Process for Efficient CO_2 Capture Using a Regenerable Sorbent

Opportunity

Research is active on the technologies titled "Process for CO_2 Capture Using a Regenerable Magnesium Hydroxide Sorbent" and "Process for Minimization of Steam Requirements and Enhancement of WGS with Warm Gas Temperature CO_2 Sorbent." These two related technologies are available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory (NETL).

Overview

Fossil fuels will be used to provide clean, affordable energy well into the 21st century, but there are concerns about impacts of greenhouse gases (GHGs), particularly carbon dioxide (CO_2) from fossil fuels. Capture of carbon from fossil fuel plants can produce CO_2 in a concentrated stream that is amenable to geological storage. Carbon capture after fossil fuels are burned for electric power production (post-combustion capture) significantly reduces efficiency and increases electricity cost. Pre-combustion CO_2 capture, which is more effective, can be done in gasification plants, where coal is converted into a clean low-carbon fuel gas which is burned in a gas turbine. However, more efficient processes for carbon capture are needed.

NETL has developed a cyclic CO_2 capture process based on a novel sorbent that can be used in gasification plants at high pressures and temperatures for high efficiency and better compatibility with gas turbine combustion, warm gas cleanup and water-gas-shift (WGS is a process to increase hydrogen content in the fuel gas). The sorbent can be regenerated to maintain activity over many absorption cycles, uses steam from the plant for regeneration and is tolerant to water in the fuel gas. The magnesium hydroxide sorbent absorbs CO_2 through the formation of magnesium carbonate and releases water as a product. The sorbent is regenerated to convert it back to magnesium hydroxide for reuse. The sorbent capacity is considerably higher and the regeneration energy is lower than that of current commercial CO_2 capture processes. Enhancements to the process allow CO_2 removal at moderate/high temperatures and high pressures while producing the H_2O concentration necessary for the WGS. This reduces the requirement for process steam, allowing more steam to be sent to a steam turbine for additional power generation and improving the overall efficiency of the process by several percentage points.

Patent Details

U.S. Patent Number 8,470,276, titled "Process for CO_2 capture using a regenerable magnesium hydroxide sorbents, issued June 25, 2013.
Inventors: Ranjani V. Siriwardane and Robert W. Stevens, Jr.

U.S. patent application 12/887,827, filed on September 22, 2010.
Inventors: Ranjani V. Siriwardane and James C. Fisher II.

Significance

- The carbon capture process operates at moderate or high temperatures in gasification-based systems for better efficiency and compatibility with other processes in the system.
- The sorbent is regenerable at high pressure to reduce costs, is not damaged by water in the fuel gas, produces steam for the WGS reaction and can improve efficiency by reducing added steam.

Applications

- Capture of carbon from fossil fuel plants that use gasification to produce a clean low-carbon fuel gas to make electricity with high efficiency and low cost.
- Potential applications in industrial boilers or chemical and/or metallurgical plants, including steam reforming of natural gas to lower carbon fuels.

Contact

NETL Technology Transfer Group
techtransfer@netl.doe.gov

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