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# ELECTROCHEMICAL RECYCLING OF RED GYPSUM WASTE: THE ELEDGE PROCESS

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## Abstract

Red gypsum is an industrial waste generated by the titanium dioxide industry. Currently, it is mainly used for environmental restoration, but this is not ideal due to problems of geographical availability of suitable sites and environmental issues. Different valorization routes have been proposed, including the utilization of red gypsum in the cement industry or its chemical recycling through thermal processes. These routes either lack the production capacity for an efficient disposal of red gypsum, or propose processes that need severe operating conditions and that generate a significant amount of $CO_2$ emissions. This paper proposes a novel process for electrochemical recycling of red gypsum based on four fundamental steps: metathesis, electrodialysis, electrolysis, and carbonatation. Preliminary estimates on a process design basis are obtained and analyzed from a phenomenological point of view, leading to the development of mass and energy balances for the process. The advantage of such system is that an industrial plant capable of treating 80000 t/y of $CaSO_4$ on an anhydrous basis leads to the production of 55234 t/y of concentrated $H_2SO_4$ and 52571 t/y of synthetic $CaCO_3$, coupled with the mineralization of 23131 t/y of $CO_2$. The process is completely electrified and has a power consumption of 8.5 MW that can be provided entirely from renewables-based power plants, leading to net-negative $CO_2$ emissions. Tuscany region in Italy is taken as a practical example, where the $TiO_2$ production industry could benefit from the ELEDGE (ELEttroDialisi di GEssi) process and couple it with a geothermal-based power plant.

*Key words:* electrochemistry, electrodialysis, recycle, red gypsum, Tuscany

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