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Unlocking Tight Oil: Selective Multi-Stage Fracturing in the Bakken Shale

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Abstract

In recent years, the formation known as the Bakken Shale in eastern Montana and western North Dakota has seen enormous growth in oil and gas production. Scientists from the United States Geological Survey have commented that the area has the potential to become “the next Saudi Arabia.”

In most cases, the Bakken horizontal wells are fracture stimulated. However, with several thousand feet of formation, effective stimulation of the entire length has proven time-consuming and costly. In the past, a single-leg zone was fractured all at the same time, regardless of the varied permeability of the layers. Although this simple method of stimulation was seen as a success at the time, a new, more efficient method using swellable packers with reactive elements now promises to optimize total recovery and minimize fracturing cost.

Case history data will show how employing multiple frac sleeves with swellable packers straddling each interval proves to be a cost-effective way to stimulate multiple zones and save days of rig time. Specific experience in the Bakken field provides an optimization model for worldwide well completion markets

Unlocking Tight Oil

Traditional methods for tight oil drilling often include several costly steps to open up new veins: multiple downhole trips, cementing, plugging, perforating and finally fracturing. With the reactive-element packer method, the open-hole packers segregate multiple frac sleeves used to set up and designate multiple fractures on a horizontal wellbore. This segmenting process allows for more fractures, reduces the time and cost for hydraulic fracturing, accelerates production and improves reservoir drainage.

In the Middle Bakken formation at the Sanish Field, North Dakota, an independent contractor sought a frac stimulation procedure to increase overall production while reducing well construction and completion costs. The contractor selected a successful recent innovation — reactive-element (swellable) packers — to perform an eight-stage compartmentalized frac job.

Challenges

The efficacy of frac stimulation is diminished when laterals exceed 5,000 ft. running an eight-stage frac job at more than 5,000 ft. involved even greater challenges.

Major pumping investments are often required for tight shale formations. Traditional methods include pumping frac fluid into the open hole or isolating separate zones of a horizontal wellbore. The former method typically results in the frac fluid flowing to areas of least resistance, which can reduce production along the rest of the wellbore. The latter method typically includes several steps (repeated cementing, plugging, perforating and fracturing) and will also require multiple trips as well as the expense of additional crew and equipment for the duration of the operation.

Completing high-angle wells also becomes problematic when getting tools through doglegs and other restrictions. The packers in the selected frac system are shorter than standard tools, which allow them to navigate better through such tight spots.