CERIS : Civil Engineering Research and Innovation for Sustainability

Lab validation of an novel modified mastic for the production of more sustainable bituminous mixtures

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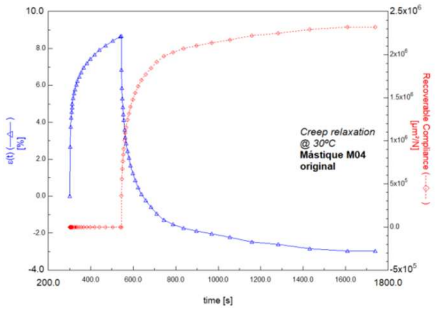
Summary

This Thesis was developed following a first one (also a PhD) in Civil Engineering (completed by the student in 2014) and led to the production and characterisation of a new mastic asphalt ("*Highly Modified Mastic with Sustainable by-products*", ***HMS***), which, among other properties, reduces bitumen and energy consumption. This new product also reuses available industrial waste (in large volumes), increases material durability and reduces gas emissions to the atmosphere. Current reality leads us to rethink and reduce the use of some less sustainable materials. This tendency was the primary motivation for developing new mastic asphalt that can replace a part of the virgin materials today. In order to fulfil these aims, a material deriving from reclaimed asphalt pavements has been developed. After having been mixed with manipulated industrial by-products and rheological behaviour modifiers, added to the residual and additional bitumen, this can substitute the fine fraction of the aggregates and a part of the total volume of mastic necessary for new formulations.

Different characterizations of the materials (binders, additives, fillers and aggregates), incorporated in the bituminous mixtures, were made (also in the CERENA research center – IST) in order to ensure the supported use of the novel developed mastic. Nine bituminous mixtures of three different types were studied (seven incorporated the new mastic, and two served as reference). Their mechanical behaviour was evaluated in performance tests, whose results were compared to others from similar studies. It was established that the mixtures with the new mastic generally behave more efficiently. Furthermore, it was possible to describe essential guidelines for producing and using this asphalt mastic, which has been strongly modified and is sustainable. Some other recommendations about its incorporation into new formulations were also defined. In addition, an accelerated ageing simulator for small samples was developed to support the advanced characterization of the materials produced. This automatic device ("*Aging for Materials*", *Agi4M*) includes the application of IR and UV radiations alternating with periods of immersion in water and has already been made available on the market.

Keywords

Novel mastic, sustainable bituminous mixtures, differentiated characterisation of elementary materials, bituminous mixtures performance, circular economy.



(a)

(b)

(a) Novel Mastic – Creep test (DMTA @ 30 ºC) – strain & recoverable compliance;
(b) Equipment developed to simulate accelerated ageing in small samples (Agi4M).