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Electrical Resistivity of Sustainable Fiber Reinforced Concretes for Smart Marine Structures

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Abstract

Self-monitoring structural materials have recently raised renovated attention due to their potential to enable continuous low-cost monitoring of next-generation smart-structures. This characteristic is particularly important in harsh environments such as highly energetic marine coastal areas, where structural damage due to excessive loading is frequent and very impactful in the performance of structures. In the context this research a sustainable fiber reinforced conductive concrete was developed and studied, with the aim of enabling the future development of self-sensing structural materials and systems for marine harsh environments. The variation of the electrical resistivity with curing time, as well as the compressive load *versus* displacement responses were investigated. Results indicated that the self-monitoring is possible with sustainable formulations that lead to reasonably conductive concretes. The experimental results seem to indicate that electrical resistivity can be a good parameter for self-monitoring of concrete structures.

Keywords: conductive concrete; conductive aggregate; carbon and steel fibers; marine structures; compression strength test; electrical resistivity; self-monitoring.

1. Introduction

The interaction between current and offshore structures and the marine environment is not favorable to the marine ecosystem. Besides that, it is nowadays hardly disputable the idea that the marine environment has been considerably affected due to anthropogenic effects, and with this the natural reefs and several marine species are under threat. It is necessary to develop new structural materials with multifunctional properties in order to attend the challenges of innovative and complex structures for the future challenges, which can both aid with tackling these problems and fulfill the demanding structural and functional requirements of marine structures that support human activities. One example of such structures are artificial reefs, which have been subject of intense research in the past few decades as part of strategies for ecosystems restoration, in some cases adopting structurally demanding designs.

Concrete has demonstrated versatility and good properties, along with good geometrical adaptability and durability, for civil engineering works for centuries. In the marine environment, the application of concrete is vast and the adaptability is satisfactory in most cases. However, it is necessary to develop multifunctional characteristics in structural materials of high performance for marine environment. The marine structures are of difficult access in case of structural damage and the continuous knowledge about the structural condition is of great importance to prevent further structural damage. Conductive concrete shows great potential as a structural material for these marine structures. The variation of electrical resistivity is a promising

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