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THE FREEZE-THAW DURABILITY OF CONCRETE WITH FLY ASH, MICROSILICA AND FIBERS

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Abstract

In recent years, the research of concrete with additions of fly ash and microsilica with metallic and polypropylene fibers has become increasingly important, especially regarding the resistance of these materials to freeze-thaw cycles. Despite the importance of these construction materials, there is a scientific deficit regarding the mechanism of formation of their structure and properties. Therefore, it is important to consider this scientific deficit and continue research in this field to improve our knowledge about these materials and to develop better solutions for durability issues. The aim of this article is to analyze the behavior of concrete with fly ash or microsilica, as a replacement for concrete at percentages of 5% and 10%, and with the addition of metallic or polypropylene fibers under repeated freeze-thaw conditions. The study focuses on the insufficiently studied mechanism of the formation of the structure and properties of fly ash concrete and microsilica concrete in combination with dispersed reinforcement. It was found that a higher amount of fly ash or microsilica can lead to an improvement in compressive strength loss, and the use of fibers can have a contribution in reducing compressive strength loss in concrete. Additionally, it was observed that polypropylene fibers are more effective in reducing compressive strength loss, compared to metallic fibers, in most of the analyzed concrete compositions. The use of concrete with 10% fly ash/microsilica could be an efficient alternative for improving performance, reducing costs, and protecting the environment in terms of freeze-thaw resistance. Additionally, adding metallic and polypropylene fibers can reduce the loss of compressive strength in fly ash/microsilica concrete, with a decrease of up to 85% for metallic fibers and up to 82% for polypropylene fibers, with variable effects depending on the quantity and type of fly ash/microsilica used.
These findings can be useful in developing more resistant and durable types of concrete under freeze-thaw conditions. In addition to the benefits of improving the strength and durability of concrete under freeze-thaw conditions, the use of fly ash and microsilica in concrete production also has significant environmental benefits, making the use of waste materials in construction a sustainable and environmentally friendly solution with numerous benefits.

Key words: concrete, fly ash, freeze-thaw, metallic fibers, microsilica, polypropylene fibers

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