Effect of Slag on the Mechanical Properties and Bond Strength of Fly Ash-based Engineered Geopolymer Composites

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Recently, the concept of engineered cementitious composites (ECCs) has been extended to the creation of engineered geopolymer composites (EGCs). Although showing similar mechanical characteristics (e. g., strain hardening and multiple cracking) to conventional ECC, the strength of existing EGC is generally low, and this sometimes restrains its applications. In the present study, a low-calcium (Class F) fly ash-based, polyvinyl alcohol (PVA) fiber reinforced EGC was developed and further modified by a ground-granulated blast-furnace slag (slag). The slag was used to replace the fly ash at content of 0%, 10%, 20%, and 30% (by weight). The effects of the slag on the mechanical properties (e.g., compressive strength, modulus of elasticity, uniaxial tensile behavior, flexural bending strength, and pullout bond strength) of the EGCs were investigated. The results revealed that all EGCs studied exhibited a strain/deflection hardening behavior under tension/flexure, and all slag replacements for fly ash enhanced strength-related properties but reduced ductility-related properties of the EGCs. The EGC mix with 20% slag replacement for fly ash (FA-20%S) had 102.3 MPa compressive strength, 6.8 MPa tensile strength, and 6.2 MPa bond strength, while the EGC mix with no slag (FA-0%S) had 72.6 MPa compressive strength, 4.7 MPa tensile strength, and 3.5 MPa bond strength at 28 days. These strength enhancements were mainly attributed to the improved density of the EGC matrix and the bond between the matrix and fiber. There are close relationships between the bond strength and other strengths, especially the tensile and flexural strengths, of the EGCs.

Keywords: Engineered geopolymer composite (EGC), Fly ash, Slag, Mechanical property