Enhancing Oil Recovery

USING ALKALI-SURFACTANT-POLYMER (ASP) FLOODING TO RETRIEVE OIL RESERVES IN MATURE WELLS GETS A BOOST WITH DYNAJET™ DRY POLYMER PREPARATION SYSTEM TECHNOLOGY FROM FLUID DYNAMICS

By Greg Kriebel

An Enhanced Oil Recovery operation that utilizes dynaJET™ Dry Polymer Preparation System technology from Fluid Dynamics can help maximize product recovery from mature oil wells.

Introduction

The debate over whether there should be more drilling for oil and gas within the United States, whether on land or offshore, has become a political football, with the respective sides unwilling to budge from their long-held positions either in favor of or against. What many don't know is that, currently, there are vast reserves of conventional oil deposits below our feet that have only been partially tapped. These deposits may have been discovered as long as 50 years ago, but their wells were capped when reduced recovery rates no longer made them cost-efficient. Now, however, recent advances in oil-production and recovery technology can make those old, supposedly played-out wells vibrant producers again. The challenge is finding and utilizing the correct – and most cost-effective – technology to retrieve these heretofore hard-to-reach oil deposits.

This white paper will identify a new method of Enhanced Oil Recovery (EOR) that relies on the injection of a chemical concoction consisting of alkalis, surfactants and polymers into the well in order to assist the trapped oil in finding its way to the surface.

The Challenge

Of course, the most difficult part of oil production is locating the deposit and then drilling the wells, but, as mentioned, many significant deposits remain trapped underground because it had become economically unfeasible to continue to try to produce the oil. In fact, when wells are first drilled and the product is flowing freely – in a process known as primary recovery – as little as 10% of the reservoir's oil ever makes its way up the well bore. Then, once the natural pressures of the reservoir are no longer enough to produce oil, which typically occurs after a number of years, the exploration company will initiate a production stage known as "secondary recovery." In this stage of production, water is injected into the reservoir where it displaces the oil, allowing it to flow to

the well bore and up to the surface. This secondary recovery process can generally see between 20% and 40% of a reservoir's remaining oil recovered.

That means that anywhere from 50% to 70% of the reservoir's recoverable product is still underground. At this point, the oil producer has two options: initiate any of a variety of EOR operations, or, if the cost of EOR is too prohibitive, cap the wells and move on to the next oilfield.

With that in mind, for years many wells were abandoned because the cost of EOR operations – which usually come in three forms: gas injection, chemical injection or thermal recovery – outweighed the return that would be realized on the recovered oil. That, however, has changed in recent years, for two reasons: the cost of oil has consistently crested the $100-per-barrel threshold and improvements in EOR technology have made it both more bottom-line friendly and able to maximize a reservoir's rate of recovery.

The Solution

One of the EOR technologies that has proven to be most effective in delivering a reservoir's trapped oil to the well bore is known as chemical injection. In this type of operation, a chemical cocktail is injected into the well where it interacts with the water that remains from the secondary recovery stage, in the process freeing the trapped oil and making it recoverable. Within the realm of chemical injection applications, one of the most successful EOR processes – with many oilfields realizing a 20% increase in the return of original oil in place (OOIP) – is known as alkali-surfactant-polymer (ASP) flooding.

In the ASP process, an alkaline agent, usually either caustic soda (NaOH) or soda ash (Na2CO3), a low dose of surfactant (0.05% to 0.5% concentration) and a polymer, which increases the viscosity of the fluid and makes it more stable, are combined with softened water and injected into the well. This ASP combination helps achieve ultra-low interfacial tension between it and the trapped oil, which allows the alkali to penetrate deeply into the

formation. This enables more of the trapped oil to interact with the ASP fluid, which, in turn, allows more of it to be released and flow to the well bore.

When considering the polymers used in the ASP-flooding process, there are two choices: dry polymers or liquid polymers. In most cases where large-scale recovery operations are in place, the better choice is dry polymers. This is true for a number of reasons:

- The volume of the chemical concoction used in ASP flooding is so high – the flow rates of ASP being injected into the well can approach 400 gallons-per-minute – that a constant trainload supply of liquid polymer would need to be on-site at the oilfield
- The massive amounts of polymer that are used exceed the viability and reliability of liquid-polymer equipment operation
- Liquid polymer can be 2.5 times more expensive than dry polymer

Of course, having an ample supply of dry polymer on hand is just one half of the equation. The other is being able to rely on a system that is able to adequately wet that dry polymer and then inject it into the ASP cocktail before it is pumped down into the well bore. That's where dynaJET™ Dry Polymer Preparation System technology from Fluid Dynamics,™ a leading manufacturer of liquid and dry polymer blending systems, and a division of the Neptune™ Chemical Pump Co., North Wales, PA, is becoming an invaluable tool in an oilfield's EOR operations.

The dynaJET technology is ideal for EOR applications because it utilizes a negative-pressure, blower-induced conveyance system to transport and disperse the dry polymer prior to the wetting process. Dispersing dry polymer prior to it coming into contact with the dilution water ensures effective polymer-particle wetting. The result is reduced mix and hydration times, higher polymer performance and lower chemical costs.

In the pneumatic-conveyance process, specially designed spray nozzles thoroughly wet each polymer particle with a high-flow shower of water as it passes through the wetting head and into the mixing tank. The mixing tanks include Neptune mixers, which have been specially designed for polymer applications to keep the hydrating polymer molecules in suspension while not damaging the fragile, uncoiling polymer.

Other benefits of Fluid Dynamics' dynaJET system include:

- Separation of polymer prior to wetting, which prevents polymer buildup at the volumetric feeder and plugging of the conveyance system
- Multiple hopper configurations that can be designed to meet every EOR system's unique needs
- Hoppers that have been designed for loading without the need for stairs or platforms, resulting in increased safety for the operator, along with cleaner operation and a reduced chance of polymer spills
- Six standard control panels, providing the flexibility to choose the features that best meet the requirements of any EOR operation without accruing any additional customization costs

Inside the dynaJET™ Technology

Conclusion

There's no way around it: for the foreseeable future, petroleum products will remain the leading source of energy when it comes to powering the nation's vehicles. So, while the search for alternative-energy sources may proceed, until those sources are viable our demand for oil will continue apace. While seeking to lessen our dependence on foreign sources of oil is a commendable goal, the fact remains that there are still many sources of domestic oil that have not been fully tapped.

Many of these oil reservoirs can be found in areas where some recovery has already been realized, and the drilling infrastructure remains in place, but extenuating circumstances have prohibited the oilfield's full potential from being realized. That no longer needs to be the case as advances in EOR technology have now made those hard-to-reach reservoirs viable, and cost-effective, again. Producers who are returning to those mature wells are more often doing so with the intention of using ASP flooding as their mode of oil recovery. The ones who are intent on maximizing their investment and return are doing so with an ASP process that features dynaJET™ Dry Polymer Preparation System technology from Fluid Dynamics. For more than 25 years, Fluid Dynamics has been a leader in the development of polymer-blending technology and its dynaJET system carries on this tradition while helping oil producers find new and exciting ways to tap the rich oil resources that are still able to be found and recovered in the United States.

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