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Compressive behaviour of tin slag polymer concrete confined with fibre reinforced polymer composites exposed to tropical weathering and aggressive conditions

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ABSTRACT

Tin slag, which is high in silica content, is a by-product of the smelting process. The outcome is anticipated to improve the compressive strength of polymer concrete composites. In light of this, the purpose of this research is to examine the durability of polymer concrete utilising tin slag as its fine aggregates and to determine the potential use of tin slag in place of other materials to create either primary or secondary type polymer concrete-based structures. Tin slag polymer concrete (TSPC) was confined to FRP composites and subjected to tropical climate and exposure to an aggressive environment. The test results were analysed and discussed in relation to compressive strength and modulus resulting from tropical climate and exposure to an aggressive environment. The results revealed that confined samples which had been externally reinforced with carbon fibre/epoxy (CFRP) and glass fibre/epoxy (GFRP) composites showed a significant enhancement in terms of strength and modulus compared to unconfined sample groups. The compressive modulus for Lab exposure increased about 7 % for GFRP_LAB, 27 % for CFRP_LAB compared to the U_LAB sample. The number of layers wrap does not significantly affect the material. Meanwhile, the decrease in modulus and compressive strength of the samples exposed to tropical climate indicated the effects of moisture on the mechanical behaviour of TSPC. There were decreased about −0.516% for U_OUT, −8.42% (GFRP_OUT) and −8.45% (CFRP_OUT).

1. Introduction

One of the fundamental materials in civil engineering, particularly in the structural industries, is cement concrete. Nevertheless, Portland cement-based concrete has disadvantages, including low flexural strength, low tensile strength, high porosity, freeze–thaw deterioration, and destruction by corrosive chemicals, among others [1]. A composite material called polymer concrete (PC) binds the aggregates together with a polymeric matrix called a binder [2]. In many applications, including construction and structural restorations, wastewater pipelines, bridges, floors, and dams, PC is widely utilised as a cement concrete alternative [3].

The strong elastic modulus of polymer concrete compounds, which depends on different types and mixed ratios of measured compound, influence the performance of PC [4]. The primary benefit of polymer concrete over conventional Portland cement concrete is the enhancement in mechanical strength and chemical resistance (PCC). Three to five times stronger compressive strength, high tensile strength (20 MPa), and high flexural strength (50 MPa) are all exceptional characteristics of polymer concrete [5]. Previous researchers, such as Muthukumar and Mohan [6], prepared PC based on furan resin by mixing aggregates with a proportion of fine fillers with a minimum void ratio. The fine fillers resulted in a low usage of the binder content without affecting the polymer concrete's properties, making it a cost-effective product [7]. Gorninski et al. [8] performed evaluation and comparison between polymer concrete with Portland cement concrete, where they measured the modulus of polymer concrete compounds. The given findings demonstrated an increase in axial compressive strength with

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