



Experimental study of Nano clay and crumb rubber influences on mechanical properties of HMA

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Abstract: During the recent years, increased traffic load, axis load and tire pressure have influenced asphalt mixtures functions and has decreased transportation and shortened their lifetime. Although asphalt mixture function depends up on its material properties, precise design and manufacturing quality, using Nano materials and crumb rubber in asphalt mixture is improving for asphalt function enhancements. The study purpose is to investigate the impact of using Nano clay and crumb rubber together on mechanical properties of binder layer asphalt mixtures by Marshall and conventional bitumen tests by modifying the bitumen properties by the crumb rubber and substitution of usual fillers by Nano clay. In this study the crumb rubber (5, 10, 15, 20 and 25 weight percent of bitumen) was mixed with the pure bitumen 60/70 in wet method and the Nano clay was used with 5 different weight percent (from 1 to 5 weight percent of the aggregates). The study results showed that Marshall strength increased by increasing Nano clay and crumb rubber composition in the mix, and the highest strength obtained with 10% crumb rubber and 5% Nano clay portions. In addition, by increasing Nano clay-crumb rubber portion in the asphalt mixture, compared to the control sample, the aggregate pore volume increased, the total pore volume of the whole mixture was relatively increased and the mixture special gravity was slightly decreased. Also, by doing the bitumen tests it was observed that the modified bitumen thermal sensitivity decreased and its viscosity and penetration degree increased by increasing the crumb rubber portion.

Keywords: Nano clay; crumb rubber; asphalt mixture; Binder; Marshall test; thermal sensitivity; HMA.

1. Introduction

Early failures on pavements has led to less utilization lifetime of the pavements and the road users' safety and also increased maintenance costs, travel time and the users' expenses. Top layer and Binder, as the upper layers in asphalt paving on which the highest stresses of vehicle transports are implied are the most important layers. Therefore, many researches have been conducted on the improvement of these layers function in asphaltic mixtures. Today, modification methods and modern additives are used for paving improvement. In this respect, this study purpose is to evaluate the influence of adding both Nano clay and crumb rubber on improvement of mechanical properties of the asphaltic mixtures, based on the experimental investigations.

Nano technology is in fact the ability to produce new materials, tools and systems in molecular or atomic scale which affect the material interactions in microscopic scale [28]. One Nano structure material has been widely used to modify asphaltic mixture properties is Nano clay. Nano clay plays a filling role in