MONASH University
Engineering

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Hydrometallurgical Extraction of Victorian Brown Coal Fly Ash for the Separation of Individual Metals and On-Site CO_2 Capture

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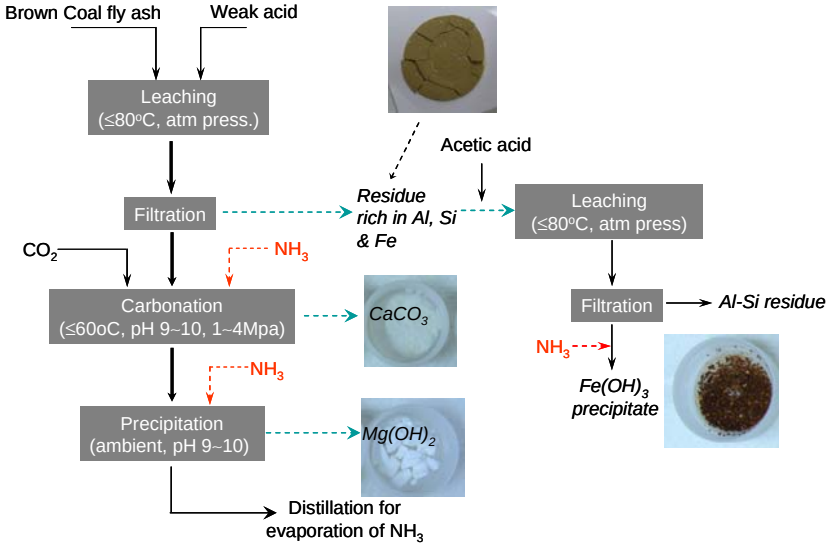
Objective

As shown on the right scheme, this project aims to hydrometallurgically extract brown coal fly ash for the separation of individual metals and accordingly, generate numerous high-purity metal oxides/hydroxides and achieve on-site CO_2 capture in the brown coal-fired power plants.



Description

Victorian brown coal is the single largest source meeting >85% of the electricity need in the State of Victoria. Its combustion yields up to 1.3 million tonnes fly ash per annum, most of which is land-filled with little being used in any value-added way. This is a joint project between Monash and Australian Industry (the Latrobe Magnesium Ltd) to separate the individual metals in brown coal fly ash, based on the enrichment of calcium, magnesium and iron within it. The hydrometallurgical leaching and precipitation methods will be examined, as shown on the above scheme. The acid-insoluble Al/Si-rich residue will be first separated. The Ca ion dissolved into the acid will then be precipitated as carbonate through reacting with CO_2 derived from flue gas. The remaining soluble ion is mainly magnesium, which is eventually precipitated as hydroxide through adjusting the pH of the solution. A successful implementation of such a technology will lead to the capture of about half a million CO_2 per annum from power plants, and generation of >1 million tonnes high-purity $CaCO_3$, $Mg(OH)_2$ and $Fe(OH)_3$ annually. All these products are highly valuable and important in numerous industrial applications.

Apart from the magnetically stirred hot plate, a high-pressure autoclave will also be used to examine the leaching and precipitation of individual metals at various temperatures in this study. A number of weak acids including acetic acid, ammonium acetate, and ammonium chloride with different concentrations will be tested. The thermodynamic equilibrium software, HSC Chemistry, will also be used for leaching/precipitation process simulation to compare with experimental observations.

One high-quality journal paper is expected to publish through the completion of this study.