



CEMENTITIOUS MATERIALS AND METHODS OF MAKING AND USING SAME

[View U.S. Patent Application Publication No. US-2025-0042811 in PDF format.](#)

WARF: P220309US02

Inventors: Bu Wang, Robert Anex

The Invention

UW-Madison researchers have developed a method to produce carbon negative supplementary cementitious materials (SCM) utilizing a carbon mineralization-based direct air capture process named DDAC-REACT (Distributed Direct Air Capture with Rapid Mineral Carbonation). DDAC-REACT uses a novel aqueous carbonation cycle to capture CO₂ from the air at low cost while simultaneously processing industrial mineral wastes (IMW) to enhance their pozzolanic (cementitious) reactivity. The processed IMW, storing the captured atmospheric CO₂ as solid carbonate (e.g., CaCO₃), can be used as SCM in conventional concrete to reduce Portland cement usage and enhance its durability. The resulting carbon negative concrete (named Carbon Geocrete) offers enhanced durability at equivalent strength, similar cost, and can be formed into reusable building components or recycled as carbon-negative aggregates at the end of life.

Laboratory data show that coal fly ash carbonated by DDAC-REACT has 1.7-2 times higher pozzolanic reactivity. In order to control the reactivity of the processed IMW, the DDAC-REACT process was modified to separately supply Si-rich residue and dissolved alumina, based on the different dissolution/precipitation behaviors between Si and Al during the aqueous carbonation step. In the modified process, the mineralization step of the process is performed using high initial pH (>13) with a mixed sodium hydroxide and carbonate solution. The high pH enhances mineral dissolution and dissolves Al. After mineralization, the alkaline solution with the dissolved Al will be sent to the air contactor for direct air capture. As the pH of solution decreases, Al will precipitate within the air contactor. Periodically, the air contactor will be flushed with concentrated NaOH solution with no air flow to redissolve the precipitated Al. This solution will provide highly reactive alumina that will be mixed with the silica-rich residue. The ratio between alumina and silica rich residue can be chosen to promote cementation and yield different material properties. The alumina-rich solution from the air contactor washing cycles can also be used with the carbonated IMW containing reactive silica in geopolymer concrete.

Additional Information

For More Information About the Inventors

- [Bu Wang](#)
- [Robert Anex](#)

Tech Fields

- [Clean Technology : Monitoring, remediation & waste reduction](#)
- [Engineering : Manufacturing & construction](#)

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