ALTA 2023 27
30 April - 6 May | Perth, Australia

DEVELOPMENT OF A DRY RARE EARTH FLOURINATION PROCESS FROM CARBONATES

By

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ABSTRACT

A dry fluorination process was developed for the production of rare earth fluorides using a novel and environmentally friendly process. The process produces rare earth fluorides in a batch process by reacting rare earth carbonates or oxalates with anhydrous hydrogen fluoride (AHF) at 125 °C and atmospheric pressure. The waste produced is water vapour and carbon dioxide. Any excess hydrogen fluoride may be reacted to extinction or scrubbed using wet or dry abatement systems.

The technology has been demonstrated on a semi-commercial scale, in a facility that produces 80 tpa rare earth fluorides. Piloting work was undertaken using neodymium carbonate as a feedstock. The kinetic studies undertaken show that the formation of NdF_3 *via* dry fluorination favours the use of $Nd_2(CO_3)_3 \cdot H_2O$ as a feedstock as opposed to Nd_2O_3. $Nd_2(CO_3)_3 \cdot H_2O$ is a less expensive raw material than Nd_2O_3 due to the calcination step required to go from the carbonate to the oxide. The kinetic study also indicated that the fluorination of $Nd_2(CO_3)_3 \cdot H_2O$ by AHF is not a strong function of temperature enabling a relatively low reaction temperature, 125 °C. Lower temperature operation allows the use of less exotic materials of construction and limits energy input requirements resulting in optimised CAPEX and OPEX.

Results from kinetic studies undertaken during the piloting phase of the work will be presented, highlighting the economic benefit of fluorinating the carbonate as opposed to the oxide. Lessons learned from the operation of the semi-commercial plant will be discussed along with recent campaigns completed using mixed oxalates as feed material. Finally, the applicability of dry fluorination technology in other critical materials will be discussed.

Keywords: Fluorination, carbonate, neodymium, rare earth