Mechanical Properties of Innovative Pothole Patching Materials Featuring High-Toughness Low-Viscosity Nano-Molecular Resins

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As asphalt pavements age and deteriorate, recurring pothole repair failures and propagating alligator cracks in the asphalt pavements have become a serious issue to our daily life and resulted in high repairing costs for pavement and vehicles. To solve this urgent issue, pothole repair materials with superior durability and long service life are warranted. In this work, **revolutionary pothole patching materials** with high toughness, high fatigue resistance that are reinforced with nano-molecular resins have been developed to enhance their resistance to traffic loads and service life of repaired potholes. In particular, **DCPD resin (dicyclopentadiene, $C_{10}H_{12}$)** with a ruthenium-based catalyst is employed to develop controlled properties that are **compatible** with aggregates and asphalt binders. A multi-level micromechanics-based numerical framework is developed to predict the mechanical properties and dynamic moduli of these innovative nano-molecular resin reinforced pothole patching materials. Irregular coarse aggregates in the finite element analysis are modeled as three sizes of randomly-dispersed multi-layers coated particles. The effective properties of asphalt mastic, which consists of asphalt binder, cured DCPD and air voids, are theoretically estimated by the homogenization technique of micromechanics in conjunction with the elastic-viscoelastic correspondence principle. Numerical predictions of overall elastic/viscoelastic properties and dynamic moduli are compared with suitably designed laboratory experimental results.

Keywords: Pothole patching materials, P-DCPD, Nano-molecular resins, Mechanical properties, High-toughness, Low-viscosity.