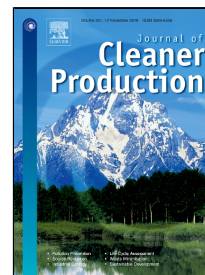


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Sustainable low-temperature asphalt mixtures with marginal porous volcanic aggregates and crumb rubber modified bitumen

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

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13 **ABSTRACT**

14 This study presents the results of the principal engineering properties of asphalt-rubber warm mixtures
15 (AR-WMA) with waste crumb rubber from used tyres and highly-vesiculated basalt of scoriaceous
16 nature, also considered a residual or marginal aggregate according to standard specifications. The
17 temperature reduction was carried out using a liquid surfactant chemical additive, of easier dosage than
18 granular solid products and in a reduced proportion (0.5% by weight of bitumen). The results were
19 compared both to asphalt-rubber hot mixtures and to hot mixtures with conventional bitumen, all of them
20 with the same aggregates. With the surfactant additive it is possible to lower the production temperatures
21 by up to a maximum of 5–10 °C complying with all the technical specifications for surface courses of
22 pavements, and by up to 25–30 °C for inferior layers or **in case of more lenient** requirements. Even in the
23 first case, it may compensate for the increase of energy and emissions due to the higher viscosity of the
24 asphalt-rubber binder. With a temperature reduction of 40 °C, certain properties such as the moisture

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