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Tensile Performance of Slag-LCDGP Based Geopolymer Reinforced With PE Fiber

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Extended Abstract

It is a well-known fact that cement production emits large amounts of carbon dioxide. Therefore, even in the field of construction, research on cement-free concrete is active to reduce carbon dioxide. Among them, geopolymer concrete without cement is similar in mechanical strength and durability to OPC concrete. As more products contain LCD panels, the amount of waste LCD glass is increasing. Waste LCD glass meets the chemical requirements of pozzolanic materials as specified in ASTM C 618 [1]. Considering the environment, we chose geopolymer that emit less carbon dioxide than waste LCD glass and OPC concrete. The geopolymer has low tensile strength and brittle properties, and to supplement for these properties, PE fibers were mixed in a geopolymer mortar based on GGBFS and LCD glass powder. LCD glass powder and GGBFS were used as binders, and the weight ratio for each was 50%. The S/B ratio is 0.2, and the W/B ratio is 0.35. The alkali activator SH has a 4 mol/L and SS/SH weight ratio of 3. Place the dry ingredients LCD glass powder, GGBFS, and silica sand in a mixer and rub for 5 minutes to ensure good dispersion. Thereafter, a pre-made alkali activator is added and the fibers are added. According to Palomo et al. [2], geopolymers cured at 85°C for 24 h had much better compressive strength performance than geopolymers cured at 65°C for 24 h. In addition, Kani and Allahverdi [3] found that for the high-strength development of geopolymers, it is more effective to pre-curing at room temperature for 7 days before heat treatment (45 - 85 °C). A specimen was made, pre-cured at room temperature for 7 days, removed from the mold, and immersed in a high-temperature water tank at 85°C for 24 hours.

A volume of 2% of polyethylene fibers was incorporated into the reinforcement and a very high strength geopolymer matrix with a compressive strength of more than 100MPa was developed. Later, in order to find the optimal PE fiber reinforcement, five fibers with a range of 300-900 aspect ratios were considered. The experimental results show that the attachment strength is 1.55MPa, which is similar to a high-strength cement matrix. The higher the aspect ratio, the more effective it was in improving tensile performance. If the aspect ratio is more than 600, the strain hardening characteristics of the pattern of multiple microcracks have been obtained. The best tensile performance was achieved when reinforced with PE fiber with an aspect ratio of 900 with a tensile strength of 5.7 MPa, a strain capacity of 7.58%, and a strain energy density of 309.6 kJ/m3. Since the tensile strength is low compared to the strain capacity, it is intended that further studies to improve the strength will be needed.

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