INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 02, February 2024, pp : 498-500

e-ISSN : 2583-1062

Impact Factor : 5.725

REVIEW PAPER ON APPLICATION OF ZYCOSOIL IN BITUMINOUS MIX

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DOI: https://www.doi.org/10.58257/IJPREMS32705

ABSTRACT

Rapid increase of urban population in India with rapid rise in industrialization needs high demand of vehicles. Road sectors are very important for the growth of economy, employments and empowerment of a country. India's road network with nearly 55 lakh Km road length is second largest road network in the world. About 98% roads are flexible in nature and rest 2% are rigid pavements. Approximately 40% roads are unpaved of total road lengths. The natural bitumen shows failure and serious problems during rainy seasons. Because of increasing traffic load in term of number of axles and high tyre pressure due to heavy vehicles the traffic related pavement distresses are found in the pavement. Stripping occurred because of moisture damage is considered as one of important pavement distress in bituminous pavement since 1990s. Moisture damage causes the stripping of pavement layer aggregate which is to be considered as a serious problem these days. Moisture damage is progressive loss of functionality of the materials because of that there is the loss of adhesion between bitumen binder and the aggregates, Zycosoil as an anti-stripping agent is used to provide the better adhesion bond between bitumen binder and the aggregates in the presence of water. The treatment and strengthening of bitumen is required to keep the pavement surface serviceable. Zycosoil, a Nano material recently used as an additive to strengthen the pavement surface and to improve the properties like penetration, ductility and moisture damage of pavement.

Keywords- Zycosoil, bituminous pavement, stripping, bitumen binder, ductility

1. INTRODUCTION

The rapid increase of urban population of India with the rapid rise in industrialization coupled with the high increase of road vehicles engaging in rapidly expanding cities to fit the developmental needs of the economy demands good quality of roads to meet the increasing pressure of road traffic. It becomes the responsibility of scientists, researchers, contractors to improve the riding quality while maintaining the economy for the country like ours. Bituminous Mixes are most commonly used in the world for the pavement construction. India has a road network of over 54 lakh kilometers as on March 2015, the second largest road network in the world. However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are being improved. As on March 2015, 61% of Indian roads were paved. About 97 to 98% of the paved roads in India have flexible pavements, within which are included surfacing of various types and thickness.

The complicated micro-structure of asphalt concrete is related to the gradation of aggregate, the properties of the aggregate and binder interface, the void size distribution, and the interconnectivity of voids. For important applications where traffic is extremely heavy, stiffer mixes are required. Keeping these facts in minds it was felt that efforts can be made to use some chemical additive in VG- 30 grade bitumen and study the various parameters of bitumen and bituminous mixes. Generally, 92 to 96% aggregate are used in bituminous concrete. Aggregate is also used for base and sub-base courses for both rigid and flexible pavements. Thus. aggregate plays an important role in the roads construction.

The country like India, where massive construction is going on, and a huge quantity of aggregate is required every day either in building or in road construction, there are limited sources of stone and if the present condition continues, in near future, there will be shortage of aggregate for important constructional works. Hence the road developers need an additive which is used to improve the various properties of binder and bituminous mix so as to helpful in the construction of long life.

The road industry is therefore looking forward for a materials and construction technology, which are environment friendly, energy efficient and cost effective for the construction and maintenance of roads. Zycosoil have been used as a construction material all over the world. Zycosoil is a very good anti striping additive and capable to increase the adhesion between asphalt binder and aggregates in presence of water. Asphalt concrete prepared with Zycosoil shows higher strength and stiffness of the mix. The addition of Zycosoil in bituminous mix increased the stability.

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2. LITERATURE REVIEW

Some of the literature reviews are presented below- Arabani et al., (2011) shows that granite is more susceptible to water as compared to lime stone because of higher free energy of adhesion in between granite aggregate and water as compared to lime stone and water. The WMA additive named sasobit and asphamin increases the moisture susceptibility by decreasing the adhesion between acidic aggregates. While on using Zycosoil as an anti-stripping agent it increases the surface free energy between aggregate and asphalt modified with WMA additive in the presence of water resulting to decrease the stripping. By using zycosoil as anti-stripping agents the dynamic modulus for wet/dry condition is increased shows better resistance to moisture damage in mixture with higher dynamic modulus value. Also, Zycosoil helps to decrease the surface area wetted by water by converting the hydrophilic silanol groups into molecular level hydrophobic siloxane (Si-O-Si) group.

Ameri et al., (2013) said that the anti-stripping additives named Zycosoil and hydrated lime slurry have more effect on the mix made with siliceous aggregate than mix made with lime stone. In the other result, the higher value of fracture energy of Zycosoil mixture in comparison to hydrated lime slurry mixture shows that the Zycosoil mix is more dominant to resist the moisture damage than hydrated lime slurry mix and it improves the adhesion bond between aggregates and bitumen binder. So, addition of Zycosoil improves the resistance to moisture damage of HMA mixture.

Khodaii et al., (2013) shows that Zycosoil decreases the difference between free energy for adhesion of asphalt-aggregate in the dry and wet condition which is considered as the amount of energy released for stripping resulting the mixture to become more resistive to moisture. Also, it decreases the rate of moisture damage by decreasing the difference between SFE of aggregate-asphalt and aggregate-water. Aggregate surface area exposed to water is also decreased after treating with Zycosoil. As the dynamic modulus ratio is increased for Zycosoil treated aggregate shows the decrease in moisture susceptibility of mixes.

Sarkar et al., (2014) stated that there is the shortage of stone aggregates in some parts of the country so there is a need to find out an optional material which can be used as aggregate in place of regularly used material so to fulfill this requirement the weak materials like over burnt bricks are used as a coarse aggregate in bituminous concrete pavement construction when it is treated with Zycosoil. As the over burnt bricks aggregates are water susceptible leads to the stripping of aggregates so anti-stripping additive Zycosoil is used to take care of this problem. The stripping percentage is decreased for both stone and over burnt brick aggregates after treating it with Zycosoil.

The optimum bitumen content is high in case of over burnt brick as compared to conventional mix because of higher porosity and roughness of over burnt brick. Stability value is increased by 30% in case of over burnt brick aggregates when it is treated by Zycosoil. Behbahani et al., (2015) concluded that the mechanical property of glasphalt such as stiffness modulus which is increased and its permanent deformation is reduced due to improvement of bitumen stiffness by using Zycosoil in the mix. The mixture modified with Zycosoil has higher tensile strength resulting in the mixture to be capable to withstand larger tensile stress. Also, the increase in specific area of modified bitumen provides better adhesion between asphalt, glass cullet and aggregate and also the improvement in moisture susceptibility is observed. In this study, the 4.5% (by weight of bitumen) zycosoil improves the moisture susceptibility. So, the use of Zycosoil can enhances the cohesive strength in between glass cullet and aggregates.

Mirzababaei Peyman (2016) shows that the siliceous aggregate has greater affinity to water than asphalt shows more affinity of it towards the moisture damage. The type of aggregate and gradation both affects the functional properties of mix but type of aggregate has greater effect and it is suggested that do not use the siliceous aggregate without anti stripper because mix of only siliceous material does not satisfy the criteria ensuring the good performance against stripping.

3. MATERIAL USED

General

In this study, the various materials used to perform the experimental investigation to conclude their suitability are described with their requirements for bituminous concrete pavement construction.

Material Used

The material used in the test program includes-

- Natural aggregates as a coarse and fine aggregate
- Stone dust as filler material
- Bitumen binder of VG-30 grade
- Zycosoil as an additive and
- Water

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