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RESEARCH ARTICLE

Circular Economy Applied to Metallurgical Waste: Use of Slags and Fly Ash from the Ferronickel Industry in the Production of Eco-Friendly Composites

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Abstract

The aim of this paper is studying the use of industrial, solid waste materials from the ferronickel industry (fly ash—FA, electric furnace slag—EFS and converter slag—CS) as a reinforcing component in new value-added polymer-based composite: eco-friendly, functional geo-membranes. The studied geo-membranes were produced by film-casting method using polyvinyl chloride (PVC) matrix reinforced by the previously mentioned metallurgical waste materials, as-obtained and modified in acid (HCl) and alkaline (NaOH) medium. The study of the produced systems was done through observation and analysis of the effect on their: (i) morphology and internal structure (SEM and FTIR analysis), (ii) thermal stability (TG/DTA/DTG analysis) and (iii) moisture stability (the swelling kinetics was followed and the ultimate rate of swelling after 24 h was determined). The morphology of the waste materials is of spherical and polygonal non-regular shape. The morphology and microstructural properties of the obtained FA/PVC composites confirmed region of well dispersed particles where the particles were tightly embedded and mechanically interlocked in the PVC matrix indicating strong interfacial interaction with the polymer matrix. All waste materials were thermally stable with minimal 0.8% weight loss, EFS has been shown as the most stable with weight loss of 0.1% near 350 °C. Generally, all the studied composites have shown a higher swelling degree in comparison with PVC, where the composites reinforced with FA have shown the best performances in adsorption test.

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