In-Situ Techniques for Recovery of Oil Sands

Using Teledyne ISCO Syringe Pumps

TELEDYNE ISCO
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Syringe Pump Application Note AN12

Overview

Oil Sands, sometimes referred to as Tar Sands, are considered a source of unconventional oil, consisting of a molasses-like oil called bitumen, mixed with sand, which is much more difficult to recover and process than conventional oil. Oil sands deposits comprise some of the largest oil reserves in the world, with particular concentration in Canada and Venezuela.

Two tons of oil sands are required to recover a single barrel of oil. Proven reserves in Canada represent the largest outside of Saudi Arabia; hence, despite the difficulties and costs of recovery, considerable investment is being made in research and development.

Teledyne ISCO Syringe Pumps are a proven reliable system component in recovery process studies, and in upgrading bitumen to a refinable compound similar to conventional crude oil.

Recovery Methods

There are two basic approaches to extraction: surface mining (open pit) and in-situ.

In-situ techniques currently being researched include:

- Steam Assisted Gravity Drainage (SAGD)
- Vapor Extraction Process (VAPEX)
- Cyclic Steam Stimulation (CSS)
- Toe to Heal Air Injection (THAI)

The processes of SAGD and CSS involve injecting steam into the well, which separates the bitumen from the sand, enabling it to be brought up to the surface. Similar methods such as VAPEX use solvents instead of steam. THAI is a version of fire flooding using a vertical air-injection well to produce oil from a nearby horizontal well.

In Canada alone, oil sands account for 80% of all oil deposits. These deposits are too deep to recover using conventional surface mining methods. In-situ recovery techniques such as SAGD have the potential to increase oil sands production substantially.

Research

The Canada Foundation for Innovation (CFI) funds research infrastructure, enabling institutions to independently prioritize their research. One such institution is the Alberta Ingenuity Centre for In-Situ Energy (AICISE), which is poised to transform the oil sands industry through the development of more efficient, cost-effective, and sustainable processes and practices for the in-situ recovery and upgrading of Alberta's oil sands resources, with minimal environmental impact. Focus will be on creating a versatile array of small pilot plants to test multiple hybrid processing concepts in-situ, with continuous delivery of dispersed catalysts, adsorbents, and reactants.

Method Testing

Reservoir characterization involves testing in-situ methods under real-world operating conditions. This requires extremely low flow rates of a highly viscous fluid under high temperatures (about 200 cP at 150°C), and high pressures (up to 1500 psi). These conditions are not reliably reproducible without the use of highly accurate and precise equipment.

Because of their ability to handle viscous fluids, high temperatures, and low flow rates, Teledyne ISCO Syringe Pumps have proven to be an excellent choice for these permeability studies.

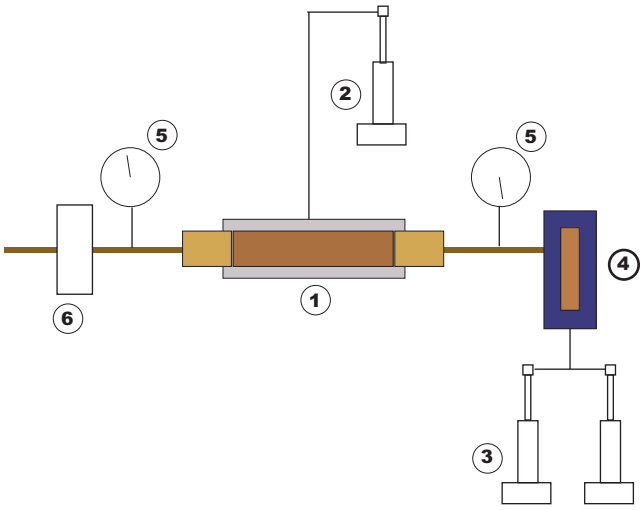

Figure 1: Analyzing core permeability Basic system components:

1. Core holder
2. Overburden pump (Teledyne ISCO single pump)
3. Flow pump (Teledyne ISCO dual pump system)
4. Accumulator
5. Pressure gauges or differential pressure gauge
6. Back pressure regulator

Upgrading Bitumen

Bitumen consists of very large and complex hydrocarbon molecules, making up a highly viscous fluid that must be diluted in order to be pumped. Therefore, it must undergo treatment to upgrade it to a molecular makeup similar to that of conventional crude, in order to be further refined to produce gasoline and diesel fuels.

In summary, the conversion process consists of:

- Thermal Conversion, also known as Coking (breaking apart hydrocarbon molecules under intense thermal conditions)
- Distillation (sorting the hydrocarbon compounds into their component parts)
- Catalytic Conversion (improving the form of the hydrocarbons in the presence of catalysts)
- Hydrotreating (removing impurities such as sulfur, nitrogen, and oxygen, while adding hydrogen)

Teledyne ISCO Syringe Pumps have proven to be very reliable and versatile in pilot plant applications where a variety of fluids are used, including acids, hydrocarbons, organic solvents, ammonia, extremely viscous liquids, heated or cooled liquids, and liquefied gases.

The schematic in Figure 2 illustrates either a continuous flow or batch reactor, which can be fed by different types of pumps. Teledyne ISCO pumps also have options for external control.

Table 1: Recommended ISCO Pumps

Model	500x
Flow Range (ml/min)	0.001 - 204
Pressure Range (psi)	0 - 5.000

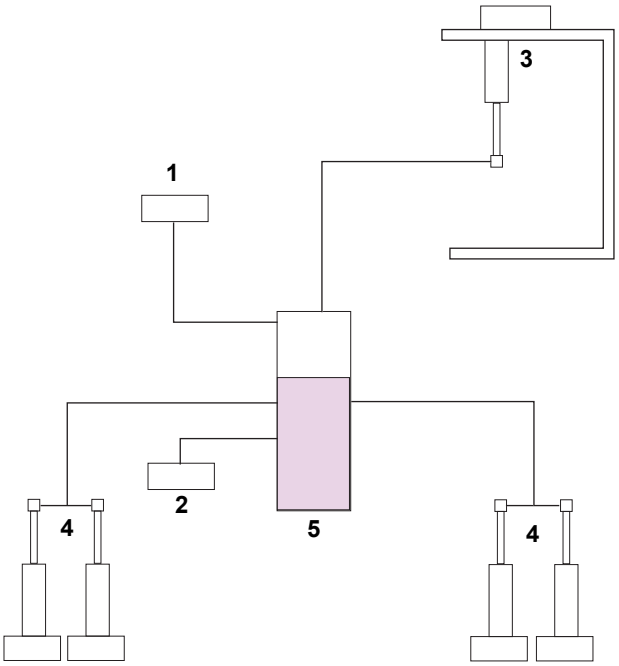

Figure 2: System schematic: Continuous flow or batch reactor

1. Diaphragm pump
2. Reciprocation pump
3. Teledyne ISCO single pump (Rack mounted upside-down to handle particulates such as sand)
4. Teledyne ISCO dual pump
5. Reactor with stirrer

REFERENCES

1) Oil Sands Discovery Centre. "The Oil Sands Story." Feb. 2008 <http://www.oilsandsdiscovery.com/oil_sands_story/story.html>.

2) Alberta Government. "Steam Assisted Gravity Dranage (SAGD)" 1995-2008. Alberta Advanced Education and Technology. Feb. 2008 <http://www.advancededucation.gov.ab.ca/technology/wwwtechnology_asp/techprior/techcomm/energy/energy_stories_936.asp>.

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Product model names have been updated in this document to reflect current pump offerings.

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