Performance of asphaltic concrete incorporating fly ash under low temperature

Ng Cui Ming[1,a,], Nicole Liew Siaw Ing[1,b], Khairil Azman Masri[1,c], Ramadhansyah Putra Jaya[1,d], Zaid Hazim Al-Saffar[2,e], Muhammad Naqiuddin Mohd Warid[3,f], and Norhidayah Abdul Hassan[3,g]*

[1] Department of Civil Engineering, College of Engineering, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Malaysia

[2] Building and Construction Engineering Department, Technical College of Mosul, Northern Technical University, 41002 Mosul, Iraq

[3] Faculty of Engineering, School of Civil Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor Bahru, Malaysia

[a]*cuiming96@gmail.com, [b]nicole95liew@gmail.com, [c]khairilazman@ump.edu.my, [d]ramadhansyah@ump.edu.my, [e]zaid.alsaffar025@gmail.com, [f]naqiuddin@utm.my, [g]hnorhidayah@utm.my

ABSTRACT

One of the most common asphalt concrete pavement distresses is low temperature cracking, also known as thermal cracking. Characterizations of low temperature cracking and formulation for pavement design have taken a lot of effort. Asphalt binder has viscoelastic behaviour, so asphalt mixture behaviour changes as the temperature changes. At high and low temperatures, the asphalt binder shows viscoelastic plastic behaviour and elastic behaviour. Low temperature cracks that grow day by day due to the movement of vehicles are the most significant pavement cracks caused by cold climates. It needs early and premature repairs to build and expand low temperature cracks. The aim of this research is to perform Low Temperature Cracking analysis of asphalt materials (laboratory and analytical assessment), in light of the latest update of binder cracking temperature. The role of basic material properties in low-temperature cracking was studied in this work. As a result, statistical analysis in the cohesive failure condition revealed that the asphalt mixture aggregate's free energy was ineffective in this cohesion failure. Fly ash had been used in the other type of asphalt mixture. It was proven that the addition of fly ash as an additive can improves the low temperature resistance of the asphalt mix. The binder with 60/70 penetration grade was used. The different amount of fly ash (0%, 1%, 3% and 5%) was added to the asphalt mixture. Marshall Stability and flow, resilient modulus and dynamic creep were carried out to investigate the mechanisms of cracking at low temperature. From the results obtained, there are significant effect comes from the addition of the fly ash. The result show that the addition of 5% fly ash produce the best outcomes for the density, stability, stiffness, resilient modulus and dynamic creep. Thus, it can conclude that the existence of fly ash in the mixture is able to enhance the mechanical performance of the AC14 dense-graded asphalt.

KEYWORDS

Fly ash; Low temperature; Asphalt mixture; Dynamic creep modulus; Stability

Acknowledgement
The support provided by Malaysian Ministry of Higher Education and Universiti Malaysia Pahang in the form of a research grant vote number PGRS210376 for this study is highly appreciated.