Evaluation of Rheological Properties and Performance of Asphalt Binder Modified with Nano Clay

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Abstract

The rheological behavior of bitumen is very complex and it can be varied from purely viscous to elastic depending on the loading time and the temperature. Bitumen plays a major role in many aspects of road performance. Various investigations have been carried out related to the modified bitumen to improve the performance of bituminous mixtures. Most of the Roads are failed due to the rutting and cracking of the bituminous layer which is due to the mostly poor performance of bituminous binders. So, the modification of the bitumen has been major approach in today and modified bitumen is effectively used in many countries during last three decades to construct the pavements. This research presents a laboratory scale evaluation of the conventional and the fundamental rheological characteristics of modified binders with micro clay and Nano clay contain 2%, 4%,6% & 8% by its weights.

Engineering fields are widely used montmorillonite (MMT) nano clay for wide range of applications. In Sri Lanka also, there had been few researches about the usability and characterization of MMT clay which is available at Mannar area near to the Giant tank. The clay powder prepared from the original samples taken from the above area was added to the original bitumen of 60/70 penetration grade binder to prepare the modified binder. The prepared clay powder was subjected to the X- ray diffraction to identify the MMT clay.

Modified bitumen samples were prepared by adding nano clay mixed at 160^0C with the mixing time of 25minutes. The properties of the modified binders with nano clay were evaluated in terms of their properties using penetration, softening temperature, ductility and dynamic viscosity tests. Finally, modified bitumen each sample were evaluated for the rutting and fatigue resistant for fresh and aged samples with the Dynamic Shear Rheometer (DSR) test.

It was observed by the results obtained from the tests that the softening point and viscosity increased up to 4% clay, penetration and ductility has decreased with increasing of clay percentage. Rutting resistance has not improved with compared to conventional bitumen and it was showed that modified bitumen and original sample were showed PG 70 grade with 2%, 4%, 6% and original bitumen sample. Finally, few samples of modified binder with nano clay was checked with Furrier Transform Infrared Spectrometer (FTIR) to identify any chemical changes with compared to conventional bitumen. As a conclusion from these findings that is

the montmorillonite clay modification helped to improve some characteristics of the bitumen binders. But at this level they are not at the stage to verify application at large scale.

Keywords: Nano clay, Montmorillonite, Viscosity, Penetration, Softening point, Dynamic Shear Rheometer

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