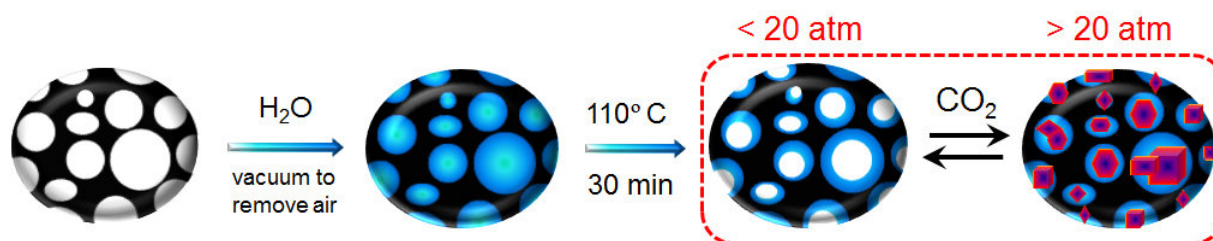


Asphalt-based filter to sequester greenhouse gas at wellhead

December 11 2017, by David Ruth



Adding water to asphalt-derived porous carbon improves its ability to sequester carbon dioxide at natural gas wellheads, according to Rice University researchers. The porous particles in the illustration are combined with water and then heated to remove excess water from the pores. The water that remains binds to the pore structures. Under pressures above 20 atmospheres, the filter material sequesters carbon dioxide and allows methane molecules to pass through. Credit: Almaz Jalilov/Rice University

Rice University scientists have found a way to make their asphalt-based sorbents better at capturing carbon dioxide from gas wells: Just add water.

The Rice lab of chemist James Tour discovered that treating grains of inexpensive Gilsonite asphalt with water allows the material to adsorb more than two times its weight in the greenhouse gas. The treated asphalt selects [carbon dioxide](#) over valuable methane at a ratio of more than 200-to-1.

The material performs well at ambient temperatures and under the pressures typically found at wellheads. When the pressure abates, the material releases the [carbon](#) dioxide, which can then be stored, sold for other industrial uses or pumped back downhole.

The research appears this month in *Nature Energy*.

Natural gas at the wellhead typically contains between 3 and 7 percent carbon dioxide, but at some locations may contain up to 70 percent. Oil and gas producers traditionally use one of two strategies to sequester carbon dioxide: physically through the use of membranes or solid sorbents like zeolites or porous carbons, or chemically through filtering with liquid amine, a derivative of ammonia.

But both these methods have drawbacks. Physical filters have a hard time differentiating between carbon dioxide and methane molecules, which are nearly identical in size (3.3 to 3.8 angstroms) and polarizability (important to bonding characteristics). Chemical approaches have better selectivity but are more expensive and corrosive, and they require a large input of energy and large equipment. Despite their high selectivity, amines capture only 13 percent by weight in carbon dioxide and need superheated steam to recycle the filtration system, Tour said, while the Rice team's system is capturing more than 200 percent by weight and no thermal source is needed.

The new Rice material features the selectivity of amines, much higher uptake of carbon dioxide and no thermal requirements, he said. Coating the pore surfaces with water adds weak chemical absorption and high selectivity while retaining the material's strong physical adsorption.

"This is known as a pressure-swing adsorption system, which is easy to implement due to its small size, and there's no need for heating since it works with the inherent pressure in the gas well," Tour said.

Water in Gilsonite forms a hydrate within pore microstructures that greatly increases the binding selectivity of carbon dioxide over methane, according to the researchers. While the grains' micropores, at 23 angstroms, are far larger than the target molecules, the addition of water tightens the pores and decreases the pore volume through which the molecules must travel. The prepared Gilsonite has a surface area of 4,200 square meters per gram, so adding water still leaves plenty of room to capture carbon dioxide, Tour said.

Over multiple testing cycles at various pressures and temperatures between freezing and 50 degrees Celsius, degradation of the material was reportedly negligible. The researchers found that about 1 percent weight of the [water](#) content was lost during cycling but determined the [water content](#) of [natural gas](#) itself would likely replace that.

More information: Almaz S. Jalilov et al. Increased CO₂ selectivity of asphalt-derived porous carbon through introduction of water into pore space, *Nature Energy* (2017). [DOI: 10.1038/s41560-017-0030-y](https://doi.org/10.1038/s41560-017-0030-y)

Provided by Rice University

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