R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Sequestration

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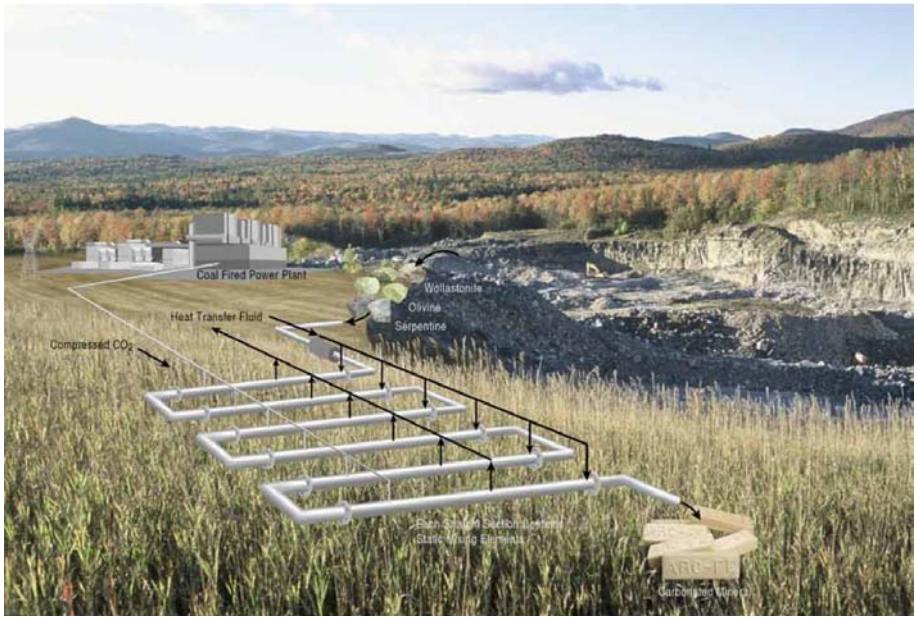
Carbon Dioxide Sequestration by *Ex Situ* Mineral Carbonation

Increasing concern about the effects of "greenhouse gases" (GHG) on the earth's atmosphere has resulted in the need for research to reduce or eliminate emissions of these gases. Carbon dioxide (CO_2) is the principal GHG, because it is the primary gaseous emission from fossil-fuel-fired power plants. Scientists at the National Energy Technology Laboratory (NETL) are part of a Mineral Carbonation Working Group (see Partners list next page) that has been conducting groundbreaking research into mineral carbonation as a means to sequester this CO_2.



Mineral carbonation is the reaction of naturally occurring calcium and/or magnesium silicate minerals with CO_2 to form stable, benign solid carbonate minerals for return to the environment. In nature, under ambient conditions, this reaction is too slow for industrial application. However, NETL researchers have been able to increase the reaction rate significantly when the reactions were carried out at high temperature and pressure.

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Due to extensive research efforts with a batch autoclave system at NETL, the parameters necessary to achieve a high conversion of gaseous CO_2 to solid carbonate have been identified. Successful autoclave reactions require heat treatment or high-intensity grinding to activate the mineral prior to carbonation. Such processes are prohibitively expensive in both capital costs and energy used, and research is in progress to find alternative mineral-activation processes that will result in high reactivity at lower cost.

Magnesium silicate minerals

Recent investigations indicate that a continuous pipeline reactor would be a better economic choice than an autoclave for commercial operation. NETL constructed a pipeline loop reactor to better evaluate the costs and technical feasibility of this approach. The high-temperature, high-pressure (HTHP) flow-loop reactor is a technical bridge to a true continuous reactor system. NETL is using it to develop the design and performance data necessary to scale up the process to a true continuous system. Tests with the flow-loop reactor have yielded important design information for the next stage of reactor development with some surprising results. Reactivity similar to that achieved in autoclaves was achieved in the flow-loop reactor with a much coarser mineral feed. The mineral reactivity is probably enhanced in the flow-loop reactor by vigorous rubbing between solid particles to expose fresh reaction surfaces. These unexpected results suggest that flow reactor technology could be more cost-effective by minimizing energy-intensive, costly grinding or other pretreatment steps in the process.

Mineral carbonate product