

Effect of the volume concentration filler/bitumen on the cohesion and adhesivity of the mastic

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Abstract

Nowadays, a certain lack of tests devised to properly assess the effect of filler on the filler-bitumen system or bituminous mastic results in a not optimal use of mineral dust in the asphaltic mixture. This is due to the fact that in the selection and dosification of the filler, only its fineness degree and the related plasticity are taken into account. Furthermore, current regulations on road construction (Orden FOM 891/04) proposes filler/bitumen dosifications based on pondered criteria, without taking into consideration, in any case, other properties that would allow a more accurate evaluation of the optimal demand of bituminous binder that the filler requires, in order to optimize the cohesion and adhesivity properties of the mastic in the bituminous mixture.

In order to perform a study of the effect that the filler exerts on the cohesion and adhesivity of the mastic, the Universal Method of Characterisation of Binders (UCL®) developed in the Laboratorio de Caminos of the Department of Infraestructura del Transporte y del Territorio of the Universidad Politécnica de Cataluña by Dr. Pérez Jiménez and Dr. Miró Recasens was used. This method, based on Cantabro test of loss by abrasion, has proven in several studies regarding performance properties of binders and mastics to be successfully used in assessing their cohesion and adhesivity in bituminous mixtures.

Experimental study stated in this work has intended to evaluate the effect of five filler with different origin and features but traditionally used in the bituminous mixtures design. This study is based on volumetric dosifications of filler with respect to the bituminous binder, obtained considering the critical concentration of filler. Blank UCL® specimens with different filler/bitumen volumetric ratios were performed to determine the cohesion and the adhesivity of the mastic by means of Cantabro test of losses by abrasion.

According to the obtained results it could be observed the benefits arising from the addition of filler to bituminous mixtures with the objective of increasing the cohesion and adhesivity properties, as well as the negative effects of an overfilling of the bituminous mixture. Moreover, it was noted the negative effects of the action of water on the adhesivity. Similarly, it was observed that the fillers of this study show a behaviour fairly close and these properties are optimized under a volumetric concentration/critical concentration (C_v/C_s) ratio ranging from 1.0 a 1.5, thus obtaining for the filler lime optimal ratios close to the lower limit of this range and, for the rest of studied fillers, optimal ratios close to the upper limit of the optimal range of volumetric dosification. It was also demonstrated the benefits of the use of lime and cement to improve the adhesivity properties of the mastic.

Finally, it is proposed a recommendation regarding the modification of currently applied pondering/weighted criteria of dosification of filler, to be replaced by volumetric-based criteria.