Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Compressive behaviour of tin slag polymer concrete confined with glass fibre reinforced epoxy under various loading speeds

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A R T I C L E I N F O

Article history:
Available online xxxx

Keywords:
Tin slag polymer concrete
Glass fibre reinforced epoxy
Strengthening
Confinement effect
Mechanical behaviour
Loading speed

A B S T R A C T

Polymer concrete reinforced tin slag is predicted to replace Portland cement as the major building material. The objective of this study was to analyze the compressive behaviour of tin slag polymer concrete (TSPC) confined with glass fibre reinforced polymer (GFRP) composites under various loading speeds. Compressive test was performed according to ATSM C579-01. Result shows that TSPC confined with five layers of GFRP achieved the highest compressive strength of 148.19 MPa at a loading speed of 7 mm/min. Comparable results were obtained by TSPC with four layers of GFRP at three and five mm/min, and TSPC with three layers of GFRP at ten mm/min loading speed. Meanwhile, a low loading speed increases compressive strength slightly, but neither the number of confinement layers nor the loading speed has a prominent effect on the modulus of elasticity. Energy absorption has increased significantly between unconfined and confined TSPC. TSPC confined with four layers of GFRP achieves the highest energy absorption when evaluated at 3 mm/min, with a 297.9% increase over the unconfined specimen. The application of confinement layers has greatly improved the compressive strength of TSPC confined with GFRP, allowing for higher loading capabilities.

1. Introduction

Portland cement concrete (PCC), which is commonly used in the building industry, has a negative environmental impact due to resource use and carbon emissions [1]. The PCC has limitations such as low tensile strength, low flexural strength, freeze–thaw deterioration, large porosity, corrosive chemical destruction, etc [2]. These restrictions are viewed as becoming increasingly severe as our concern for energy and material conservation grows [2]. In this regard, polymer concrete (PC) has been introduced in industrialized countries to replace PCC as the major structural material for the civil construction sector [1,2]. PC has found widespread use in a wide range of applications, including structural and construction restorations, wastewater pipe lines and coatings, reinforced slabs, bridges, floors, highway pavement overlays, and dams [2,3]. The advantages of PC over PCC are fast curing, high mechanical strength, chemical resistance, recyclability, durability, and the use of a variety of aggregates [2,4–6]. Nevertheless, the key factors that could have a negative impact on in-service performance are PC brittleness and strength variation [6]. One option is to strengthen it with aggregates to increase its strength, ductility, and toughness.

According to Golestaneh et al. [3], the tensile, flexural, and compressive strengths of reinforced epoxy polymer concrete including silica powder were 16.2, 22.5, and 128.9 MPa, respectively. The increased in mechanical strength is due to the reinforcement of

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https://doi.org/10.1016/j.matpr.2023.04.141
2214-7853/