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Abstract

Modification of Road Bitumen with Partial Desulfurized Crumb Rubber †

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Abstract: Incorporating crumb rubber into road bitumen represents a fundamental advancement in enhancing pavement performance and managing tire waste. While poly(styrene-butadiene-styrene) is a common choice for enhancing elasticity, its inherent limitations and environmental implications necessitate the exploration of alternatives. This study introduces the development of a novel crumb rubber derivative with superior elastic properties. The resulting modified bitumen exhibited a 58.3% reduction in crumb rubber sulfur content and a consistent asphaltene content of 18.7 ± 0.2%, ensuring its homogeneity. This research marks an advancement in producing elastic bitumen for specialized applications, contributing to sustainable road construction practices.

Keywords: crumb rubber; desulfurization; road bitumen

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1. Introduction

The utilization of crumb rubber (CR) for modified road bitumen enhances the overall performance of pavement and offers a safe and green solution for the utilization of waste tires [1]. The modification of road bitumen involves the utilization of an elastomer to improve elastic behavior. The most utilized copolymer for the modification of road bitumen is poly(styrene-butadiene-styrene) (SBS), but the elastic component of this copolymer is a maximum of 30%. In our previous research [2], desulfurized crumb rubber was obtained in the presence of metallic oxides, and the conversion in the desulfurization process of vulcanized rubber was influenced both by the size of the adsorbent particles and also by the nature of the adsorbent.

This paper presents the development of a new component from the processing of crumb rubber, which has improved elastic properties necessary for modified road bitumen.

2. Materials and Methods

Crumb rubber utilized in the present research was made from waste tires. For obtaining the elastomer for modified bitumen, a step of partial desulfurization of the crumb rubber in the presence of iron oxides at 260 °C was needed. The experimental studies of modification of road bitumen type D50/70 with desulfurized crumb rubber were performed in a semi-continuous installation provided with automatic temperature control at 160 °C, mechanical stirring at 220 rpm and a controlled dosing system of the desulfurized powder solution. The stability and homogeneity tests were performed by determining the

asphaltene content, using the classical method of separation with solvent, of the upper area and the lower area of a tube of 25.4 mm diameter and 100 mm length containing the modified bitumen with desulfurized crumb rubber.

3. Results

The validation of the desulfurized crumb rubber was made by determining the sulfur content and testing the modified road bitumen's physical properties, stability and homogeneity. After desulfurization, the sulfur concentration of crumb rubber decreased by 58.3%. The asphaltene content of modified road bitumen determined in the upper and lower areas was 18.7 $\pm$ 0.2%, demonstrating the homogeneity of the mixture.

4. Conclusions

To study the modification of road pavement bitumen with partial desulfurized crumb rubber, firstly we obtained a partial desulfurized crumb rubber, followed by the conditioning of bitumen to obtain modified bitumen with improved elastic properties for applications in sensitive areas such as bridges and runways.

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