E2DT 2025
3rd INTERNATIONAL CONFERENCE ON ENERGY, ENVIRONMENT & DIGITAL TRANSITION
Palermo, Italy, 12-15 October, 2025

BATCH CARBONATION OF CONSTRUCTION WASTES IN A SPOUTED BED SEMI-INDUSTRIAL PLANT

Vila P[*a,b], Sukunza X[a], Tellabide M[a], Errasti M[b], Pablos A[b], Olazar M[a,b], Aguado R[a,b]

a Department of Chemical Engineering, University of the Basque Country UPV/EHU, P.O. Box 644, 48080 Bilbao, Spain.

b Spouted Bed Solutions S.L., Zitek Mintegia, Edificio Rectorado UPV/EHU, Barrio Sarriena s/n, 48940 Leioa, Spain.

Tel: +34 946 015 994; Fax: +34 946 013 500

*pauvila@sbsprocess.com

Abstract

The need to achieve net zero carbon emissions by mid-century requires the implementation of technological solutions that can either reduce emissions or even remove the CO_2 already present in the atmosphere. In recent decades, there have been significant advances in the industrial implementation of CO_2 capture technologies [1]. One of the most promising post-combustion methods developed at a semi-industrial scale is based on carbonation-calcination cycles. Although any mineral can undergo carbonation, it has been shown that divalent metal oxides exhibit a greater potential [2].

Spouted Bed Solutions S.L. is a start-up established by the Catalytic Processes and Waste Valorisation Research Group from the Department of Chemical Engineering at the University of the Basque Country. The company focuses on scaling up the conical spouted bed technology, which has successfully been applied to a variety of thermal processes associated with waste valorisation. The main objective is to reach a Technology Readiness Level (TRL) 9, thus ensuring the successful commercialization of the technology. Among the processes proposed, carbonation is one of the most promising developments. In fact, this process enables waste material valorisation, while it contributes to CO_2 mitigation and therefore, to avoid global climate change. This alternative process is proposed for sectors that generate carbonatable waste, such as concrete and construction material manufacturers. High-value products are obtained, which can be used as additives in manufacturing process, thereby reducing both the CO_2 emissions and waste treatment costs. It is not a cyclical process; rather, the material susceptible to carbonation passes through a spouted bed reactor only once, achieving high conversion rates of CO_2 to carbonates.

In this study a semi-industrial pilot plant has been commissioned and built, where batch experiments have been conducted with five materials, including three construction waste samples and two reference materials of known carbonation potential. The results demonstrated that Waste 1 and Waste 2 exhibit high carbonation potential, with CO_2 sequestration rates of 149.71 g CO_2/kg and 113.05 g CO_2/kg, respectively. Nevertheless, Waste 3 hardly captured CO_2. These encouraging results suggest another round of experiments for their validation, as well as for assessing process efficiency in continuous operation. Additionally, a portable demonstration plant will be designed and installed in an industrial facility. This plant will enable the validation of the technology under real conditions, thereby stepping further in the development of this technology up to a higher TRL.

Keywords: *CO_2 Capture, Carbonation, Waste Valorisation, Conical Spouted Bed, Pilot Plant.*

References

[1] P. Gkotsis, E. Peleka, A. Zouboulis, Membrane-Based Technologies for Post-Combustion CO2 Capture from Flue Gases: Recent Progress in Commonly Employed Membrane Materials, Membranes 13 (2023) 898. https://doi.org/10.3390/membranes13120898.

[2] A. Sanna, M. Uibu, G. Caramanna, R. Kuusik, M.M. Maroto-Valer, A review of mineral carbonation technologies to sequester CO2, Chem. Soc. Rev. 43 (2014) 8049–8080. https://doi.org/10.1039/C4CS00035H.