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Perspective

Experimental Procedure of CO_2 Geological Storage

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DESCRIPTION

Global warming is a result of billions of tonnes of anthropogenic carbon dioxide (CO_2) emissions per year from stationary and non-stationary sources. The atmosphere's CO_2 emissions are partially absorbed by the natural carbon cycle. Contrarily, significant CO_2 emissions build up, making it the main source of greenhouse gas emissions and raising global temperatures. According to estimates, the Earth's temperature was 1°C higher in 2017 than it was in the middle of the twentieth century. CO_2 storage in subsurface formations, which are prevalent throughout the planet, offers a solution to this issue. Each year, deep saline aquifers and other geological formations store millions of tonnes of CO_2. The security of CO_2 containment, fluid dynamics, and storage potential are all greatly impacted by the minute amounts of organic material present in these geological formations. Understanding the behavior of supercritical CO_2 in rock/brine systems necessitates looking at the wetting properties and influencing factors of geological formations. Wettability is a crucial factor in determining the containment security and storage capacity as well as how well injected CO_2 can replace formation water. The wettability of CO_2 depends on a number of variables, including pressure, temperature, and salinity, type of formation, surfactants, and chemicals.

A method that has promise for reducing anthropogenic CO_2 greenhouse gas emissions is the storage of carbon dioxide (CO_2) in porous geological media. The average Earth temperature during the middle of the 20^{th} century increased by 0.99°C (1.78°F) in 2016, according to a joint analysis from the National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA) (NASA and NOAA, 2016). Over the course of two centuries, the global CO_2 emissions increased considerably from 280 ppm in 1750 to 410 ppm in 2020. There are numerous alternative methods that have been used to reduce CO_2 emissions, such as carbon-free wind and solar energy, geothermal energy, hydrogen synthesis, and CO_2 geological storage. Additionally, geological storage of CO_2 has shown to be a successful strategy for lowering anthropogenic greenhouse gas emissions. Millions of tonnes of CO_2 emissions are trapped in geological storage formations worldwide using this technique (i.e., coal bed methane formations, deep saline aquifers, basaltic rocks, depleted hydrocarbon reservoirs, and tight shale formations). The COVID-19 results in the slowdown of global industry, which resulted in a 2.94 billion tonne (8 percent) decrease in the predicted global CO_2 emissions in 2020, which were 36.8 billion tonnes. In order to inject CO_2 into geological storage media, Carbon Capture and Storage (CCS) principally relies on extracting CO_2 from anthropogenic sources (such as coal-based thermal power plants) (destined sinks, such as deep saline aquifers and depleted hydrocarbon reservoirs). Following numerous trapping mechanisms, CO_2 is transformed into a porous medium after being delivered into geological storage formations. Those are structural or hydrodynamic trapping, residual or capillary trapping, adsorption trapping, brine and mineral trapping.

CO_2 is initially gathered from fixed CO_2 sources (e.g., chemical processing plants, power generation plants, coal-fired based plants, and several other non-stationary carbon emitters, such as automobiles). The environment receives billions of tonnes of CO_2 from these sources, half of which is used in carbon cycles and other natural processes. The atmosphere picks up almost half of the remaining quantity, growing by 2 ppm annually. Pre-combustion, oxyfuel combustion, and post combustion capture are the typical foundations of the CO_2 capturing technique. High-pressure compressors are used to compress the (captured) CO_2 (with an operational capacity of more than 10 MPa). Pipelines and cargo ships are used to carry it to the storage facilities. Given the fact that CO_2 is not combustible like natural gas, transportation of this gas is thought to be safe. Finally, compressed CO_2 is injected for permanent immobilization into subsurface formations at appropriate injection parameters (e.g., rate of injection and injection pressure).

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