

Effect of temperature on fatigue behaviour of hot recycled mixtures with 30% RAP.

Author: Aitor Beguiristain Buira

Tutor: Félix E. Pérez Jiménez

Abstract:

Recycling of milling materials is a pavement rehabilitation technique that has increased during the last years. Thus, the guarantee of use of these materials has to be improved so investigation in this field is carried out in this thesis.

Most of the damages in asphalt pavements are due, directly or not, to the fatigue of the layers. Fatigue behaviour of recycled bituminous mixtures is one of the most investigated subjects right now.

Characterisation of pavements behaviour under fatigue load implies the consideration of a large amount of variables. Within them, the variable that presents most influence on the fatigue behaviour is the temperature. The importance of this variable is mostly due to the alteration of bitumen in front of temperature variations: low temperatures imply an elastic behaviour and when temperature increases viscosity appears and rises.

In this context, to evaluate the effect of temperature in recycled pavements, three-point-bending test with controlled displacement is carried out using several samples of recycled bituminous mixture with 30% RAP. This methodology has been applied at temperatures of 5°C and 35°C.

The achieved results in this test have allowed us to calculate the fatigue laws and dynamic modulus for each temperature (17.000 MPa and 2.000 MPa, respectively). The two fatigue laws (one for 5°C and the other for 35°C) behave in a parallel way. In addition to this, another fatigue law corresponding to samples of the same bituminous mixture, but now tested at 20°C, is compared with the previous ones, which allows visualizing a wide range of testing temperatures.

An analytical model called ECO-ROUTE has been applied to study the behaviour of a real pavement built with a hot recycled mixture. Fatigue behaviour of four pavement cross-sections has been analyzed with this model.

According to the test results and the model behaviour, the most important conclusion we can formulate is that medium temperatures are unfavourable to the fatigue behaviour of recycled pavements. Recycled bituminous pavements should have longer life when placed in extreme temperatures.

In addition to this, a new breakage criterion has been investigated. This criterion is based on the existence of a point of "critical deformation". We have observed that at low temperatures this criterion is equivalent to the classical one, but at high temperatures there is a great difficulty in the determination of the "critical deformation" point. Investigation of this subject must go on.