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Environmental suitability of MSWI fly ash geopolymers: evaluation by leaching tests

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This work is focused on the possible reutilization of municipal solid waste incinerator (MSWI) fly ash as a metakaolin replacement in the acid-based geopolymer. This type of geopolymer, obtained by the reaction between an aluminosilicate source (metakaolin) and phosphoric acid to form an Al-O-P/Si-O-P matrix (Wang et al, 2019), have displayed better performance than the traditional alkali-silicate geopolymer, in terms of corrosion resistance (Wagh et al, 2011), thermal stability and mechanical strength (Celerier et al, 2019). The replacement of up to 30 % wt has proved to not significantly alter the remarkable performance of the material, obtaining compressive strength values higher than 30 MPa. However, since fly ash contains dangerous substances as chlorides, sulfates, and heavy metals, which must be stabilized, it is important to evaluate the leching stability of the final materials.

Therefore, test cube blocks of 1x1x1 cm size, containing 10, 20 and 30 % wt of previously washed fly ash replacement with respect to metakaolin are prepared, with Al/P molar ratio of 1, liquid-to-solid ratio raging from 0.95-1 and 3 days at 60°C as curing temperature.

Leaching tests, according to the European standards EN-12457 (2002), using deionized water at a ratio liquid to solid of 10, are applied to geopolymers blocks to evaluate the concentration of salts and heavy metals that usually exceeds the law threshold in the raw fly ash. Leachates are analyzed by ionic chromatography and ICP-MS: the results show that the concentrations of chlorides are under the legislation limits provided for not dangerous waste, as well as sulfates and fluorides; relatively to heavy metals Zn, Pb, Cd exceed the concentrations limits. Further tests and analyses are carried out to evaluate the impact of synthesis parameters on the leaching stability of these materials.

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