UNIVERSITI TEKNOLOGI MARA

CHARACTERISATION OF NANOSILICA MODIFIED ASPHALT BINDER

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ABSTRACT

The base asphalt binder has several disadvantages which limits its use in heavily trafficked highway and in high temperature environment due to its low resistance to rutting. Therefore, base asphalt binder is normally modified to enhance its properties. Nanosilica (NS) has been used in many fields to improve the properties of materials due to its enhancing properties such as large surface area, good dispersal ability, strong adsorption, high chemical clarity and excellent stability. The aim of this study was to investigate the use of NS as an asphalt binder modifier to improve the binder properties. Penetration grade 60/70 (PEN 60/70) asphalt binder was modified with NS in colloidal form with an average size of 10 to 15 nanometer (nm). The asphalt binder was mixed with different percentages of NS by weight of the asphalt binder. The nanosilica modified asphalt binders (NSMB) were tested for different properties such as physical properties, morphological properties, rheological properties, chemical properties and mechanical properties. The result obtained from physical properties shows that the additions of NS significantly improve the properties of base asphalt binder in terms of penetration, softening point and viscosity. It was also found that NSMB is stable during the high temperature storage period. From PI and PVN result, the addition of NS to the base asphalt binder has improved its temperature susceptibility. SEM images showed that NS particles dispersed well in base asphalt binder and AFM images showed that the addition of nanosilica in asphalt binder improved its surface stiffness. In addition, NSMB significantly increases the $G^*/\sin\delta$ value, failure temperature, and percentage creep recovery while, decreased the non-recoverable creep compliance, which indicated higher elasticity and beneficial in increasing the rutting resistance as compared to the base asphalt. FTIR spectroscopy showed that the addition of NS into the asphalt binder improved the aging resistance. On the other hand, from APA test, it was found that NSMB reduced the rutting depth of asphalt mixture. It can be concluded from the analysis that a maximum of 2% NS be added into the base asphalt for optimum binder modification.

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