METASTABLE HYDRATED CARBONATES FOR ALGAE BIOFUEL PRODUCTION

Valentina Prigiobbe, Department of Civil, Environmental, and Ocean Engineering, Stevens Institute of Technology, Castle Point on Hudson, 07030, Hoboken, USA
valentina.prigiobbe@stevens.edu
Xiaoguang Meng, Department of Civil, Environmental, and Ocean Engineering, Stevens Institute of Technology, Castle Point on Hudson, 07030, Hoboken, USA
Christos Christodoulatos, Department of Civil, Environmental, and Ocean Engineering, Stevens Institute of Technology, Castle Point on Hudson, 07030, Hoboken, USA

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In this work, we present a study to develop a mineralization process to capture and reuse carbon dioxide (CO_2) for the growth of algae, from which then carbon is extracted and converted into a biofuel. The classical CO_2 mineralization process consists in fixing CO_2 into stable carbonates. During the formation of the carbonates hydrated phases can form, which transform into stable carbonates, eventually. However, if carbonates are designed to be reused, e.g., to provide carbon to a bioprocess through dissolution within a brine, the formation of metastable carbonate phases is preferred as these phases have a solubility which is much higher than the solubility of the anhydrous phases. To design a process that can capture CO_2 into hydrated minerals and provide carbon for algal growth, meeting the requirements of the synthesis of the carbon into fatty acids, requires a well-constrained mineralization. In particular, optimal thermodynamic conditions for precipitation and dissolution must be selected.
Here, we present an experimental and modeling study of the precipitation and the dissolution of nesquehonite ($MgCO_3 \cdot 3H_2O$). We investigated the process between 25ºC and 50ºC and 1 and 5 bar of CO_2. Batch experiments were performed using $MgCl_2$-CO_2-Na_2CO_3 aqueous system and monitored with online Raman spectroscopy. Precipitation and dissolution were modeled using a population balance equation (PBE) coupled with a geochemical model. Nucleation, growth, and dissolution rates were described by constitutive equations based on classical nucleation theory, the birth-and spread growth mechanism, and transition state theory, respectively. The kinetic parameters were estimated by fitting Raman spectroscopy measurements using multivariate kinetics modeling.