Technology For Producing Heavy Oil Making Headway

Producing ultraheavy oil doesn’t get a lot of traction from operators looking to produce liquids economically and efficiently during these challenging times. However, North America is home to some of the richest deposits of ultraheavy oil around the globe, spanning Utah, Colorado, Wyoming, parts of Alaska and offshore California, to name a few. The Department of Energy estimates the total U.S. heavy oil resource is about 104 billion barrels in place. This staggering amount of heavy oil is more than five times the country’s proved reserves.

The primary issue with producing heavy oil is not finding the resource, but producing and selling the crude in a rapidly changing market. In a steady market, these operations can produce effectively for up to 50 years. However, the cost and energy required to produce and process heavy oil can be as high as 40 percent, making these resources challenging in the best of times.

Not surprisingly, there has been a lot of work conducted to find ways to safely and effectively identify and produce these resources, and not all of it is brand new. In a 1923 paper titled Oil Reserves of the United States (923953-G SPE), David White from the U.S. Geological Survey discusses what was perceived then as vast heavy oil resources, stating, “In this country, petroleum is a rapidly wasting asset, and an occasional appraisal of the amount remaining in the ground is a simple business procedure to safeguard the general welfare and prosperity of the republic.”

White’s 1923 estimate was that the United States had 9.15 billion barrels of oil in place with 4.0 billion in the heavy-oil group. Regarding the speculative nature of these figures, White went on to say, “Oil geologists and engineers understand well (that) the chances of error that must attend estimates of petroleum in the ground . . . further the inevitable differences of opinion among geologists of equal rank and experience.” While White was a little off on total barrels of oil, he seems to have pegged geologists!

A 1985 paper titled, Potential of Thermal Recovery in the United States (SS-85_21 PETSO C), George Stosur and Keith Frye of the U.S. Department of Energy discuss the potential of thermal recovery. Stosur and Frye asserted that nearly 80 percent of the enhanced oil recovery being conducted at the time was through steamflooding and in situ combustion. They also estimated production using those methods would approach 1 million barrels a day at the turn of the century.

Stosur and Frye suggested advancements in sweep efficiency injectants and downhole steam generators, better tubulars, higher temperature packers, and environmental control equipment would help improve the steamflooding process. They reinforced the importance of steamflooding to improve heavy oil production over the next 30 years, even though it is was highly sensitive to crude oil prices.

One of the challenges in producing ultraheavy oils is removing the impurities or upgrading them prior to transporting and refining. In a 2007 IHS article on hydrotreating, the authors describe heavy oil as having a high boiling temperature as well as containing large amounts of asphaltenes, sulfur, nitrogen and metals. Hydrotreating heavy oils creates a reaction between the crude and hydrogen with a specific catalyst at high pressure and temperature. This process isolates the sulfur, nitrogen and metals, allowing them to be removed.

While hydrotreating is the standard for “upgrading” heavy crude prior to transport, many folks are working on ways to improve the process. Ceramtec, an advanced materials and ceramic company, has been working on a process that uses molten sodium or lithium metals to remove impurities. The process is expected to provide more flexibility and economics.

Finally, in the September issue of the Journal of Petroleum Technology is an article titled, “Testing Heavy Oil Production without Steam Heating.” Author Stephen Rassenfoss describes a new device that heats thick oil sands with radio waves to reduce crude oil viscosity. The process involves an electromagnetic heating element combined with a solvent, and is designed to mobilize heavy oil at a significantly lower temperature.

The project uses technology developed by the military to reduce the heat emitted by communication devices. The well design is similar to steam-assisted gravity drainage, however, the antenna is installed in the upper well where solvent will be injected to thin the bitumen, resulting in the crude flowing downward into a production well. The process is called enhanced solvent extraction incorporating electromagnetic heating, or ESEIEH. If commercially viable, it could reduce surface equipment and improve the economic and environmental impact of producing oil sands.

Producing heavy oil remains an economic challenge. However, technology and innovation will continue to grow our production.