Minding the gap ahead of future fuels

April 4 2018

Tad Patzek has been the architect of many breakthroughs in waterflood, foam injected and steam-based oil and natural gas recovery processes. Credit: KAUST

Oil expert Tadeusz Patzek aims to ensure that efficient recovery of oil and gas remains feasible whilst scientists find alternative green energy sources.

The days of easy oil extraction are dwindling across the globe, bringing an imperative for careful and inventive ways to utilize the Earth's remaining fossil fuel resources. Tadeusz Patzek at KAUST is a leading

expert in onshore and offshore oil recovery processes. He is committed to maintaining oil and gas production at sustainable levels to give scientists and engineers the opportunity to find replacement fuels for the future.

"Put succinctly, the key to my research is how to maintain oil and gas recovery for longer," says Patzek. "A changing climate means there is little doubt that the oil and gas industry will have to change drastically. Oil and gas are priceless resources that we must use wisely and not burn mindlessly.. Long-term field management to maximize ultimate recovery is now a key issue and lowering production costs is another."

Patzek arrived at KAUST in early 2015 from the United States, where he had worked for many years at Shell Development, the University of California at Berkeley, and the University of Texas. As well as being a key faculty member, Patzek is director of the new Ali I. Al-Naimi Petroleum Engineering Research Center (ANPERC) at KAUST, which he has established and built up over the past two years.

"ANPERC's focus is on the wise use of hydrocarbon-based energy, working on ways of extracting the remaining natural gas and oil reserves with the smallest possible environmental impact," says Patzek. "A main goal is to produce interdisciplinary research on fluid flow in complex geological formations.. The future of hydrocarbon fuels relies on effective flow mechanisms, using water, heat and chemicals to ensure efficient and safe recovery."

In the 1980s, within a few weeks of starting as a researcher at Shell Development, Patzek came up with a radically new description of foam flow in porous rock. The insights from his research helped to revolutionize foam recovery-a process by which high-pressure foam is pumped into difficult-to-reach oil reservoirs and porous rocks holding oil or gas droplets to release reserves that would otherwise be impossible

to retrieve.

Patzek has been the architect of many breakthroughs in waterflood, foam and steam-based oil and natural gas recovery processes. As a chemical processes engineer and applied physicist, he has used computational modeling to visualize the optimal extraction methods for complex reservoirs.

The success of waterflooding-using water to displace oil from pore spaces in rocks-depends upon the localized geology of a site, the pH and salinity of the extraction water, and the water already present within the rock with consideration for the chemical composition of the rock itself. In a 2017 paper, Patzek and his team used models to demonstrate the complexities of using low-salinity waterflooding in calcite-a carbonate mineral often found in limestone1. Carbonate-based reservoirs remain challenging to extract from, not least because acidic water can rapidly dissolve calcite.

Over the past five years, Patzek has lent his expertise to the controversial process of hydraulic fracturing, or fracking; the extraction of natural gas from shale rock by breaking apart, or fracturing, the rock layers using high-pressure fluids to release gas trapped inside. Patzek's recent work modeling the potential yields from fracking sites in the U.S. suggests that forecasts of a 'flood' of natural gas stemming from these shale formations may be overestimated.

In October 2017, at the Annual Technical Conference and Exhibition in San Antonio, Texas, Patzek's team presented on their current research, including a paper outlining a novel, simple physics-based model that can predict production from shale oil wells2. Their model uses parameters from the physics of oil recovery and hydrofractured well geometries and appears to be more accurate and robust than other prediction methods.

These are the kind of oil-recovery methods that scientists hope will bridge the gap while we find alternative fuels for the future. However, as Patzek reminds us, the focus must be on revolutionizing how we perceive oil and natural gas and ensuring that these new recovery methodologies do not make us complacent.

More information: Tadeusz W. Patzek et al. A Simple Physics-Based Model Predicts Oil Production from Thousands of Horizontal Wells in Shales, *SPE Annual Technical Conference and Exhibition* (2017). DOI: 10.2118/187226-MS

Provided by King Abdullah University of Science and Technology