MceCge08-007

Effect of soluble salts present in fly ash and steel slag on the properties of alkali-activated binders

Sombra Júnior, A.J.(1); Lima, E.F.(1); Carvalho, G.(1); Cabral, A.E.B.(1); Costa, H.N.(1);
(1) UFC;

Portland cement concrete (PCC) ranks as the second most widely used material globally, surpassed only by water. However, the production chain of PCC is responsible for significant environmental impacts due to high energy consumption and greenhouse gas emissions. The most harmful emissions include dust, sulfur, nitrogen oxides (NOx), and carbon dioxide (CO2). In this context, PCC is accountable for approximately 3% of dust and 7% of global CO2 emissions. Due to the challenges in making PCC an environmentally sustainable material, continuous efforts are being made to develop new materials that can partially or entirely replace it. In this regard, alkali-activated binders (AABs) emerge as a promising alternative to PCC. These materials are produced from aluminosilicate sources (precursors) activated by alkaline solutions. The most commonly used precursors include fly ash, slags, and metakaolin, which are typically activated by sodium silicate (Na2SiO3) and sodium hydroxide (NaOH). Optimizing the combination of precursors and activators, adjusted by dosing parameters, results in composites with mechanical properties equal to or superior to cementitious materials. However, the direct influence of different precursor treatment methods, or the lack thereof, remains insufficiently explored in the literature. Research indicates that ion contamination can affect the geopolymerization process, leading to changes in the microstructure and properties of AABs. Some dissolved ions are expected to be detrimental to the reactions, while others may not, which can be verified through preliminary treatment of the precursors. This study aims to investigate the effect of precursor pre-treatment and its impact on the chemical and mechanical properties of synthesized AABs. The material will undergo a process of removing soluble salts that may interfere with alkaline synthesis. These salts are removed through washing and decantation to minimize their effects on precursor reactivity. The synthesized AABs exhibited, depending on the binary system adopted, compressive strength at 28 days of curing between 30 MPa and 60 MPa, with treated pastes showing an increase of up to 15% in strength. The results indicate that AABs are efficient and sustainable materials, enabling the development of even more robust alternative concretes with a lower carbon footprint.