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Benefits flow from waterflooding oil reservoirs

Waterflooding – the injection of water into an oil reservoir to recover more petroleum from it – is a common oil industry practice. The technique is one of several used to sustain and prolong oil production in the province. Saskatchewan's 200-plus active waterflood projects are key to keeping up production in many older reservoirs.

Secondary or enhanced oil recovery (EOR) methods are needed because only a small fraction of the oil in a reservoir can be produced by primary means (the reservoir's natural drives). Initial recovery ranges from only about 5 per cent (Lloydminster-area heavy oils) up to about 20 per cent (better quality oils like those produced in the province's southwest and southeast). These methods must, naturally, also be both economic and effective, or companies may not bother trying to coax more oil from the reservoir.

Waterflooding – usually the first secondary method applied to a reservoir – meets both these criteria. In most situations it will help recover a significant portion of the oil in the reservoir. Capital costs, mainly for surface facilities to handle the injection and production water, are relatively inexpensive compared with those of most other EOR methods. Operating costs for a waterflood are typically lower than for other EOR techniques.

Where does the water come from? A common misconception is that oil companies use valuable surface water and, by injecting it into an oil formation, render it dirty and salty. While a limited number of projects do use some surface water, those practices are disappearing. Most projects use water from an underground aquifer that is similar to the oil formation's native water, usually quite salty and not suitable for human or animal consumption.

Virtually all of the injected water is produced with the oil. The two fluids are separated on the surface, the oil content remaining in the water is removed, and then the water is reinjected. So in fact most of the water gets repeatedly recycled – only a small amount of 'new' water, roughly equal to the amount of oil produced, is required on a daily basis. Water

fractions in the produced fluids can be as high as 99 per cent before water handling costs make the practice uneconomic.

Waterflooding already has its advantages as a proven technology, but there is still room to improve. Waterflooding enhancements will be crucial to the continued productivity of a large number of reservoirs throughout Saskatchewan. While other EOR technologies will certainly recover more of the oil from a given reservoir, the economics may not be that favorable to their application in the province. The science behind waterflooding must be advanced to sustain the oil industry.

Work is already underway to improve waterflooding technology and also to extend its application to heavy (more

viscous) crudes, once thought impractical. One method involves the addition of a small amount of soap-like chemicals to the water – this helps to free the oil attached to the reservoir rock. Researchers expect that this technique could recover an additional 10 to 20 per cent of a reservoir's original oil. This can be as good as discovering a new reservoir.

Other approaches are being developed to control where the water goes in the reservoir. In most applications, water is less viscous than the reservoir oil, and so tends to flow along the easiest path through the reservoir, missing a large amount of the remaining oil. There are ways to raise the water's viscosity and get it to flow into areas where there are higher oil concentrations.

One of these methods involves creating and injecting micro-bubble solutions. It was recently "tested" by over a thousand school children in "Canada's Largest Science Experiment," held in Regina and Saskatoon.

Oil producers and researchers are working hard to find the best waterflooding practices to increase recovery and to achieve quicker success. Many investment opportunities compete for oil companies' attention. For Saskatchewan's reservoirs to be a part of their production strategy, effective and relatively low-cost technology must be "on tap".

