Electrodialytic pre-treatment for the applicability of fly ash and APC residues as substitute for cement in mortar

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Fly ash (FA) and air pollution control (APC) residues are municipal solid waste incineration residues that are classified as hazardous waste. Their classification is due to their contaminants content, such as leachable heavy metals, salts and organics such as dioxins. Their hazardousness and instability constitute an environmental problem and, consequently, stabilization prior disposal is required. Fly ash and APC residues present distinct chemical and physical characteristics, because of, e.g. fuel gas cleanness and composition of the waste that is burned. These different characteristics will influence the removal of contaminants and will be crucial for their possible valorization and reuse.

Electrodialytic (ED) process was applied to two types of incinerated ashes (IA) - wet FA and APC residues - aiming their pre-treatment before the incorporation in cement. A set of eight ED experiments were conducted for 7 days with a L/S of 3.5, 100g of ash and 350 mL of deionized water. Also, a set of major parameters were tested: current density (0.1 or 1.0 mA cm^{-2}) and number of cell compartments (2 or 3), according to Figure 1. The results showed that after 7 days of the ED process the IA pH stayed alkaline, which difficult the removal but promoted the immobilization of the heavy metals.

Then, 5% of Ordinary Portland Cement was replaced by IA in mortars, with or without ED pre-treatment. Four parameters were analyzed: Initial characteristics, compressive strength, heavy metals leachability, and chloride content. Mortars with the ED treated IA residues show similar compressive strengths compared to the raw residue, but lower than the reference mortar (0% of IA). The ED upgraded IA for incorporation in cement seems a viable option since prevents the leaching of heavy metals. Comparing the IA, for wet FA the best option prior its reuse is to apply a pre-treatment. In APC residues, e.g., compressive strength decreased after a pre-treatment, therefore, for this type of ash it is thus preferable to aggregate the raw residue. Chloride content decreased in wet FA after ED pre-treatment that is an important achievement, since the soluble salts have a weak interaction with cement matrices and might present a threat for steel corrosion in reinforced concrete structures.

This study suggests new possibilities for these IA waste reuse, providing a great advantage in the waste management system.

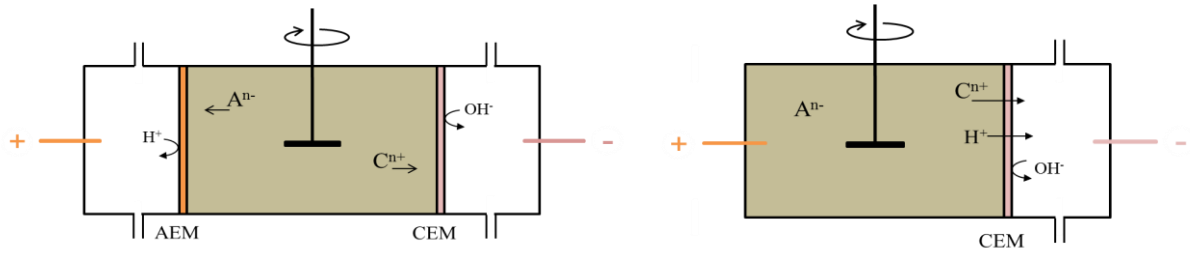

Figure 1. The experimental set-up of the three and two compartment electrodialytic cell. AEM-anion exchange membrane, CEM-cation exchange membrane.

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