SPE Conference Points To The Future Of Oil Recovery

The Society of Petroleum Engineers’ Improved Oil Recovery Conference in Tulsa is a biennial tradition that spans more than 40 years and has become a must-attend event for those working in and around improved oil recovery operations.

The 2018 conference chair, and former Tech Connections columnist, Lance Cole introduced this year’s conference theme of acceptance, perseverance and disruption as the keys to enhancing the future of improved oil recovery. Cole highlighted how acceptance captures the idea of coming to terms with realistic oil prices, and that waiting on higher prices to embrace technology was not ultimately profitable in the long-term.

He went on to say that perseverance captured the industry’s spirit to weather the ups and downs of the market while making incremental advances along the way. But probably the most important and key to the future success of the oil and gas industry will be “disruptive technology.” Cole mentioned bright-water and nano applications as examples of disruptors for improved oil recovery.

The Improved Oil Recovery Conference began with a plenary session where IOR pioneer Larry Lake moderated a panel session that included Charles McConnell speaking to carbon dioxide and gas injection; Gary Pope from the chemical perspective; Raj Mehta, professor representing thermal technology; John Harju for unconventional; and Shauna Oppert speaking on the geosciences. The group discussed how operators could utilize past experiences in IOR technology as they moved into the future, while understanding and embracing the disruptions along the way.

Some highlights of the technical session included a paper titled, “Longitudinal Fracturing in a Mature Permian Waterflood: A Case Study” (SPE-190208), by Ahmed Wagia-Alla, Riley Roach and Joseph El-Azzi from Occidental Petroleum. The authors highlighted how horizontal drilling was applied successfully in a mature waterflood at Occidental’s North Wasson Clearfork Unit as the first waterflooded, longitudinally fractured horizontal in the Permian Basin Leonardian Series.

The field is located on the Permian Basin’s Northwestern Shelf, where the Middle Clearfork reservoir was developed with 20-acre vertical well spacing. Their geological models revealed a series of relatively thin, discontinuous lenticular extensions of “pay” quality porosity in areas of poor areal sweep efficiency. Although horizontal development typically is used for greenfield tight, unconventional resources, this concept was evaluated as an alternative to traditional vertical infill drilling in this conventional, heterogeneous, waterflooded reservoir.

Because the widely accepted practice of maximizing stimulated rock volume with closely spaced, transverse fractures would jeopardize waterflood sweep efficiency, the horizontal well was drilled parallel to the in-situ maximum horizontal stress, rather than perpendicular.

A horizontal pilot well was drilled with the objectives to:

- Prove the effectiveness of multistage, longitudinal fractures to increase oil production from a heterogeneous reservoir, thereby improving recovery efficiency in a mature waterflood; and
- Investigate the ability to manage the well’s decline with waterflood support from offset vertical injection wells.

Initial results have shown the pilot was successful in meeting both objectives. Furthermore, this horizontal well, which cost five times as much as a vertical well, had an initial peak rate that was seven times greater than a typical vertical well in the field. And in the first year, it produced about seven times as much as a typical vertical well.

Later in the week, in a paper titled, “Bakken IOR Model for a Pilot Injection Project” (SPE-190221), B. Todd Hoffman from Montana Tech discussed how to improve recovery factors in the Bakken formation.

Hoffman said the need for IOR processes was clear, but there had been only minor work in this area and no commercial field applications. He discussed the drawbacks of models and their poor track record for unconventional IOR. He also examined a case-history of matching the model to an IOR injection pilot in Mountrail County, N.D., that included both water and gas injection tests.

Interwell connectivity was reproduced by matching the injection data, which Hoffman was hoping would improve predictions from the model. Various situations were tested, including both gas and water injection scenarios.

In the actual field pilot, gas was injected for two months in the injection well, and there was only a minor response. Hoffman then modeled injecting into all three wells in a huff-and-puff manner for 10 years. The results showed 30 percent more oil recovered than primary recovery.

Hoffman then modeled additional scenarios in which water was injected in both a continuous and huff-and-puff manner. The continuous case had early breakthrough and poor sweep, but the huff-and-puff injection case indicated oil rates would increase almost as much as the best gas injection cases.

While the models could not show a definitive increase in oil production, they did identify IOR techniques that had a better chance of success in the Bakken.

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