Demolished concrete mineralization as CCU approach

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Majority of CO_2 emissions from the Portland clinker production originate from limestone thermal decomposition. The clinker production process is technologically matured. Hence, the emissions cannot be reduced by process efficiency improvements. In addition, substitution of limestone by carbon-free raw materials is limited since clinker production volumes are much higher than all other materials. However, hydrates formed upon cement hydration spontaneously bind atmospheric CO_2 making old demolished concrete a significant carbon sink. This potential is not yet utilized. Industrial application of old concrete mineralization as a CCU pathway requires understanding and mastering of the underlying mechanisms of the process involved. In this contribution, impact of material and process conditions on the mineralization kinetics and efficiency as well as on resulting properties of the mineralized demolished concrete paste is discussed. It is demonstrated that all CO_2 emissions released from limestone during the clinker production can be sequestered by the hydrates produced by hydration of the cement. This mineralization process can be accelerated to be completed within few hours even at ambient pressure and temperature. The mineralized demolished concrete paste mainly contains calcium carbonate and silica-alumina gel characterized by excellent pozzolanic reactivity. This characteristic of the gel enables utilization of the mineralized fines as supplementary cementitious materials for the new cement and concrete production.