Waste Management

Volume 34, Issue 11, November 2014, Pages 2373–2381

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

M. de Beer[a, b] , J.P. Maree[c], L. Liebenberg[b], F.J. Doucet[d,]

[a] DST/CSIR National Centre for Nanostructured Materials, Council for Scientific and Industrial Research, PO Box 395, Pretoria 0001, South Africa

[b] Centre for Research and Continued Engineering Development, North-West University, Pretoria, South Africa

[c] Department of Environmental, Water and Earth Science, Faculty of Science, Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa

[d] Industrial Mineralogy Laboratory, Council for Geoscience, Private Bag X112, Pretoria 0001, South Africa

## Abstract

The production of elemental sulphur and calcium carbonate (CaCO3) 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 (H2S) and CaCO3. H2S 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 CaCO3; however, the reaction yielded low-grade carbonate products (i.e. <90 mass% as CaCO3) which comprised a mixture of two CaCO3 polymorphs (calcite and vaterite), as well as trace minerals originating from the starting material. These products could replace the Sappi Enstra CaCO3 (69 mass% CaCO3), 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 CaCO3 (i.e. >99 mass% as CaCO3) or precipitated calcium carbonate (PCC).

Keywords

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