EFFECTS OF CALCIUM LEACHING ON INTERFACIAL PROPERTIES OF PVA FIBERS IN CEMENTITIOUS MATRIX

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Since fiber reinforced composites are often used in an aggressive environment (bridge decks, drainage pipes etc.), it is necessary to estimate their durability and ability to maintain superior mechanical properties in such conditions. One of microscale mechanisms that has a dominant influence on achieving desirable mesomechanical behavior, such as multiple cracking, is fiber-matrix interfacial bond. In the present study, the effect of calcium leaching on the bond properties and fiber-matrix interfacial zone are experimentally investigated. To this end, a series of tests is performed, in which a single fiber is pulled out from cementitious matrix under displacement control. Both chemical and frictional bonds are calculated from the measured load-displacement curves, and the effect of environmental exposure on these parameters is clarified. In order to gain a deeper insight into the microscale mechanical phenomena associated with calcium leaching, the fiber-matrix interfaces of both control and chemically attacked specimens are examined by nanoindentation and ESEM. These experiments show that leaching severely degrades the stiffness of the farther transitional zone.

Key words: *calcium leaching, PVA fiber, cementitous matrix*

1. Introduction

Fracture properties of fiber reinforced cementitious composites (FRCC) can be radically improved if they are capable of multiple cracking. In a uniform tensile stress field, multiple cracking manifests itself by formation of a large number of distributed sub-parallel matrix cracks bridged by fibers. In an overall stress-strain diagram, multiple cracking is associated with so-called pseudo strain-hardening – the material is capable to carry increasing stress while cracks form and open. Employing micromechanics and fracture mechanics, Li and Wu [8], Leung [6], and Kanda and Li [4] formulated conditions for multiple cracking and pseudo strain-hardening in terms of micromechanical parameters of fiber, matrix and fiber-matrix interface. These parameters included, for example, fiber volume fraction, fiber aspect ratio, fiber and matrix elastic moduli, matrix fracture toughness, initial flaw size, fiber-matrix bond characteristics, etc. Using these criteria, it was possible to optimize the material composition so as to achieve the desired multiple-cracking ability and overall ductility with a relatively small amount of short fibers. Note that the use of minimum content of short fibers is a prerequisite for producing and processing the composite with standard concrete technologies. To emphasize the use of the rigorous micromechanics-based material design methodology, these materials are called Engineered Cementitious Composites (ECCs) [7]. A typical ECC consists of cementitious matrix with very fine aggregate and contains up to 2 % by volume of PVA fibers 12 mm long and 40 μm in diameter. Such a composite

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