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ENHANCED RECOVERY

Alternative Carbon Carrier Technology Could Improve Oil Production — and Carbon Storage, Too

In a study that applied alternative carbon carrier technology to enhanced oil recovery (EOR) scenarios, researchers at The University of Texas at Austin found that the new method recovered up to 19.5% more oil and stored up to 17.5% more carbon than conventional EOR methods.

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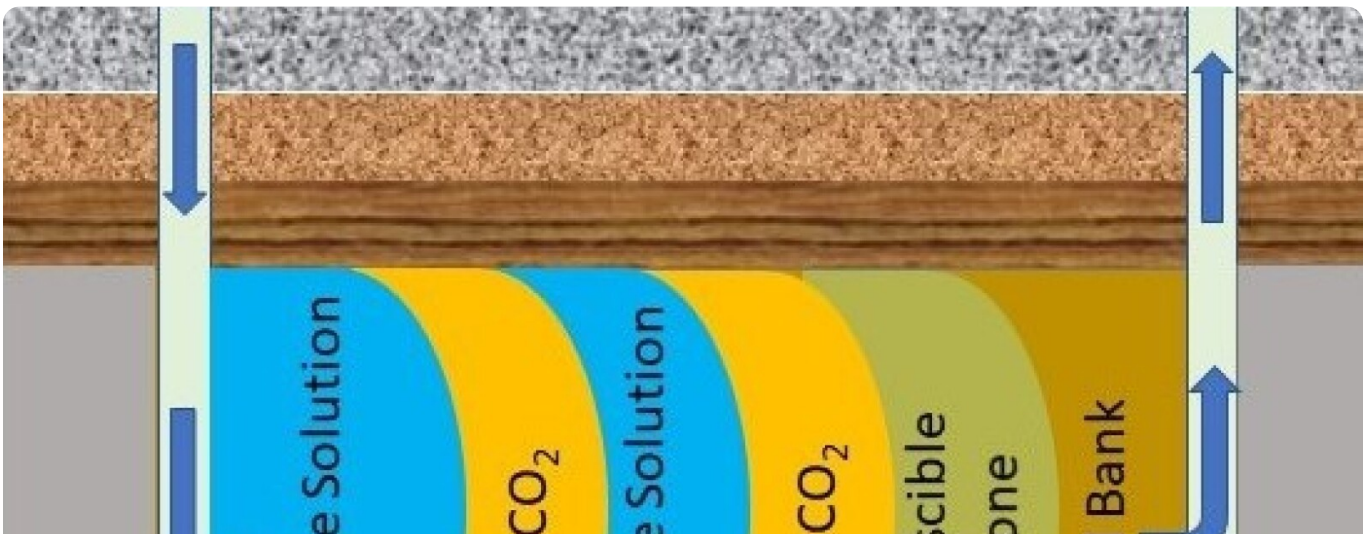

A simplified figure from the study demonstrates the process of enhanced oil recovery (EOR) with slugs of a formate solution and carbon dioxide. The formate solution is an alternative carbon carrier proposed by researchers at The University of Texas at Austin. In modeling studies, this solution is better at producing oil and storing carbon than conventional EOR methods. *Source: Mirzaei-Paiaman et al.*

A new method for enhanced oil recovery (EOR) proposed by researchers at The University of Texas at Austin (UT) is showing promising results in modeling studies — producing more oil, storing more carbon, and doing so more safely than conventional enhanced oil recovery methods.

This trifecta of benefits stems from alternative carbon carrier technology research being led at UT.

Alternative carbon carriers are chemical compounds specifically engineered to store larger quantities of carbon molecules in subsurface formations. When these compounds are synthesized from carbon dioxide (CO_2), it can help optimize the transportation, use, and storage of this greenhouse gas.

In a study that applied the technology to EOR scenarios, researchers at the UT Jackson School of Geosciences and the Cockrell School of Engineering found that the new carbon carrier method recovered up to 19.5% more oil and stored up to 17.5% more carbon than conventional EOR methods.

“The idea behind this technique is to maximize oil recovery while also increasing the amount and security of carbon storage,” said the study’s lead author, Abouzar Mirzaei-Paiaman, a research assistant professor at the Jackson School’s Bureau of Economic Geology.

The results were published in *Energy & Fuels*, a journal of the American Chemical Society.

Oil and gas companies have been using EOR to squeeze more oil out of reservoirs for decades. CO2-based EOR works by using CO_2 gas to dislodge the residual oil from pores in the rock and traps the CO_2 underground in the process.

With carbon capture and storage technology, it’s possible for companies to use CO_2 emissions produced by burning hydrocarbons to recover more oil — which helps reduce the net carbon footprint of the oil by keeping some of the emissions out of the atmosphere. When it comes to maximizing the amount of

“We don’t really have to use the CO_2; we can find a better way,” he said. “Our idea was to capture the CO_2 and to convert the CO_2 into a formate species like sodium formate or potassium formate.”

Formate is a carbon-based molecule that can be synthesized from CO_2 gas. It’s more readily stored in the rock pores than a comparable quantity of CO_2 gas in the same conditions, according to Okuno.

Moreover, water-based solutions of formate compounds are also more viscous than CO_2, which helps improve efficiency in recovering remaining oil and storing carbon in the formation.

The EOR method tested by the researchers involved alternating slugs of CO_2 gas to dislodge the oil with slugs of the water-based formate solution to help sweep the oil toward a production well. The researchers tested their method against two conventional EOR methods: One using CO_2 gas alone, the other alternating slugs of CO2 gas and water.

All three EOR methods were tested in a simulated reservoir that was created using data from real oil fields in the Permian Basin in West Texas.

The researchers found that the new carbon carrier method increased oil recovery by 19.5% compared with exclusive CO_2 injection and by 1.9% compared with combined CO_2 and water injection. For carbon storage, the carbon carrier method increased carbon storage by 2.5% compared with exclusive CO_2 injection and 17.9% compared with combined CO_2 and water injection.

In addition to oil recovery and carbon storage, the researchers also analyzed how securely the carbon was stored in the reservoir. They found that the formate-alternating-CO_2 injection was the most secure option because it minimized the amounts of free-flowing CO_2 — which can potentially escape from the reservoir. It also created a chemically buffered environment that could better preserve the integrity of the reservoir rock.

Across the board, the study shows promising results for EOR with carbon carriers. However, making it a reality for industry to refine and develop further will require more steps, Okuno said. For one, formate is not yet being produced from CO_2 at the quantities needed to sustain EOR production.

"Whenever policy and regulations support a technology, companies move toward that direction," he said.

The research was funded by the State of Texas Advanced Resource Recovery program, a research program at the Bureau of Economic Geology focused on maximizing the production and profitability of earth resources in Texas while encouraging responsible economic development, supporting education and environmental stewardship. The Energi Simulation Industrial Affiliate Program on Carbon Utilization and Storage in the Center for Subsurface Energy and the Environment also supported the research.

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