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Characterizations of Graphene Reinforced Cement Matrix Composites using Nanoindentation

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KEYWORDS: *Graphene-cement Composite, Room Temperature Indentation Experiment, Graphene Covered with Monosilane, Stiffness, Hardness and Young modulus cement matrix composites*.

ABSTRACT

The effects of graphene on the cement matrix composite (CMC I 42.5) mechanical properties have been investigated in this paper by nanoindentation technique [1, 2, 3]. A mix with a water-to-cement ratio of 0.4 was designed. The graphene powder XG Science xGnP-M-5 (GN), graphene covered over with monosilane (Si) and graphene covered over with oxidized monosilane (OX+Si) was introduced as 0.05 wt.% and 0.1 wt.% (designated as 0.05, 0.1 GN; 0.05, 0.1 GN+Si and 0.05, 0.1 GN-OX+Si). The control mix for reference was prepared without mixing the graphene powder (designated as (CEM I 42.5 R). The same size and type of aggregates were used for all these cement matrix composite mixes. The nanoindentation experiment was conducted using a Alemnis AG nanoindenter (Switzerland) with Alemnis Mechanical Indentation Control Software. A maximal penetration load of 100 mN was chosen for the Berkovich tip. The load was increased in 20 s with velocity 5 mN/s, followed by 5 s holding and 20 s to decrease the load. The indented zone was randomly chosen. For each mix, nanoindentation technique was used for measuring the hardness (H), stiffness (S) and Young's modulus (E) over time. It was found that the addition of graphene increased Young modulus, and hardness. The highest improvement was achieved for the 0.05 GN-OX+Si matrix composite. On the other hand, an overall increase toughness of the matrix composite was noticed.

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