Tin Slag Polymer Concrete Strengthening by Basalt and Aramid Fiber Reinforced Polymer Confinement

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ABSTRACT

This study investigates the potential of Tin Slag Polymer Concrete (TSPC) strengthening through confinement using basalt fiber reinforced polymer (BFRP) and aramid fiber reinforced polymer

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(AFRP) confinement. TSPC short cylindrical column samples have been wrapped with BFRP and AFRP in a single layer (30 mm overlap) using Sikadur-330 epoxy and final samples were coded as TSPC-UC, TSPC-BF and TSPC-AF for unconfined, BFRP and AFRP for confined respectively. After curing for 30 days at room temperature, compressive test has been performed to know the strength, modulus, strain, fracture energy and failure modes of unconfined and confined TSPC. Test result shows that AFRP confinement (114.24 MPa) provide more upsurge in strength enhancement compared to BFRP (81.52 MPa). Fracture energy value of TSPC-AF (821.18 J) is higher than TSPC-BF (538.66 J), but compressive modulus of TSPC-AF (3.23 GPa) is lower than TSPC-BF (4.32 GPa). In addition, yield stress value of TSPC-AF (80.71 MPa) is higher than TSPC-BF (57.21 MPa). Moreover, stress-strain curve and failure mode has shown that TSPC-AF exhibit higher degree of brittleness compared to TSPC-BF. Finally, it is noticed that there are some similarities in strength augmentation of TSPC amid BFRP and glass fiber reinforced polymer (GFRP) as well as between AFRP and carbon fiber reinforced polymer (CFRP) confinement.

KEYWORDS*: Compressive behavior, Confinement, Polymer concrete, Fracture energy, Strength enhancement.*

1. INTRODUCTION

Polymer concrete is a particulate composite material which applied polymeric resins instead of cement in conventional concrete material as composite matrix. In general, fiber reinforced polymer (FRP) composites and particulate reinforced polymer composites were widely employing polyester resins as the matrix due to its high level of resources availability.[1] This thermosetting resin is preferred in industries owing to its economic price, ease of processing, better mechanical characteristics and its excellent resistance to solvent due to its cross-linking three dimensional network.[2-4] The fabrication cost is also less due to minimum handling requirements owing to its ability to cure at room temperature. On addition of catalyst such as Methyl Ethyl Ketone Peroxide (MEKP) to the polyester, the cross-linking of polymer chain in the polyester starts which sets the entire resin in a three dimensional structure. Unsatisfactorily, the polyester cured matrix having cross-linking of polymer chains in its structure that exhibit sufficient strength and stiffness at ambient curing temperature possesses unacceptable fracture resistance.[5] Fortunately, it is understood that reinforcement of polyester with rubber and particulate fillers can sufficiently raise the toughness of the light weight polyester composite system.[6] Conversely, the reinforcement of rubber elements to the polyester composite system diminishes the strength and stiffness on comparing with neat polyester or particulate reinforced polyester composite. It is also evident that the strength and stiffness of the polyester composite system improved on reinforcing with rigid filler particulates such as alumina and silica without affecting its glass transition temperature.[7-9] On the other hand, the reinforcement of rubber particulates to the polyester composite system possesses better toughness compared to the rigid filler