Sustainable low-temperature asphalt mixtures with marginal porous volcanic aggregates and crumb rubber modified bitumen

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ABSTRACT

This study presents the results of the principal engineering properties of asphalt-rubber warm mixtures (AR-WMA) with waste crumb rubber from used tyres and highly-vesiculated basalt of scoriaceous nature, also considered a residual or marginal aggregate according to standard specifications. The temperature reduction was carried out using a liquid surfactant chemical additive, of easier dosage than granular solid products and in a reduced proportion (0.5% by weight of bitumen). The results were compared both to asphalt-rubber hot mixtures and to hot mixtures with conventional bitumen, all of them with the same aggregates. With the surfactant additive it is possible to lower the production temperatures by up to a maximum of 5–10 ºC complying with all the technical specifications for surface courses of pavements, and by up to 25–30 ºC for inferior layers or in case of more lenient requirements. Even in the first case, it may compensate for the increase of energy and emissions due to the higher viscosity of the asphalt-rubber binder. With a temperature reduction of 40 ºC, certain properties such as the moisture damage strength ratio, rutting resistance and stability were even superior compared to conventional mixtures without rubber (produced at 170 ºC). The results obtained may be extrapolated to other volcanic regions both insular and continental areas where this type of aggregates are commonly found and with rigorous environmental requirements.

Keywords: Low-temperature mixture, Warm mix asphalt (WMA), Volcanic aggregate, Vesicular basalt, Asphalt-rubber (AR), Reclaimed tyre rubber, End-of-life tyre (ELT), Surfactant additive