Conversion of calcium sulphide to calcium carbonate during the process of recovery of elemental sulphur from gypsum waste

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Abstract

The production of elemental sulphur and calcium carbonate (CaCO\textsubscript{3}) from gypsum waste can be achieved by thermally reducing the waste into calcium sulphide (CaS), which is then subjected to a direct aqueous carbonation step for the generation of hydrogen sulphide (H\textsubscript{2}S) and CaCO\textsubscript{3}. H\textsubscript{2}S can subsequently be converted to elemental sulphur via the commercially available chemical catalytic Claus process. This study investigated the carbonation of CaS by examining both the solution chemistry of the process and the properties of the formed carbonated product. CaS was successfully converted into CaCO\textsubscript{3}; however, the reaction yielded low-grade carbonate products (i.e. <90 mass% as CaCO\textsubscript{3}) which comprised a mixture of two CaCO\textsubscript{3} polymorphs (calcite and vaterite), as well as trace minerals originating from the starting material. These products could replace the Sappi Enstra CaCO\textsubscript{3} (69 mass% CaCO\textsubscript{3}), a by-product from the paper industry which is used in many full-scale AMD neutralisation plants but is becoming insufficient. The insight gained is now also being used to develop and optimize an indirect aqueous CaS carbonation process for the production of high-grade CaCO\textsubscript{3} (i.e. >99 mass% as CaCO\textsubscript{3}) or precipitated calcium carbonate (PCC).

Keywords

Gypsum waste; Carbonation; Valorisation; Calcium carbonate; Calcium sulphide