Effect of fibres addition on the physical and mechanical properties of asphalt mixtures with crack-healing purposes by microwave radiation

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Resumen

Microwave heating is regarded as a promising technique to promote crack-healing of asphalt mixtures reinforced with steel wool fibres. In addition to serving as a heat source when subject to microwave radiation, steel wool fibres are expected to affect the physical and mechanical properties of the asphalt pavements. However, it is not clear what this effect is, and what is the optimum fibre content that can provide effective crack-healing without having a negative impact on other relevant mixture properties. This paper reports a study of the steel wool fibres spatial distribution and their influence on the physical and mechanical properties of asphalt mixtures. For this purpose, five different dense asphalt mixtures, with the same aggregates gradation and bitumen content, but with five different percentages of steel wool fibres were manufactured. Then, their mechanical properties such as particle loss resistance in dry and wet conditions, and stiffness modulus and cracking resistance in Mode I of fracture at four different temperatures were evaluated. Samples of these mixtures were examined using Scanning Electron Microscopy and analysed using X-ray micro computed tomography to study the condition and distribution of fibres within the bitumen matrix. Microscopy results showed that fibres can be damaged during the mixing and compaction processes. A larger variability in the local distribution of fibres for mixtures incorporating a higher fibre content was observed in the tomography analysis, with presence of fibre clusters more than double of the average fibre content of the mixture. Although addition of fibres appears to reduce the bulk density of mixtures, according to tomography analysis differences in average porosity between samples were not statistically significant. Finally, it was confirmed that regardless of test temperature, steel wool fibres did not have a relevant influence on the improvement of particle loss resistance, stiffness modulus and cracking resistance of asphalt mixtures.

Palabras clave

Palabras clave de autor: Asphalt mixture; Physical properties; Mechanical properties; Fibres distribution; X-ray microtomography
KeyWords Plus: STEEL WOOL FIBERS; CONCRETE; PAVEMENTS; BEHAVIOR