Waste Sulfur Disposal: Conceptual Design of a Sulfur Sequestration Process Using Alkaline Minerals

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Abstract (Summary)

Excess production of by-product sulfur from oil and gas requires sequestration beyond acid gas injection and the piling of elemental sulfur. Here we introduce a process concept for the disposal of sulfur as magnesium sulfate brine. Besides H2S and air, the process requires the addition of an alkaline mineral, such as olivine (Mg2SiO4), and water or seawater. As a waste product, MgSO4 is benign and thermodynamically stable. The product brine could therefore be disposed of in the ocean or in permeable underground formations, without the need to closely monitor its fate. The overall process is highly exothermic (895 kJ/mol S) and can provide carbon-neutral thermal energy for steam generation and other processes. Two unit processes are reviewed to assess their potential to operate at industrial reaction conditions (~ 1 μmol/cm3/sec). The unit processes include 1) the absorption of SO2 into aqueous solution and its subsequent catalytic oxidation to yield dilute sulfuric acid, and 2) a neutralizing unit, which dissolves the mineral olivine in the acid. The reaction kinetics of the neutralizing unit is favorable; the development of the absorbing-oxidizing unit will require additional research.