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MECHANICAL, ELECTRICAL AND SELF-SENSING PROPERTIES OF CEMENTITIOUS MORTARS CONTAINING SHORT CARBON FIBERS

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ABSTRACT

This paper is aimed at exploring mechanical, electrical and self-sensing properties of cement based mortars through the addition of short carbon fibers, at different dosages (2%, 3%, 4% by weight of cement). Compression and bending tests on carbon fiber reinforced mortars (CFRM) were performed. The addition of carbon fibers showed to enhance the mortars' flexural strength by increasing the fibers content, while no improvement was found in the compressive strength. Electrical resistivity of the CFRM, at different days of curing, was evaluated by AC impedance measurements, using two stainless steel wire meshes as electrodes. The electrical resistivity decreased with time, until reaching a constant value after about 60 days of curing. Carbon fibers were able to drastically reduce the mortar resistivity, up to values below 150 $\Omega\cdot$cm. The effect of fibers dosage on the ability of the mortar to change its electrical conductivity when subjected to different stress states was also studied. The specimens were gradually loaded up to 50-60% of the maximum compressive strength, carrying out two loading/unloading cycles, while resistivity was measured using a multimeter. Depending on the fibers dosage and stress state within the material, CFRM resistivity changed with significant variations.

Keywords:

Carbon fibers, conductive mortar, electrical resistivity, dielectric properties, multifunctional concrete, self-sensing.

1. Introduction

Advances in concrete technology in the last decades have led to the development of innovative cementitious composite materials with enhanced properties. The possibility of making structural materials able to carry out one or more non-structural functions, while maintaining high mechanical properties, has been investigated by several studies [1-3]. The use of multifunctional structural materials can reduce costs, increase the reparability and thus the durability of the materials once placed in service conditions, and facilitate the design process. These non-structural functions include strain-stress sensing capacity [4-9], self-healing [10,11], heat-retention [12-14], electrical conductivity [15-20] and electromagnetic interference (EMI) shielding [21,22].