J. Civil Eng. Mater.App. 2022 (September); 6(3): 175-183

Journal of Civil Engineering and Materials Application

Journal home page: https://jcema.com

Received: 04 July 2022 • Accepted: 24 September 2022

Research

doi: 10.22034/jcema.2022.159996

Optimization of 5-component Fibers and Glass Fibers in Asphalt Mixtures Based on Functional Characteristics

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ABSTRACT

Nowadays, due to the increase in the amount of traffic and the number of axles, the use of additives in asphalt concrete has become common. In recent decades, one of the goals of engineers in asphalt technology has been to increase the bearing capacity and improve the tensile strength of asphalt mixtures. One of these effective additives in this matter is fiber. Fibers mainly contribute to the reinforcement of asphalt mixtures. Accordingly, in this research, the properties of asphalt mixtures reinforced with 5-component fibers and glass fibers have been investigated. 5-component fibers are added in 0.05, 0.075, and 0.01% of the weight of stone materials, and glass fibers are added in 0.1, 0.2, and 0.3% of the weight of stone materials in asphalt mixtures and finally, based on performance characteristics including Marshall resistance, indirect tension, moisture sensitivity, dynamic creep, and resilient modulus are the most optimal among the above percentages. According to the results of this research, 5-component fibers have the best results in many of the mentioned characteristics at 0.075 percent and glass fibers at 0.2 percent.

Keywords: 5-component fibers, glass fibers, optimization, performance characteristics, asphalt mixture.

1. INTRODUCTION

Due to being faced with traffic load (which is dynamic) and being affected by weather conditions, roads have a shorter useful life compared to other civil structures [1,2]. For this reason, solutions began in 1920, and in 1926, a woven fabric was used, which was not very effective [3]; until 1966, the use of various fabrics in road construction became common [4]. Zube recorded the first successful reinforcement of asphalt concrete [5]. In the 1960s, the use of cellulose fibers and asbestos in asphalt concrete was proposed, the first one was not suitable due to gradual decomposition in the structure, and the second one was not suitable due to its toxicity [6]. In the early 1970s, the European road industry felt the need for pavements resistant to rutting, abrasion, and various damages caused by heavy traffic loads and ice-breaking tires. In order to solve this problem, asphalt mixtures with bone mineralization (SMA) were developed. In these mixtures, due to the high contact surface of the coarse-grained materials, the incoming loads are better distributed, and if the underlying layers are strong enough, the SMA mixture will be more effective against heavy loads [7]. Another feature of this mixture is preventing the road surface from becoming slippery and not creating reflective cracks and cracks caused by fatigue. The high void space of coarse-grained materials, the relatively high consumption of bitumen, and the thick coating of bituminous stone materials in SMA mixtures are factors for bitumen spill and Extruding bitumen during its storage, transportation, and distribution. As a result, fibers were used as a kind of stabilizer to reinforce the asphalt mixture. At first, it was thought that the use of fibers (especially waste fibers) would not play a role in bearing the incoming loads and that these fibers would play the role of filler; But gradually, it became clear that the fibers play an effective