Pitt engineers to design affordable CO2 thickener to augment oil extraction

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PITTSBURGH—Crude oil extraction could be improved significantly and accessible domestic oil reserves could be expanded with an economical CO2 thickener being developed by University of Pittsburgh engineers, thanks to a $1.3 million grant from the U.S. Department of Energy.

Current oil-extraction methods across the United States involve oil being "pushed" from underground layers of porous sandstone or limestone reservoirs using a first-water-then-CO2 method known as the water-alternating-gas method. CO2—which is obtained from natural CO2 reservoirs and pipelined to oil reservoirs—is an ideal candidate for oil extraction given its ability to push and dissolve oil from underground layers of porous rock. However, its viscosity (or thickness) is too low to efficiently extract oil. As such, it tends to "finger" through the oil rather than sweep oil forward toward the production well. This process, "viscous fingering," results in oil production companies recovering only a small fraction of the oil that's in a field.

During the late 1990s, a team at Pitt was the first to demonstrate that it was possible to design additives that could greatly enhance CO2's viscosity at low concentrations, although the compounds were both costly and environmentally problematic.

"The thickeners we developed years ago were too expensive for wide use," said principal coinvestigator Eric Beckman, George M. Bevier Professor of Engineering in Pitt's Swanson School of Engineering. "So, in this proposal, we're looking at designing candidates that can do the job at a reasonable cost."

Beckman and Robert Enick, principal coinvestigator and Bayer Professor and Vice Chair for Research in Pitt's Department of Chemical and Petroleum Engineering, intend to build upon earlier Pitt models of CO2 thickeners, but this time with a more affordable design that could cost only several dollars per pound. Ideally, their small molecule thickener would be able to increase the viscosity of pure CO2 100 times—something that hasn't previously been accomplished.

"An affordable CO2 thickener would represent a transformational advance in enhanced oil recovery," said Enick. "More than 90 percent of CO2 injection projects in the U.S. employ the WAG method to hinder the fingering of the CO2. However, if a thickener could be identified that could increase the viscosity of the CO2 to a value comparable to that of the oil in the underground layers of rock, then the fingering would be inhibited, the need to inject water would be eliminated, and more oil would be recovered more quickly using less CO2."

"It's clear there exists a very wide market for this type of CO2 thickener," said

Beckman. "It's been long recognized as a game-changing transformative technology because it has the potential to increase oil recovery while eliminating water injection altogether."

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This $1.3 million grant from the Department of Energy is through the National Energy Technology Laboratory under the category of "Unconventional Gas and Oil Technologies."

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