A Primary Pre-Processing Strategy for Coal Fly Ash to Enhance Its Performance and Usability

Brinthan Kanesalingam[1], Shivadhahini Srinivasan[1], Janaka Senadheera[1], Ashane Fernando[2], Chulantha Jayawardena[1], Ravindi Jayasundara[1], Maheshwari Wickrama[1]
[1]*University of Moratuwa, Colombo, Sri Lanka*. [2]Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka

Abstract

Coal fly ash (CFA) is a byproduct of thermal power plant combustion and has attracted significant attention from researchers owing to its material properties and ability to address waste management and wastewater treatment issues. CFA has the potential to be used in a variety of applications, including as a pozzolanic material, soil stabiliser, and structural fill. However, it is also a potential precursor for synthesising zeolites that are widely used in wastewater treatment. This study focused on pre-processing CFA for wastewater treatment using continuous washing cycles at various operating temperatures. We studied the pH and conductivity of the solution after washing over multiple cycles, as well as the mean diameter and mineralogy of the settled CFA. We analysed and optimised the results using response surface methodology to determine the optimal combination of the number of washing cycles and temperature for removing soluble ions and increasing the surface area of the CFA particles. Our findings showed that five washing cycles at 70°C were sufficient to minimise soluble ions, such as Ca, Mg, and Na, and maximise the mean surface area of the CFA particles. These results demonstrate significant improvements in CFA's physical and chemical properties as a precursor for zeolite synthesis. In addition, our results illustrate the potential for further processing of the extracted solution and floating particles to satisfy the concepts of "Waste to Wealth" and "Circular Economy." Based on these findings, we recommend further research to explore the potential of CFA for synthesising commercial zeolites for wastewater treatment.