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Synthesis of aluminium hydroxide morphologies via generative adversarial networks

Juan Jose Jaime Altamirano[1,*], Steven Psaltis[1], Ted Steinberg[1], Tom Rainey[1], Alistair Gillespie[1,2]

[1]School of Mechanical, Medical and Process Engineering, Queensland University of Technology, Brisbane, Australia
[2]Rio Tinto Aluminium Pacific Operations, Brisbane, Australia

[*]juanjose.jaimealtamirano@hdr.qut.edu.au

ABSTRACT

The Bayer process remains the most effective method for extracting alumina from bauxite ores. In the Bayer process, a wide variety of morphologies of aluminium hydroxide are generated during precipitation due to different mechanisms such as nucleation, growth, agglomeration, and breakage. Morphological information is not currently incorporated into models of aluminium hydroxide precipitation, leading to discrepancies between simulated outcomes and observations. To facilitate the inclusion of this morphological information into computational models, this range of morphologies must be captured and characterised. One method of doing this is through SEM imaging, though this would be a time-consuming process. In this research, we develop a library of synthetic aluminium hydroxide morphologies by utilising Generative Adversarial Networks (GANs) on existing SEM images. A deep learning approach is employed, where a model is trained using more than 1000 preprocessed SEM images that we have captured. After monitoring and evaluating the model's performance, the generator function from the trained model is used to generate synthetic data. This study is expected to enhance understanding of the precipitation process and assist in process control.

KEY WORDS

Deep learning, Bayer process, morphology, image synthesis, aluminium hydroxide

BIOGRAPHY

Juan Jose Jaime Altamirano is a PhD student Queensland University of Technology in Brisbane, Queensland. Holding a bachelor's degree in Chemical Engineering from Universidad de Guadalajara, Mexico. His research focuses on the characterization of granular materials using image analysis and machine learning techniques. He is experinced in image capturing and data science techniques and aims to develop a carrer that combines both industry experience and academic research. Since 2023, he has been a member of the Pacific Alumina Value Chain collaboration group, a partnership between Rio Tinto Australia, the University of Sydney and Queensland University of Technology.

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