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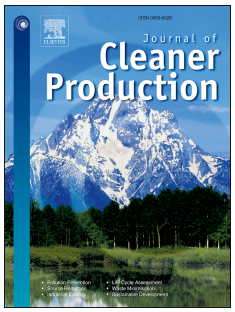

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Warm recycling of flexible pavements: effectiveness of Warm Mix Asphalt additives on modified bitumen and mixture performance

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Abstract

In pavement industry, environmental and economical sustainability stimulates technical solutions able to drastically decrease pollutants and energy costs caused by high production temperatures. In this sense, recent research efforts focused on innovative technologies able to significantly reduce mixing and compaction temperature. The so called Warm Mix Asphalts (WMA) are bituminous mixtures produced at reduced temperatures through specific additives based on different mechanisms. The novelty of WMA technologies determines a lack of experience about their effectiveness, which requires dedicated research activities, especially when polymer modified bitumens and Reclaimed Asphalt Pavement (RAP) are used.

Given this context, the present study proposes a comprehensive laboratory investigation on dense-graded mixtures produced through different WMA additives representative of the main categories currently available on the market (i.e. chemical, organic and water-based). Mixtures were prepared including Styrene-Butadiene-Styrene polymer modified bitumen and 25% of RAP to evaluate potential benefits deriving from the combination of warm and recycling techniques. For a complete understanding of WMA additive effects, mechanical tests (i.e. compactability, stiffness, fatigue) carried out on mixtures in a broad range of loading configurations were integrated by rheological analyses on bitumens.

Results indicate that lower production temperatures allowed a significant decrease in stiffness, effectively balancing the inclusion of RAP material without penalizing mixture performance. Compactability, volumetric and fracture properties indicate the possibility to produce suitable recycled warm mixtures when the appropriate WMA additive is selected. The chemical additive appeared able to provide overall improved performance, whereas the organic additive made the mixture brittle and susceptible to permanent cracking.

Key Words: warm mix asphalt; recycling; asphalt mixture; emission; binder