Combining reclaimed asphalt and non-petroleum-based binders for the design of sustainable asphalt mixtures

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Introduction

The use of alternative materials in asphalt pavements has become a critical matter in pavement engineering due to sustainability issues. These issues include the utilisation of finite resources, the need to re-use of wastes and reduce the generation of Green House Gases emissions. To cope with these issues, two approaches can be considered. Firstly, the use of Reclaimed Asphalt (RA) in new asphalt mixtures has become a common practice in the last decades in the asphalt industry particularly in small amounts (<20%). However, there are still some concerns on the use of higher amounts (>20%), due to uncertainties in its performance. Secondly, the use of non-petroleum-based binders as alternatives to conventional bitumen is starting to gain force in this field. Recently, the combination of both approaches has been shown to be feasible and could lead to more sustainable solutions in pavement engineering. Nevertheless, more research is needed to give confidence to these innovative asphalt mixtures towards their final implementation. On this regard, the aim of this investigation is to optimise the combination of a RA source and an alternative binder, made from vegetal by-products of other industries (biobinder) and targeting the maximum content of both materials in the asphalt mixture.

Methodology

For this purpose, two sources of reclaimed asphalt (RAs) and two type of biomaterials were characterised, namely a biobinder and a bioemulsion. The cohesion and stiffness properties of the RAs were studied by means of ITS and ITSM testing 100% RA specimens manufactured at different temperatures. With this, the degree of activation of the RA binders was estimated. On the other hand, the biobinder, bioemulsion and the extracted binder from the RA were conventionally and rheologically characterised at the whole range of service temperatures of pavements.

The optimisation of the design of the sustainable asphalt mixtures was performed using the rheology and performance-related properties of the RA, the extracted binder from RA and the biobinder, and the different results and hypothesis on the degree of blending between both binders obtained from the RA characterisation.

Results

The results of the RAs characterisation show the potential of these methodologies to determine the degree of binder activation as an intrinsic property of RA. The characterisation of the biomaterials reveals their ability to fully replace asphalt binders in hot and cold asphalt mixtures. Finally, the optimisation of the asphalt mixture design using the rheological and performance-related properties of the individual components of the mixture and the degree of blending between binder show its key role in the design of suitable and sustainable asphalt mixtures including alternative materials.

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