Advanced Mineral Carbonation: An Approach to Accelerate CO2 Sequestration Using Steel production wastes and Integrated Fluidized Bed Reactor

Abdel-Mohsen Mohamed[1], Maisa El-Gamal[1 *], Suhaib Hameedi[1]

[1] Zayed University, Abu Dhabi, United Arab Emirates
* Maisa.Elgamal@zu.ac.ae

Abstract

Industrial pollution is the major source of global warming through emissions of greenhouse gases (GHG's) like CO2, CH4, and NO2, causing noticeable increasing in the world's temperature. Mineral carbonation is a method of carbon capture and storage (CCS) through which CO2 is sequestered with advantage of permanent sequestration and no need for post-storage surveillance and monitoring through stabilizing the reactive mineral wastes released from metal industries. This paper applied a simple and an inexpensive hydration process as a pre-treatment step for the carbonation of Ladle Furnace (LF) slag, one of the steel production by-products in UAE, followed by direct gas-solid carbonation in a new designed integrated fluidized bed reactor (FBR). About (10-15) % by weight of produced steel, alkaline solid residues were generated, based on the characteristics of the manufacturing process. The integrated FBR was designed to control the flow rate up to 50 l/min with step accuracy of 0.1 l/min, and temperature up to 200°C through a double jacket electrical heater. Operating pressure can be adjusted up to 6 bars. All parameters are monitored by SCADA system. A mixture gas of 10% CO2, balanced with air, was used to perform the carbonation process and evaluation the carbonation efficiency as well. A gas analyzer installed at the outlet of FBR was used to measure unreacted CO2 gas after leaving the reactor, and calculate the amount of CO2 captured accordingly. Results of analytical techniques like TGA and XRD emphasized the sequestration of CO2 and show a high efficient carbonation process.