ABSTRACT

Used tyres have become an environmental problem for most countries in the world. The European Union has recently brought in legislation to encourage the public authorities to recycle this kind of residues. Spain approved its own National used tyres recycling programme, that forbids the admission of these residues in landfields since the 1st of January of 2007.

In the last few decades, civil engineering, specially in roadworks, has been using scrap tyre rubber in specific conditions as a modifying element of hydrocarbon binder used in the asphalt blends.

In this context, the aim of the present work has been to evaluate the crumb rubber modified effect on the properties of a M10 type gap-graded.

Four different blends with different scrap tyre rubber ratios have been analyzed. The first blend under study has been produced with BM3C asphalt binder and no rubber on its composition. This blend has been used as reference for the tests performed. The second blend under investigation has been produced using BM-PN binder with scrap tyre rubber introduced by wet process with a tyre ratio of 10% of the asphalt binder weight. The third blend has been made with a BM-PN binder, the same used in the second case, including scrap type rubber by dry process with a tyre ratio of 1% of the aggregate weight. Finally, the last blend tested uses the same BM-PN asphalt binder with addition of scrap tyre rubber by dry process with a 2% tyre ratio of the aggregate weight.

In order to evaluate the effects of the scrap tyre rubber into the M10 gap-graded, three different tests have been performed: the Cantabre test that evaluates cohesion and adhesivity to find the optimum content of binder for each blend; the Catalonia Direct Traction (CTD) test that evaluates parameters such as tenacity, maximum stress, maximum stress deformations or punctual stress deformations; and the laboratory trail test, that outputs the blend deformation velocity in the 105-120 min time interval.

Under the Cantabre test point of view, those blends with rubber on its composition have less cohesion and adhesivity, higher weight losses and more binder is needed in order to maintain their properties. From the results obtained with the tests performed in the present work, it can be seen that the increase of rubber the blend results in a loss on its performance.

From the CTD test point of view, those blends with scrap tyre rubber have less ductile performance and a tenacity loss when compared with no rubber blends. Analyzing the behaviour of the three different rubber blends under study, it can be seen a difference of those that introduce the rubber by dry process, in comparison with the one produced by wet process. The performance results of the three rubber blends under investigation show that the BM-PN 2% has a performance loss in comparison with the BM-PN and the BM-PN 1% that have a similar behaviour.

The results obtained by the laboratory trail test show that those blends with scrap tyre rubber on its composition have lower deformation velocity than the reference blend without rubber and therefore offer more resistance to permanent deformations. Furthermore, it has been observed that the ratio of rubber in the blend is inversely proportional to the deformation velocity.