Innovative method inexpensively and energetically efficiently reduces CO2 emissions

November 28 2012

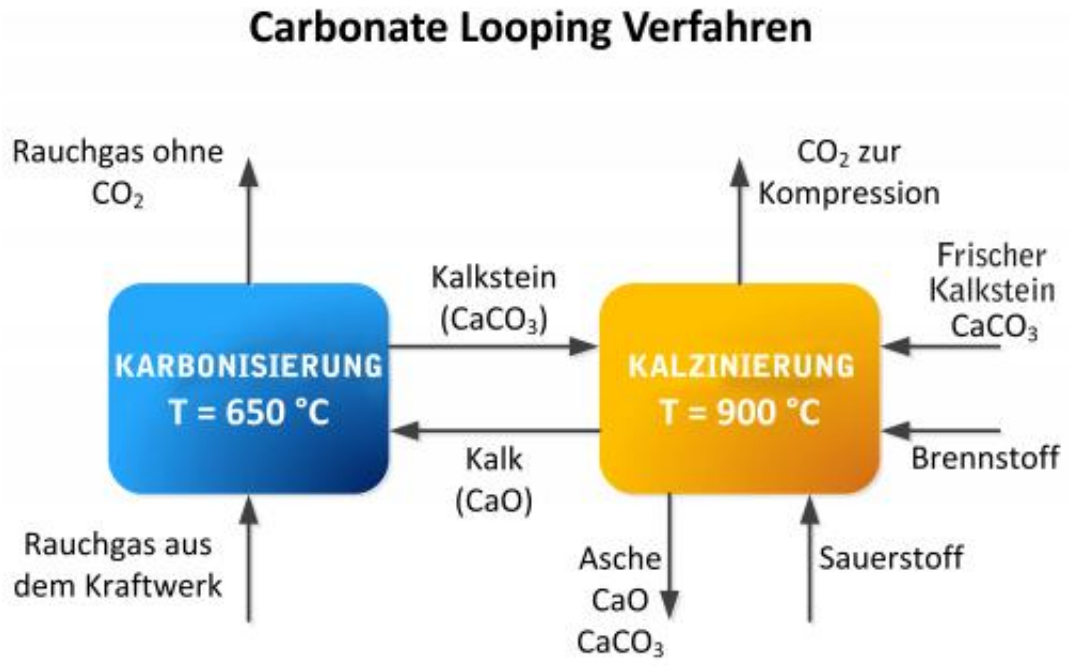
In their pilot system for capturing CO2, the TU Darmstadt researchers have been investigating the “carbonate-looping” method for the past four years, with success. Credit: Thomas Ott

The "carbonate-looping" method for capturing carbon dioxide (CO2), which has been researched at TU Darmstadt (Germany) could reduce power-plant CO2 emissions by more than 90 %, while utilizing less

energy and incurring less expense than former approaches.

The TU Darmstadt, which operates one of the world's largest pilot systems for capturing CO2, has been investigating the "carbonate-looping" method for the past four years, with success. Yet another major benefit of the method is that it may be retrofitted to existing power plants.

Large quantities of the greenhouse gas CO2 are generated during the combustion of fossil fuels, such as coal and natural gas. A key technology for arriving at lower-emission, more environmentally friendly, power plants is thus carbon capture and utilization (CCU) applied to fossil fired power-plants. CCU could allow reducing CO2 emissions arising from employing fossil fuels for generating electricity and various other purposes by industry to a minimum and thereby significantly contribute to reducing greenhouse-gas emissions. However, previous approaches to CO2 capture required high energy inputs and operating costs, which reduced their efficiency and hindered their acceptance.



The carbonate-looping method involves initially employing naturally occurring limestone for binding CO2 contained in power-plant exhaust gases in a first-stage reactor. The, now pure, CO2 is then reliberated in a second-stage reactor and may subsequently be further processed or stored. Credit: EST / TU Darmstadt

Limestone binds the CO2 contained in power-plant flue gases

The TU Darmstadt's Institute for Energy Systems and Technology has been conducting pilot-scale investigations of various innovative methods for CO2 capture. Means are being developed for virtually totally avoiding CO2 emissions, while keeping energy inputs and operating costs extremely low.

In conjunction with that work, the "carbonate-looping" method has emerged as a particularly promising approach that the Darmstadt researchers have meanwhile studied for more than 1,000 operational

hours. The carbonate-looping method involves initially employing naturally occurring limestone for binding CO2 contained in power-plant flue gases in a first-stage reactor. The, now pure, CO2 is then reliberated in a second-stage reactor and may subsequently be further processed or stored.

The TU Darmstadt's pilot-scale research system proved capable of capturing more than 90 % of the CO2 emitted, while reducing both the energy input and operating costs formerly required for CO2 capture by more than 50 %. Yet another benefit of the "carbonate-looping" method is that it may be retrofitted to existing power plants. Institute Director Prof. Dr.-Ing. Bernd Epple, who, along with his staff of more than thirty coworkers, have been investigating the method, remarked that, "This method represents a milestone along the way to CO2 free power plants and will allow coal-fired, natural-gas-fired, waste-derived-fuel-fired, and biomass-fired, power plants to reliably, cost-effectively, generate electricity and heat, without burdening the environment."

Suitability for utilization on full-scale systems

Since various investigations and simulations conducted in parallel have indicated that the method would be suitable for utilization on full-scale systems, the experience gained by the TU Darmstadt group is currently being applied to a system that has been scaled up by a factor of twenty. The aim of that project, which is being supported by the German Federal Economics Ministry and various industrial associates, is planning such a scaled-up system for installation on an existing, German, power plant. However, which power plant will be involved remains to be decided.

The investigations of the "carbonate-looping" method have been supported to date by grants totaling more than five million Euros from the German Federal Economics Ministry and various industrial

associates. Another project that is supported by grants totaling 1.5 million Euros from the European Union and industry is aimed at further improving the method's energetic efficiency.

Provided by Technische Universitat Darmstadt