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Methane Proves Hard to Capture

Keeping natural gas from leaking, as well as separating it from other gases, is a key new area of scientific research

By Umair Irfan and ClimateWire | Tuesday, April 23, 2013 | 4 comments

With drillers tapping into massive stores of natural gas across the United States, scientists are researching ways to capture it more effectively.

A sugar beet plant in Minnesota with a methane by-product. Researchers are working on ways of capturing the gas produced in industrial and energy production.
Image: Flickr/D. Bjorn

Natural gas mostly consists of methane but has smaller amounts of carbon dioxide, hydrogen sulfide and nitrogen in the mix. Energy companies are looking for a cheap way to separate these gases to yield a pure methane stream. Developers also want to control methane leaks because the gas is an especially potent heat trapper in the atmosphere.

But methane is a shy molecule, one that doesn't interact much with its surroundings, unlike its more gregarious companions like carbon dioxide. Creating a substance that can coax methane out of a gas stream while letting everything else go by is tricky, so researchers are using computer simulations to test thousands of materials to come up with a few that could do the job.

"We are looking for ways in which stray methane can be concentrated and utilized," said Amitesh Maiti, a physicist at Lawrence Livermore National Laboratory. "This is a very interesting chemistry challenge."

Maiti co-authored a paper published last week in the journal *Nature Communications* that examined how a liquid solvent and solid structure could capture methane from dilute to moderately concentrated sources.

The solid structures in this case were zeolites, porous minerals commonly used as adsorbers. Researchers modeled how methane molecules interact with each other inside these structures at a nanometer scale in a way that is "almost like a flight simulator for molecules," according to Berend Smit, another co-author and a professor of chemistry and chemical engineering at the University of California, Berkeley.

Smit explained that the researchers optimized the simulation for graphical processors, computer chips that are limited to fewer instructions but can perform more calculations simultaneously compared with conventional processors. With this method, scientists screened 87,000 zeolite structures to see how well they could filter methane, narrowing the list to a handful of potentials.

The material's pore structure plays different roles depending on the methane concentrations. At low levels, the material must have a higher affinity for methane than nitrogen. The goal here is to raise methane's concentration to 5 percent, which is when the gas becomes flammable.

At higher concentrations, methane can interact with other methane molecules, increasing how effectively the material absorbs the gas. Raising the gas's concentration to the 60 percent range makes it easier to liquefy and transport. Refiners can repeat the cycle and reuse the zeolite material to generate an even more concentrated methane stream.

Liquid filters, on the other hand, produced meager results. "What we found from this work is that liquids are not particularly good for methane capture," Maiti said.

For researchers, the next step is to make and test these materials in the real world to see whether the filtering performance of these zeolites matches their calculations. Smit added that the simulation process could be useful for identifying materials to capture carbon dioxide as well.

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