

# Physical, rheological and chemical features of recycled asphalt embraced with a hybrid rejuvenating agent

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## ABSTRACT

Rejuvenating agents are considered desirable options in rejuvenating recycled asphalt's properties. Hence, the capability of integrating waste engine oil (WEO) and maltene to rejuvenate the traits of recycled asphalt was investigated. The penetration, softening point, ductility and viscosity were measured to determine an ideal amount of hybrid rejuvenating agent. Then, the rejuvenated asphalt was evaluated against different samples through maltene to asphaltene ratio, rolling thin film oven (RTFO), storage stability, dynamic shear rheometer (DSR) and bend beam rheometer (BBR) tests. Later, the Fourier Transform Infrared (FTIR) spectroscopy, thermogravimetric analysis (TGA) and contact angle were employed. Based on the physical tests and the statistical analysis, the properties of recycled samples were restored approximately to that of the virgin asphalt by adding appropriate doses of hybrid rejuvenating agent. Meanwhile, the DSR and BBR results reported comparable performance between the rejuvenated and virgin samples. The hybrid rejuvenating agent has reduced the chemical ageing index and asphaltene content of the recycled asphalt. Moreover, TGA exhibited that the rejuvenated samples became more sensitive to temperature compared to recycled asphalt. In conclusion, 5% and 10% of the hybrid rejuvenating agent can renovate recycled asphalt for subsequent reuse in pavements depending on the characteristics of recycled asphalt.

**KEYWORDS:** RAP; recycled asphalt; asphaltene; maltene; hybrid rejuvenating agent

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