

Summer Research Program 2011/2012

Thermal Reduction of Victorian Brown Coal Fly Ash for the Generation of Value-Added Iron and Magnesium Metals

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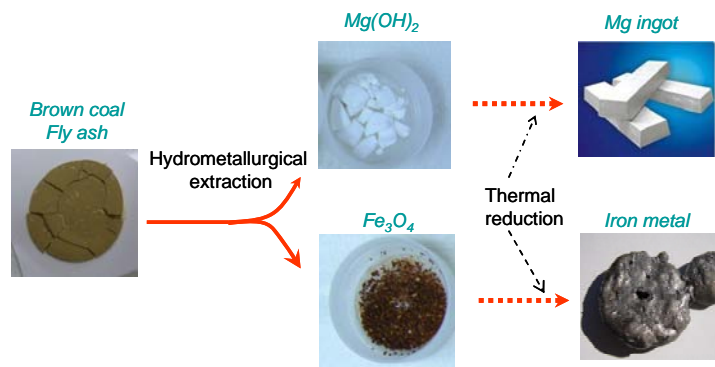
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Objective

As visualised on the right, the proposed project aims to use the zero-value Victorian brown coal fly ash to generate high-purity (>90%) iron and magnesium metals which are key feedstock in industrial applications such as aluminium alloying for automobiles.



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 ways. This is a joint project between Monash and Australian Industry (the Latrobe Magnesium Ltd) to generate the value-added high-purity iron and magnesium metals through thermal reduction of brown coal fly ash, based on the enrichment of iron oxide and magnesium oxide in the fly ash. As visualised in above scheme, the abundant magnesium oxide and iron oxide in fly ash are separated by hydrometallurgical extraction. The resulting two oxides are then reduced thermally to get pure magnesium ingot and iron metal, respectively. Such a process is highly cost-effective as fly ash is a zero-value waste in industry, which is also highly achievable as magnesium oxide and iron oxide in brown coal account for approximately 20 and 45 wt%, respectively.

The thermal reduction experiment will be carried out in a high-temperature thermo-gravimetric analyser (TG/DTA) to examine the use of a variety of reductants including brown coal-derived char (*i.e.* activated carbon), ferrosilicon (FeSi), and synthetic-gas (H₂/CO mixture) for fly ash reduction. The resulting samples will be analysed by numerous analytical facilities including XRD, SEM, ICP-OES and XRF. In addition, the thermodynamic equilibrium modelling through the use of a commercial software, FactSage, will also be carried out to compare with the experimental observation.

A high-quality journal paper is expected from this study. To date, no study has yet been conducted to address the use of brown coal fly ash for value-added metal generation.