

Oxalates for non-conventional greenhouse carbon mineralization

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To limit the concentration of CO₂ in the atmosphere, many synergic capture methods coupled with the reduction of emissions have been proposed. Mineral trapping and accelerated weathering of silicate rocks have been suggested as the most suitable hosts for mineralized carbon. Natural weathering can remove some CO₂ from the atmosphere. Still, the weathering rate is slow, although the natural process can be accelerated for industrial purposes.

Within this framework, we proposed a new mineralization method reducing C(IV) to C(III) using ascorbic acid (vitamin C) as a green CO₂ reductant [1,2]. The red-ox reaction was validated and explained thoroughly.

Using this method, CO₂ is mineralized as calcium oxalate, almost insoluble, which doubles the capture efficiency compared to classical carbonation. The reaction's effectiveness was evaluated under variable conditions and reached very high values, up to 80% of CO₂ removed from the atmosphere, depending on the experimental setup.

The reaction products are limited to calcium oxalate dihydrate (weddellite), while occasionally, the monohydrate crystal phase (whewellite) was detected as a byproduct. The system was intentionally kept out from the stability field of the carbonates to avoid competition between the two phases on the carbon capture process and to extend the lifetime of the reductant.

As weddellite can be trusted as a stable solid-state reservoir of carbon dioxide, its thermal degradation was evaluated in situ by combining HT-XRPD and TGA [3].

Carbon mineralization experimental behavior was explained applying stable isotope analysis to the products of the reaction.

References

- [1] Pastero, L.; Curetti, N.; Ortenzi, M.A.; Schiavoni, M.; Destefanis, E.; Pavese, A. CO₂ Capture and Sequestration in Stable Ca-Oxalate, via Ca-Ascorbate Promoted Green Reaction. *Science of The Total Environment* 2019, 666, 1232–1244, doi:10.1016/j.scitotenv.2019.02.114.
- [2] Pastero, L.; Marengo, A.; Boero, R.; Pavese, A. Non-Conventional CO₂ Sequestration via Vitamin C Promoted Green Reaction: Yield Evaluation. *Journal of CO₂ Utilization* 2021, 44, 101420, doi:10.1016/j.jcou.2020.101420.
- [3] Curetti, N.; Pastero, L.; Bernasconi, D.; Cotellucci, A.; Corazzari, I.; Archetti, M.; Pavese, A. Thermal Stability of Calcium Oxalates from CO₂ Sequestration for Storage Purposes: An In-Situ HT-XRPD and TGA Combined Study. *Minerals* 2022, Vol. 12, Page 53 2021, 12, 53, doi:10.3390/MIN12010053.