: Waste Rope, Parapro polypropylene polymer, Sodium silicate, Polymer modified bitumen.

I. INTRODUCTION

This paper presents a part of research on the rheological properties of bitumen modified by parapro polypropylene polymer with sodium silicate used as a binder. Parapro polypropylene polymer obtained as a waste ropes, whose disposal is a matter of concern can be used successfully to modify the bitumen, these waste polymers are added in 5%, 10%, 15% and 20% percentages in S65 grade bitumen with 2%, 4%, 6%, 8% of sodium silicate and its effect on different properties of bitumen are evaluated. The obtained bitumen content with polypropylene fibers are used to assess the volumetric properties of Marshall Mix design to evaluate the stability of flexible pavement. The rheological study of polymer modified bitumen (PMB) was done by using penetration, ring & ball, softening point and viscosity test. The results are related to the changes in the rheological properties of polymer modified bitumen. It was observed for polymer specimens that the Engineering properties are increased and flow values reduced in a recognizable way, which shows that the modified bitumen is preferred for national highways and high temperature zones. The change of the properties of bituminous mixture shows the constructive outcome of polypropylene fibers.

Synthetic polymers can come in a variety of forms, such as common plastics, the nylon of a jacket, or the surface of a non-stick frying pan. One of the most common environmental problems associated with synthetic polymers pollution is that 44 percent of seabird species are known to have ingested synthetic polymers that have been mistaken for food. persistent organic pollutants, are known toxins that remain in the environment for many years, such as the pesticides DDT and toxaphene. A 2007 study by researchers at the University of the Pacific sampled synthetic polymers found at coastal sites in the northern Pacific ocean, and found the presence of harmful toxins in every sample of synthetic polymers. These synthetic polymers can continuously secrete harmful chemicals into fish and wildlife when ingested and threatens the health of ocean fisheries that humans eat from. Americans alone use an estimated 102.1 billion plastic bags - a synthetic polymer - each year,

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and less than 1 percent of these bags are recycled. Not only do these synthetic polymers slowly leach harmful chemicals in the soil, their longevity and non-biodegradability means new landfills will be a constant need as synthetic polymer use continues and grows.

II. MATERIALS

A. Parapro polypropylene Polymer

Polypropylene polymer is user friendly but not eco-friendly as they are non-biodegradable generally, it is disposed by way of land filling or incineration of materials which are hazardous. The better binding property of Polypropylene polymer in its molten state has helped in finding out a method of safe disposal of waste polypropylene polymer. This study presents the use of waste in hot bituminous mixes to enhance pavement performance, protect environment and provide low cost roads. Polypropylene (Pp), also known as polypropene, is a thermoplastic polymer used in a wide variety of applications including packaging and labeling, textiles (e.g., ropes, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components etc…

B. Sodium Silicate

Sodium silicate is a white powder that is readily soluable in water, producing an alkaline solution. They are glassy, colourless and soluble in water. Therefore it is also known as water glass or liquid glass. Sodium carbonate and silicon di oxide react when molten to form sodium silicate and carbon -di oxide. The main applications of sodium silicate were in water treatment, drilling fluids, concrete and general masonry treatment, detergent auxiliaries, refractory use, dye auxiliary, food preservation, metal repair, aquaculture.

III. EXPERIMENTAL METHODS

A. Penetration Test

The standard 100g, 25°C and 5sec penetration test was performed both on base bitumen and the concentration of polymer varying between 5%- 20% with sodium silicate varying between 2% - 8%. Hence, the penetration results in mm. The results of the test are shown in chart 1.

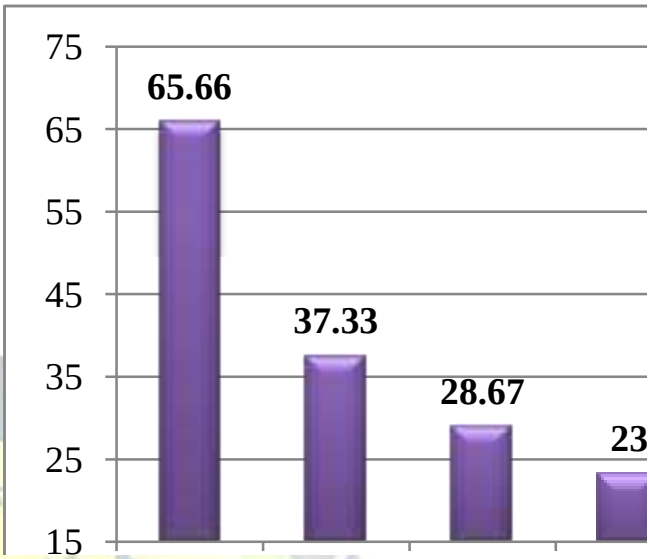

Chart 1: Penetration test results

B. Softening Point Test

Ring and ball is the standard test to determine the consistency of the bitumen, which represent the temperature at which a change of phase from solid to liquid occurs. It is the temperature at which standard 3/8 inch steel ball weighing 3.55gm fall and touches the base plate. Hence, softening point in °C. The results are shown in chart 2.

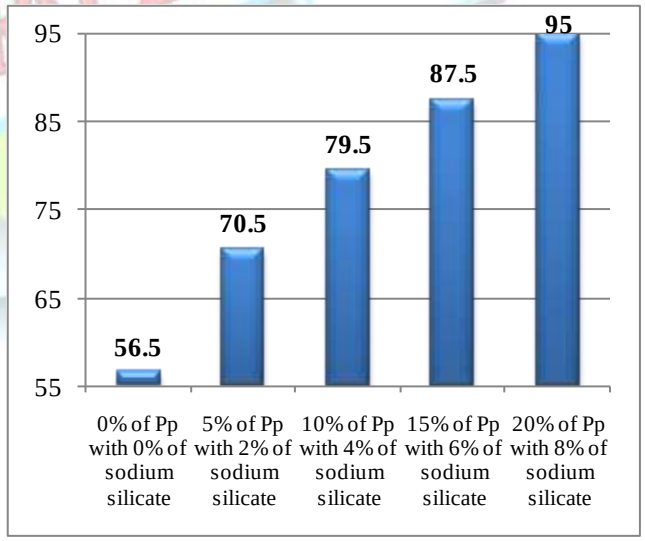

Chart 2: Softening point test results

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C. Viscosity Test

Viscosity test was conducted using Brook Field viscometer on virgin and polymer modified bitumen. The dynamic viscosity measurement were made at 80ºC. The test was carried out on all polymers up to the concentration of 3% and viscosities measurements were made on increasing shear rates (shear stresses). Hence, viscosity results in seconds. The results are shown in chart 3.

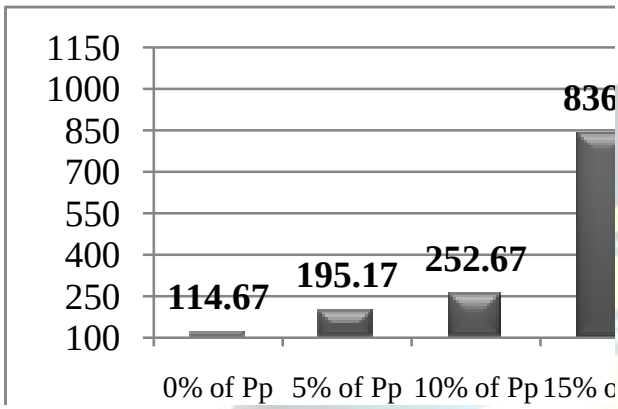

Chart 3: Viscosity test results

D. Ductility Test

The ductility of a bituminous material is measured by the distance in centimeters to which it will elongate before breaking when a briquette specimen of the material are pulled apart at a specified speed and at a specified temperature. Hence, Ductility values in cm. The results are shown in Chart 4.

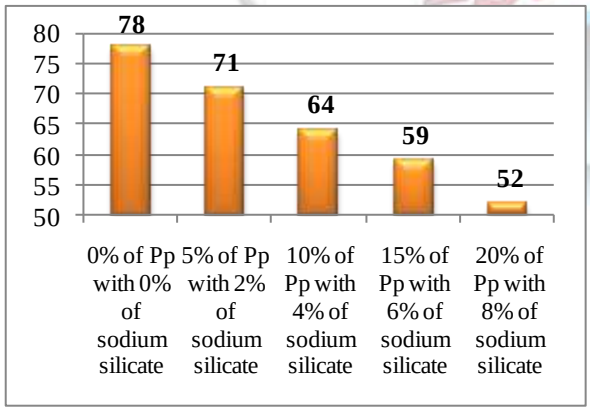

Chart 4: Ductility test results

E. Marshall Stability

Marshall stability is related to the resistance of bituminous materials to distortion, displacement, rutting and shearing stresses. Marshall stability measures the maximum load sustained by the bituminous material at a loading rate of 50.8mm/min. The test load is increased until it reaches the maximum. Beyond that, when the load just start to decrease, the loading is ended and the maximum load (ie., Marshall stability) is recorded. During the loading test, dial gauge is attached which measures the specimen's plastic flow owing to the applied load. The flow value refers to the vertical deformation when the maximum load is reached. The results are shown in chart 5 and chart 6.

Table -1: Marshall Stability Values

S.No	Sample	Stability Values(Kg)	Flow Value(mm)
1.	Bitumen 0% Pp with 0% sodium silicate	1217	5.14
2.	Modified Bitumen-I 5% Pp with 2% sodium silicate	1518	4.72
3.	Modified Bitumen-II 10% Pp with 4% sodium silicate	1700	3.17
4.	Modified Bitumen-III 15% Pp with 6% sodium silicate	1929	2.86
5.	Modified Bitumen-IV 20% Pp with 8% sodium silicate	2186	1.62

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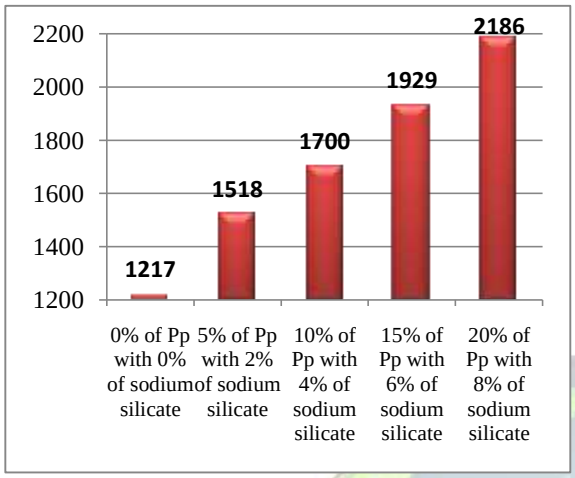

Chart 5: Marshall Stability test results

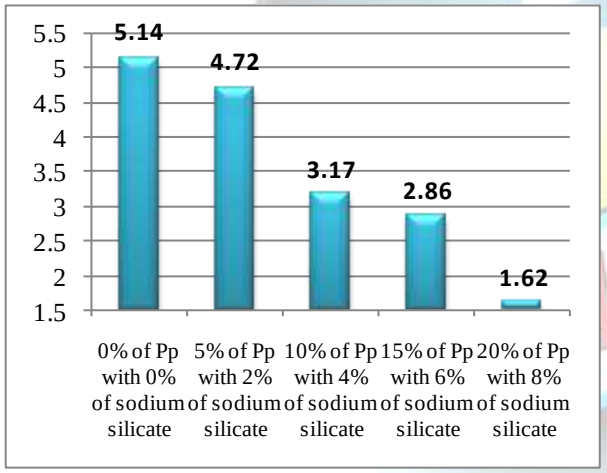

Chart 6: Marshall Flow test results

IV. CONCLUSION

From this project on the Enhancement in stabilization of biutminous roads using parapro polypropylene with sodium silicate, parapro polypropylene polymers are added in 5%, 10%, 15% and 20% in bitumen with 2%, 4%, 6%, 8% of sodium silicate and its effect on different properties of bitumen are studied and evaluated. Also it is found that, the marshall stability value increases with decreases in marshall flow value upon the addition of polypropylene and sodium silicate i.e. the resistance to deformations increases under heavy wheel load. i.e. the resistance to deformations increases under heavy wheel load. It is found that polymer modified bitumen i.e. 10% of parapro polypropylene with 4% of sodium silicate shows the better improved properties for flexible pavement construction. The result of this polymer modified bitumen of 10% of polypropylene with 4% of sodium silicate is found to be satisfactory. The test values are within the required specifications and also it may offer resistance to rutting. So, polymer modified pavements would be a boon for India's hot and extremely humid climate condition. This also can reduce the amount of parapro polypropylene rope waste which otherwise are considered to be a threat to the hygiene of the environment.

REFERENCES

[1]. C. Neeladharan et.al, "Enhancement of Stabilization in Bituminous roads using Polyethylene and Epoxy resin," International Research Journal of Engineering and Technology, vol. 4, no. 4, pp 2401-2404, 2017.

[2]. C.Neeladharan et.al, "Enhancement of Stabilization in Bituminous Roads using Propylene Glycol," International Journal of Advanced Research Trends in Engineering and Technology, vol.5, no.5, pp. 95-99, 2018. DOI: 10.20247/IJARTET.2018.05S05030018

[3]. C.Neeladharan et.al, "Enhancement in stabilization of bituminous roads using Polypropylene and Calcium Hydroxide," International Journal of Advanced Research Trends in Engineering and Technology, vol.5, no.5, pp. 100-103, 2018. DOI: 10.20247/IJARTET.2018.05S05030019

[4]. IS 1206-1978 Methods for testing Tar & Bituminous material for Viscosity.

[5]. IS 1203-1978 Methods for testing Tar & Bituminous material for determination of penetration.

[6]. IS 2386(Part 1) -1963 Methods of testing a Aggregates for concrete particle size and shape.

[7]. IS 2386- 1963 (Part 3) Methods of test for Aggregates for concrete Specific gravity, Absorption, (Part 4) Methods of test for Aggregates for concrete Impact value.