Effect of fiber reinforcement on the durability of reinforced concrete in Arabian Gulf Region.

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Abstract

The concept of using fibers in concrete to improve resistance to cracking and fragmentation is old and intuitive. During the last 25 years different types of fibers and fiber materials were introduced and are being continuously introduced in the market as new applications. These fibers can be made of metals, minerals, or organic materials. In the past three decades, extensive research on fiber reinforced concrete has shown that some types of fibers can be added to concrete to improve its durability and physical properties.

Cracking induced by plastic shrinkage, drying shrinkage and thermal gradient on the surface of fresh and mature concrete due to the severe environmental conditions of the Arabian Gulf region has been marked as one of the several casual factors of deterioration of reinforced concrete in the area.

In this thesis, commercially available synthetic fibers, namely, polypropylene, is used as fiber reinforcement. Different types of specimens of polypropylene fiber reinforced concrete and cement concrete were cast with different water/cement ratios to determine the effect of this type of fiber in minimizing plastic and drying shrinkage cracks of concrete. Physical properties such as compressive strength, tensile strength, flexural strength, permeability, absorption, pulse velocity and electrical resistivity were determined for different curing conditions and different ages. The specimens were also subjected to cycles of heating at elevated temperatures of 90 C and 140 C and cooling to room temperature to determine the effect of these high temperatures on the performance of polypropylene fibers in concrete. Corrosion monitoring was conducted in terms of half-cell potential measurement of steel reinforcement of the specimens placed on racks in the exposure site and watered daily by sea water to form ponds on the slab surface. Another set of specimens immersed in 5% NaCL solution and an electromotive force of 5.0 volts was impressed through the specimens to accelerate the corrosion process. The corrosion current versus time was recorded until the specimen was cracked.

A comparison was made between the performance of polypropylene fiber reinforced concrete and portland cement concrete. The effect of polypropylene fibers in minimizing plastic shrinkage and drying shrinkage cracks in concrete has been found to be very significant in this study. The results have indicated that the physical properties of polypropylene fiber reinforced concrete were very similar to that of portland cement concrete. The effect of cycles of heating (up to 90 C) and cooling to room temperature on the performance of polypropylene fibers in concrete was negligible.