C&EN
news of the week
APRIL 6, 2009 EDITED BY WILLIAM G. SCHULZ & LAUREN K. WOLF

DEALING WITH CO_2

CLIMATE CHANGE: Technologies to capture greenhouse gas advance

TWO LEADING chemical companies, Dow Chemical and Air Products & Chemicals, have signed agreements to test competing technologies for capturing carbon dioxide emitted by coal-fired power plants. The advances come as geochemists find that most CO_2 sequestered underground is likely to dissolve in deep-formation brine.

Dow and French power plant builder Alstom are joining forces to construct a pilot facility at Dow's South Charleston, W.Va., site that will capture about 1,800 tons of CO_2 per year from the flue gas of a coal-fired boiler.

The West Virginia plant is the product of a joint agreement that Dow and Alstom entered last year to develop an amine-based CO_2-removal technology similar to what Dow already markets to the natural gas industry. Both technologies take advantage of the interaction between CO_2, a weak acid, and amines, which are weak bases.

The project is one of several being set up by power companies in the U.S. and Europe to test carbon capture and sequestration (CCS) technologies. In December, Alstom and the Polish utility PGE Elektrownia Belchatow embarked on a 100,000-ton-per-year CCS project that is also based on Dow's amine technology. Peder Danielsen, a marketing director with Dow's oil and gas business, says the West Virginia facility will help establish chemistry and engineering parameters for the Polish project and for U.S. CCS projects Dow is also pursuing.

Air Products will install its CO_2 purification and compression technology at a CCS demonstration facility that opened last fall in Schwarze Pumpe, Germany. Built by Alstom and operated by the Swedish utility Vattenfall, the power plant employs oxyfuel technology, which uses pure oxygen to burn coal, yielding a CO_2-rich flue gas that is relatively easy to purify. Vattenfall, which wants to reduce its CO_2 emissions to 20% of current levels by 2030, is also exploring how it will sequester the captured CO_2 underground.

These carbon-capture advances come as a scientific team is reporting that CO_2 sequestered underground is more likely to be trapped in deep-formation waters than in carbonate minerals (*Nature*, DOI: 10.1038/nature07852). The study is unique in that it examined naturally occurring CO_2 held in underground geological formations for thousands to millions of years. Most studies have examined the fate of recently injected CO_2.


VATTENFALL

Vattenfall's oxyfuel pilot plant in Schwarze Pumpe, Germany.

The team drew and tested samples from nine U.S., European, and Chinese natural gas and CO_2 well fields. They used the ratios of isotopes of carbon (^{12}C and ^{13}C) and the noble gases (He and Ne) remaining in the samples to infer where the CO_2 wound up—in the water or in the rocks. Scientists at the Universities of Manchester and Toronto developed the geochemical tools, says Barbara Sherwood Lollar, a geology professor at the University of Toronto and the study's coauthor.

The study finds that a maximum of 18% of CO_2 will precipitate to form carbonate minerals, but the majority will dissolve in water. Scientists had previously conjectured that most CO_2 would wind up bound to underground formations.

"This is the second best outcome," says Stuart M. V. Gilfillan, the study's lead scientist and a researcher at the University of Edinburgh. Trapping CO_2 in minerals would be most secure, he says, but CO_2 dissolved in brine is a "good outcome."


STUART GILFILLAN

This Colorado natural gas field was among nine CO_2 global sample test sites.

It is unclear exactly how much of the total CO_2 in the original formation becomes trapped, Gilfillan adds, and that will await more research. The testing methods will also be used to determine the fate of CO_2 at injection sites, notes Manchester's Christopher J. Ballentine, the project's director.

"This is a nice illustration of what is going on down there," says Susan D. Hovorka, senior scientist at the University of Texas, Austin, and a leader in CO_2 geological field research. "Our team does these really short tests to understand what happens in hours, weeks, days. Stuart looked at what has happened over 'geology time.' "—MICHAEL MCCOY AND JEFF JOHNSON