

Interactive comment on “Global CO₂ uptake of cement in 1930–2019” by Rui Guo et al.

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1. General comments: Thank you for recognizing the importance of this piece of research. In this article, we focused on updating the global cement carbon uptake inventory and its distribution, the detailed analyses such as how the carbonation factor affects the uptake had been presented in our previous work (doi: 10.1038/NGEO2840), Therefore, we did not place special emphasis on the analysis of the results. Our results demonstrate that carbonation of cement products is an important anthropogenic carbon sink, which has not been thoroughly assessed or documented. Using our consistent framework and model, regular updating the annual and cumulative estimates of cement carbon uptake can be realized, so that their inclusion in the global carbon budget is foreseen. Additionally, our work can bring instruction and inspiration for carbon capture technology and carbon neutralisation path.

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2. Specific comments: Cement carbonation produces calcite by aqueous precipitation reactions, and it is the main and the most stable polymorph. While calcite dissolution does take place in nature e.g., prominently in the karst area, in typical micro-environments of cement/concrete, calcite dissolution reactions are not favoured because calcite is continuously supersaturated to enhance precipitation. (<https://doi.org/10.1016/j.jcou.2020.02.015>; <https://doi.org/10.1016/j.jcou.2020.101428>). In addition, other co-existing phases such as calcium hydroxide have much higher solubility than calcite. Existing research have shown that in the karst area dissolving 1 mole of calcium carbonate consumes 1 mole of CO₂. Based on this theory, calcite dissolution could be helpful to the CO₂ uptake of cement. However, it is not the main chemical mechanism in cement materials life cycles. Hence, we did not consider the effect of calcite dissolution on the CO₂ uptake of cement. Nevertheless, quantitative determination of calcite dissolution in cement products and its effects may be an important research topic in light of global warming and acid atmospheric deposition.

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