Oil Sands Recovery - Production Technologies

Primary Production Methods

Natural reservoir pressure or simple mechanical pumps are the two most common approaches used to raise oil the surface. Most heavy oil reserves have to be pumped.

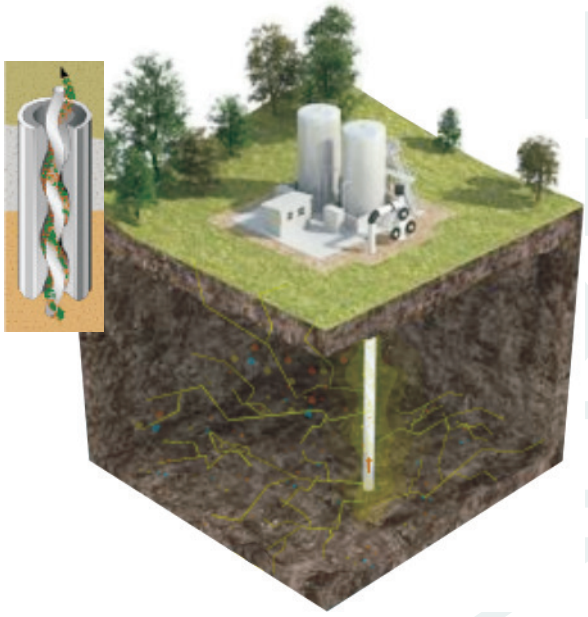
There are many factors which can make your selection of the most appropriate recovery method for heavy oil a challenge. These include viscosity, reservoir complexity, environment, economics and refining.

The solution is a combination of upfront engineering to analyze your field; engineering and design options; as well as reservoir and fluids characterization to understand the formation and oil characteristics throughout the reservoir. A field evaluation enables you to decide on and simulate the well construction and completion options which best fit your reservoir. This is combined with access to accurate reservoir monitoring and control systems and technologies, which will help manage your wells.

Several recovery techniques can be considered for heavy oil in primary production:

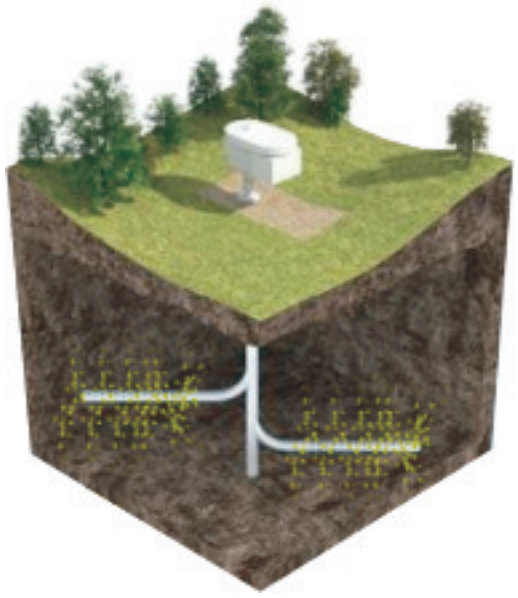
CHOPS (Cold Heavy Oil Production with Sand)

Vertical wells are drilled into the zone of interest, and sand production is encouraged using special screens and slotted liners. Producing sand from unconsolidated formations produces “wormholes” which facilitate oil flow to the surface.



Artificial Lift - Progressive cavity pumps (PCP’s), especially topdrive PCP’s, are the preferred method for artificial lift in CHOPS because they are best suited to handle high levels of sand. Bottomdrive electric submersible progressing (ESP) cavity pump systems can be used. Monitoring equipment helps to extend the life and reliability of pumps managing solids and to predict potential failures before they occur.

Perforations - The CHOPS recovery method encourages high levels of sand production. To enhance CHOPS, a perforating program can stimulate the creation of wormholes and utimately improve flow.



Multilaterals

Multilaterals provide a way to increase pay zone contact in your field with ever faster and more accurate drilling technologies, supported with appropriate completions systems to maximize production. A key challenge to successful multilaterals is maintaining isolation of branch junctions to the main well. This can be accomplished with or without sand control.

Well Placement - Keeping horizontal wells properly positioned within the zone of interest and away from water and boundaries is critical to production success. PeriScope directional, deep imaging while drilling is a key tool to meet this challenge.

Sand Control - Screens and slotted liners are the typical method used to control sand in unconsolidated formations for multilateral operations.

Artificial Lift - Progressive cavity pumps (PCP’s) including both electric or hydraulic topdrive PCP’s and bottomdrive ESP’s, are the preferred method for artificial lift in multilaterals.

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Cold Enhanced Oil Recovery (EOR) Production Methods

Depending on the characteristics of the reservoir, cold enhanced oil recovery (EOR) production methods can provide a cost-effective recovery option.

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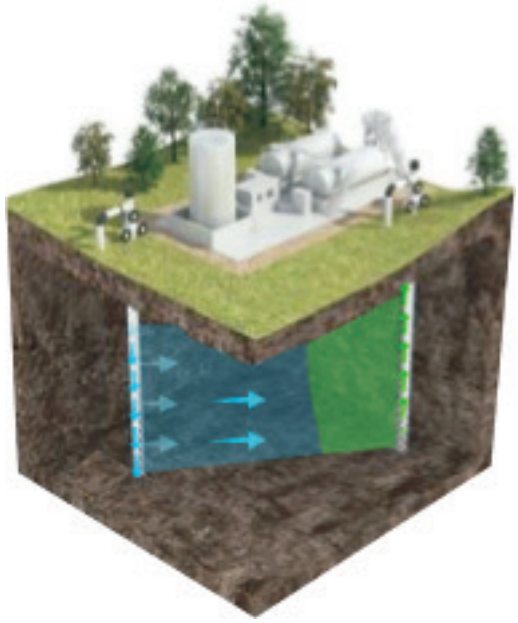
The solution is a combination of upfront engineering to anyalze the field: engineering and design options; as well as reservoir and fluids characterization to understand the formation and oil characteristics throughout the reservoir. A field evaluation is performed to decide on and simulate the well construction and completion options which best fit the reservoir. This is combined with access to accurate reservoir monitoring and control systems and technologies, which help manage the wells.

Several cold EOR production methods offer recovery options for heavy oil:

VAPEX (Vapor Extraction Process)

The VAPEX process is a technology similar to SAGD but instead of steam, solvent is injected into the oil sands resulting in significant viscosity reduction. The injection of vaporized solvents such as ethane or propane help create a vapor-chamber through which the oil flows due to gravity drainage. The process can be applied in paired horizontal wells, single horizontal wells or a combination of vertical and horizontal wells. The key benefits are significantly lower energy costs, potential for in situ upgrading and application to thin reservoirs. The outstanding technical challenges are that it has yet to be field-tested and field injection and production strategies have yet to be developed.



Waterflood

One of the simplest EOR methods is waterflood-water injection. It is used to drive a front of heavy oil from one vertical wells towards another vertical producing well.

NEW TECHNOLOGY

Oil Sands Recovery - Production Technologies

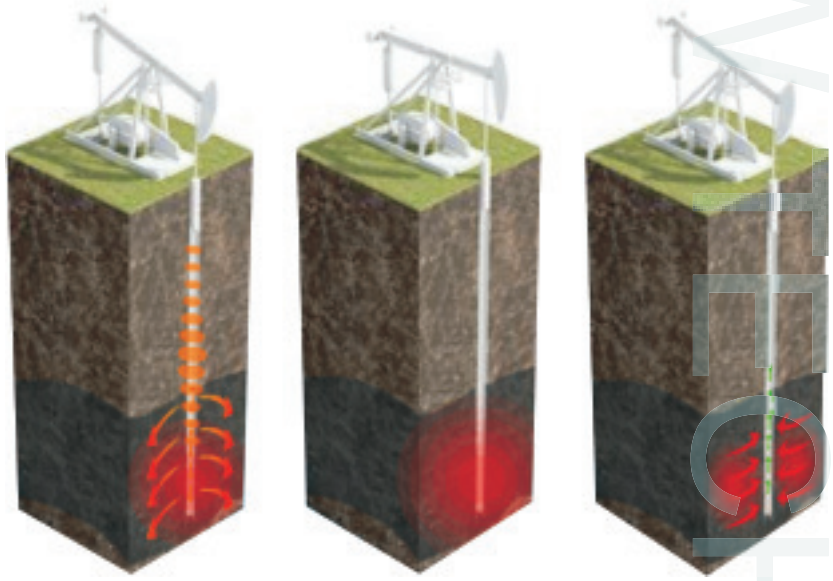
Thermal Heavy Oil Production Methods

A variety of in situ methods are used to recover bitumen, especially from deposits that are too deep to surface mine. All in situ approaches face two major challenges. How can the viscosity of the bitumen be reduced so it will flow? And how can the bitumen be recovered? Different deposits may favour different production methods. Today, two major in situ techniques, Cyclic Steam Stimulation (CSS) and Steam Assisted Gravity Drainage (SAGD), are used commercially in Alberta's oil sands.

Thermal methods promise some of the highest recovery factors. They also promise the largest potential capital expenditure and operating costs and therefore risk. The following three techniques tested for new thermal production methods currently stand out above the rest:

CSS (Cyclic Steam Stimulation, also known as "huff and puff")

CSS injects high-pressure, high temperature (about 350°C) steam into oil sand deposits. The pressure of the steam fractures the oil sand, while the heat of the steam melts the bitumen. As the steam soaks into the deposit, the heated bitumen flows to a producing well and is pumped to the surface. This process can be repeated several times in a formation, and it can take between 120 days and two years to complete a steam stimulation cycle.



HCSS (Horizontal Cyclic Steam Stimulation)

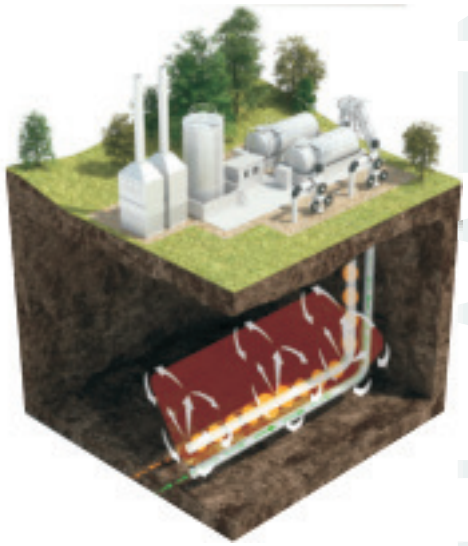
Same process as CSS above, except that a vertical well is drilled from the well pad from which multi-lateral wells branch out horizontally

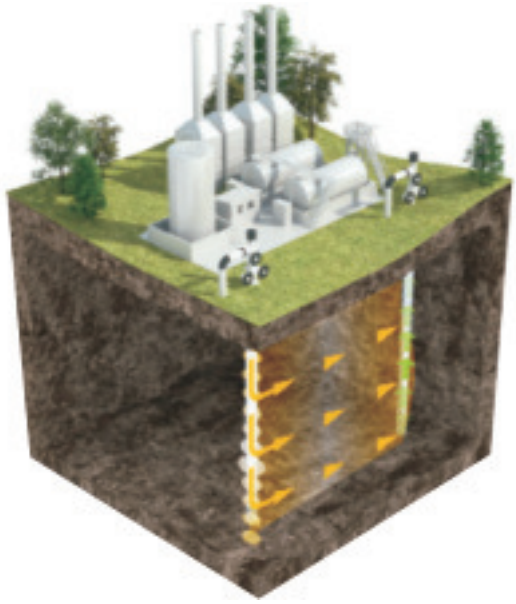
NEW TECHNOLOGY

Thermal Heavy Oil Production Methods (continued)

SAGD (Steam Assisted Gravity Drainage)

SAGD is the most popular enhanced oil recovery technology currently being adopted by Canadian heavy oil producers. An estimated one trillion barrels of oil in the Athabasca deposit are potentially recoverable with the present technology. Surface mining is only feasible for recovering up to 20% of the oil sands deposits, making SAGD the best known alternative for recovering the potential 80% of the remaining oil sands deposits. SAGD technology requires the drilling of two parallel horizontal wells through the oil-bearing formation. Into the upper well, steam is injected creating a high-temperature steam chamber. The increased heat loosens the thick crude oil causing it to flow downward in the reservoir to the second horizontal well. This second well is located parallel to and below the steam injection well. This heated, thinner oil is then pumped to the surface via the second horizontal, or production well. Water is injected into the bitumen-drained area to maintain the stability of the deposit.





Steamflood

Two vertical wells are used. One injects steam into the reservoir, creating a steam front to reduce the viscosity of the oil and pushes the oil towards the a producing well.

Other Enhanced Oil Recovery Production Methods

THAI (Toe-to-Heel Air Injection)

THAI technology offers many potential advantages over SAGD, including higher resource recovery of the original oil in place, lower production and capital costs, minimal usage of natural gas and fresh water, a partially upgraded crude oil product, reduced diluent requirements for transportation and significantly lower greenhouse gas emissions. The THAI process also has potential to operate in reservoirs that are lower in pressure, containing more shale, lower in quality, thinner and deeper than SAGD. This type of technology could be utilized in deep heavy oil resources both onshore and offshore.Toe-to-Heel Air Injection (THAI) is a simpler to SAGD. It combines a vertical air injection well with a horizontal production well, eliminating the need for a horizontal well to inject steam. Technologies are currently being tested by Petrobank Energy's Whitesands project.