

## Moisture sensitivity and heavy metal leaching potentials of asphalt mixtures incorporating rubber modifiers and wax-based admixture

Sharvin Poovaneshvaran <sup>a</sup>, Ali Jamshidi <sup>b</sup>, Mohd Rosli Mohd Hasan <sup>a</sup>, Mohd Fahmi Haikal Mohd Ghazali <sup>a</sup>, Waqar Ahmed Gul <sup>c</sup>, Ramadhansyah Putra Jaya <sup>d</sup>

<sup>a</sup> School of Civil Engineering, Universiti Sains Malaysia, Engineering Campus, 14300, Nibong Tebal, Penang, Malaysia

<sup>b</sup> School of Science, Technology and Engineering, University of the Sunshine Coast, Queensland, Australia

<sup>c</sup> Department of Civil Engineering, College of Engineering, King Abdulaziz University, P.O. Box 80204, Jeddah, 21589, Saudi Arabia

<sup>d</sup> Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, 26300, Kuantan, Pahang, Malaysia

### ABSTRACT

Moisture damage is one of the most frequent damages that occurs on asphalt pavements. The application of rubberized materials for asphalt is widely acceptable due to cost saving and environmentally friendly. The purpose of this study is to assess the performance of rubberized asphalt mixtures containing wax-based admixture, namely Tough Fix Hyper (TFH), in terms of moisture sensitivity and hazardous compound leaching potential. The moisture absorption, chemical immersion, and boiling water tests were used to assess the resistance to moisture damage on aggregate-binder bonding characteristics. Following that, the trend of moisture sensitivity was evaluated through an image analysis procedure. To simulate the environmental impact of leaching, the toxicity characterization leaching procedure (TCLP) test was adopted. The results showed that interaction between the crumb rubber or latex with TFH decreases the stripping value of the mixes significantly based on the chemical immersion test. Furthermore, the image analysis of the samples subjected to boiling water conditioning showed that pixels of asphalt samples without TFH, ranging from 524,949 to 472,346, decrease from 520,870 to 289,070, indicating that the asphalt remained coated area improved by 67.70–91.39%. The analysis of the leachate test revealed that the heavy metals, including arsenic (As), nickel (Ni), copper (Cu), chromium (Cr), vanadium (V), and cadmium (Cd), were not detected. However, zinc (Zn) was detected in the modified mixture, ranging from 0.05 to 0.114 mg/L, which lies within the allowable norm. In conclusion, the incorporation of crumb rubber and TFH in asphalt mixtures poses no environmental risk.

### KEYWORDS

Bonding; Environmental studies; Moisture damage; Renewable resources; Sustainable pavement; Waste recycling

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