

Characterization of rubberized cement bound aggregate mixtures using indirect tensile testing and fractal analysis

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The main focus of this paper is to investigate the tensile properties of virgin and rubberized cement bound granular mixtures. This was conducted using indirect tensile testing with lateral displacement measurements, nondestructive resonant frequency testing, X-ray CT and quantitative assessment for cracking pattern using fractal analysis. The investigated properties were density, compacity, indirect tensile strength (ITS), indirect tensile static modulus, toughness, dynamic modulus of elasticity, dynamic modulus of rigidity, dynamic poisson's ratio, fractal dimension and fracture energy. To keep the same aggregate packing, the natural aggregate was replaced by waste tyres' crumb rubber of similar gradation. Four volumetric replacement percentages (0%, 15%, 30% and 45%) of the 6 mm fraction size were utilized. This adjustment was observed to affect the material density not only due to the lower specific gravity, but because it also affects the compactibility of the mixture negatively due to the damping action of the rubber particles. In addition, strength was also affected detrimentally. However, material toughness was improved and stiffness was mitigated. The latter findings were supported by quantitative assessment of the cracking pattern which revealed more tortuosity and a higher fractal dimension as a result of rubber content increasing. A failure mechanism for this type of mixture was suggested and support by examining the internal structure of failed samples using X-ray CT. Overall, construction of cement-stabilized aggregate base with a small percentage of added crumb rubber may ensure a more sustainable and environmental-friendly pavement material and, at the same time, improve the properties of stabilized layers. However, behaviour of these mixtures under cyclic loading and evaluation of their durability should be assessed to fully validate their use.