cured under ambient conditions. Different percentages (0.6%, 1.2%, and 1.8%) of polyester fiber were used, both with and without nanosilica. Additionally, a reference mixture containing only nanosilica was prepared.All mixtures had a liquid to binder ratio of 0.50, and the ratio of NaOH to Na_2SiO_3 solution was kept at 2.5:1 by weight. The produced mixes, after 28 days of ambient curing, were immersed for another 28 days in solutions containing 3.5%, 5%, and 5% of sodium chloride, magnesium sulphate and sulfuric acid, respectively. For comparison, control specimens which were not exposed to chemical attacks were tested at the same age of 56 days. Moreover, water absorption and sorptivity tests were conducted to explain the durability performance in a more detailed way. The test results express that the combination of both materials showed a synergistic effect and resulted in greater improvements in compressive and flexural strengths. Both materials can reduce the reduction in compressive strength caused by sulfuric acid exposure, but polyester fiber can increase mass loss. The presence of magnesium sulfate and sodium chloride can lead to a reduction in strength, but the addition of both polyester fiber and nanosilica can mitigate these effects. The addition of fibers creates a network of pores that can limit water absorption, and nanosilica can further enhance the microstructure and reduce water absorption. However, using polyester fiber beyond 1.2 percent can adversely affect the rate of water absorption.

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Abbreviations: SF, Silica Fume; OPC, Ordinary Portland cement; AAC, Alkali Activated Concrete FA: Fly Ash; GGBFS, Ground Granulated Blast-furnace Slag; XRF, X-ray Fluorescence; SP, Superplasticizer; AAM, Alkali Activated Mortar; PLF, Polyester Fiber; NS, Nano Silica; WA, Water Absorption

1. Introduction

Portland cement production, due to its chemical processes, is responsible for 7% of global CO_2 emission every year [1, 2]. The necessity for creating alternative cementitious binders with a smaller carbon impact is increasing worldwide [1, 3]. To reduce the cement industry's environmental impact, silica fume (SF), Ground granulated blast-furnace slag GGBFS, fly ash (FA), and powdered granulated blast furnace slag were employed as cement replacements worldwide [4–7]. For the same reason, several recycled materials were used to produce better building materials with lower negative environmental impact [8, 9]. Other methods such as improvement of the technical and durability performance were used for the same purpose to produce better mixes with longer service life. Nano materials such as nano silica, nano alumina, nano iron nano clay and nano titanium as partial substitute of the binder have been studied by many researchers [10, 11]. Also, several fibers were used in order to improve the performance of the cementitious composites [12, 13]. Moreover, combined usage of fibers and nano materials were investigated to improve the technical performance in a side and prolong the service life on the other side [14, 15]. Despite of higher environmental impact, deterioration of numerous infrastructure, industrial, and utility service structures experience huge annual economic losses due to the deterioration of ordinary Portland cement (OPC) concrete in severe chemical conditions [1]. Due to the high calcium hydroxide concentration of Portland cement, which reacts with acids to produce a higher volumetric increase, Portland cement concrete has a low endurance against acid attack [16].