Changing the World’s Perspective on Heavy Oil*

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Abstract

The world’s resources of heavy oil and bitumen are estimated to be over 8 Trillion barrels. The challenge of recovering these reserves with in situ combustion technology is discussed. Earlier attempts at in situ combustion have been unsuccessful until the THAITM method was proposed. This process has been successfully computer simulated and tested in the laboratory. These results indicate the robustness of the process that has lead to field testing at the Whitesands pilot in the Athabasca oil sands.

The process has many benefits over earlier thermal technologies. Recovery is greatly enhanced, partly since the combustion temperatures exceed 350° C. The product is upgraded in situ that yields a higher price at delivery or at the refinery. Costs are reduced when compared to thermal processes needing large steam generators and fuel to operate. This process eliminates a need for NG and water and can provide its own electrical power. The produced gas stream contains sufficient NG to operate air compressors and to generate electrical power. The reduced footprint allows this design to be placed remotely to access heavy oil that is presently economically stranded.

Projected gas purchased for in situ projects in Alberta is expected to be over 350 BCF by 2016. This may be better used to generate electricity and to heat our homes by using this process. Resource estimates for Alberta’s oil sands are over 1.7 TBO. Currently a small portion is being mined, while the larger in situ portion is actively being produced using thermal steam technology.
The effectiveness of the popular SAGD and CSS processes is limited to the very thick pay on the eastern limits. These processes are challenged by pay thickness of less than 20m, and by reservoirs with shale laminae. However, these thinner reservoirs represent a very large part of the resource. The best technology will be needed to turn these resources into reserves.

New technology is the key to unlocking the world’s enormous heavy oil resources. The THAI™ technology is a step change in this direction.
Changing the World’s Perspective on Heavy Oil
AAPG Conference
Calgary, AB
September 2010
Massive global potential
  – Comparing conventional and heavy oil resources

Introduction to the THAI™ technology
  – From theory, to model, to field testing, and to commercial

Benefits of a superior recovery process

Guidelines
  – Where does THAI™ work best?
• Heavy oil and bitumen enhanced recovery has required increased well density and large surface facilities as a consequence of viscosity
  – In situ combustion techniques have now evolved into a process that dramatically increases recovery while minimizing surface footprint
Conventional vs Heavy Oil

• Conventional reserves
  • Peak world production occurred in 2004
  • Remaining reserves are 1.32 TBO (BP and others)
  • New discoveries are not expected to impact decline.

• Heavy Oil and Bitumen resources
  • 9 TBO resources known throughout the world

• The challenge is capturing these resources efficiently with a minimal environmental impact
  • New technology is unlocking this potential
Global Heavy Oil Potential

Estimated heavy oil resources:
- > 1 trillion barrels of oil
- > 100 billion barrels of oil
- > 10 billion barrels of oil
- Heavy oil accumulations
A significant source of supply is Canada’s oil reserves, which are #2 in the world, second behind Saudi Arabia. Without our oil sands, Canada would not even be on the energy map. In fact, 97 per cent of Canada’s 173 billion barrels of oil reserves come from oil sands. As far as our oil output is concerned, oil sands account for over half.
Heavy Oil Opportunities

Alberta Oil Sands
1.7 trillion Bbls

Saskatchewan Oil Sands

Sutton

Dawson

Whitesands

Saskatchewan Heavy Oil
21 billion Bbls

Kerrobert

Saskatchewan Medium Oil
3.6 billion Bbls

Saskatchewan Bakken Light Oil
5 billion Bbls
Kerrobert Heavy Oil Trend

The Kerrobert Project is the first THAI™ project in Saskatchewan.

This Mannville Channel contains over 1.0 BBbls of original heavy oil.
Earliest ISC pilots date back to the 1920’s in USA, and were first successful in the 1950’s in California.

Most of these attempts were not commercial and often had complications with extremely high temperatures at the production wells.

Recent ISC pilots include Battrum (Roseray) and Provost (Upper Mannville) and the commercial Suplacu de Barcau (Romania).
• This new process was envisioned in the 1990’s with the advent of horizontal wells
• It was jointly proposed by Dr. Conrad Ayasse, Dr. Malcolm Greaves and Dr. Alex Turta and later acquired by Petrobank in 2003 for pilot testing
• Computer modeling indicates the robustness of the process
• Lab simulation in a 3D combustion reactor is conducted with consistent results confirming the process
Toe to Heel Air Injection
THAI™ Process

Click to View Movie
THAI™ Benefits

• Benefits of a superior recovery process
  – High recovery
  – Minimal water usage
  – Minimal natural gas required
  – Cost effectiveness
  – Reduced emissions
  – Upgraded product
  – Self-supporting design
  – Minimized footprint
  – And CO₂ capture ready
Archon Technologies

- World’s only 3-D combustion reactors
  - Ongoing combustion analysis of bitumen and heavy oil from around the world
  - Ability to evaluate various combustion scenarios to expand technology footprint

- Capable of conducting a wide variety of analysis to support field operations
  - Oil quality
  - Produced gas
  - Produced water
  - Solids
• High quality produced water
• No difficult emulsions
• Easy oil/water separation
• Useable water product with minimal treatment
• No corrosive fluids
Purchased natural gas demand for oil sands operations

Source: ERCB ST98-2008
Whitesands THAI™ Pilot

Small Footprint
TIMELAPSE (4D) Seismic

Timelapse anomaly associated with McMurray THAI® production
Consistent THAI™ upgrading since start up
Confirmed CAPRI™ catalyst upgrading
“CAPRI™ oil” quality up to 15° API

Native bitumen 8° API, 550,000 centipoise
In-situ upgraded THAI™ oil 12° API, 1,225 centipoise

Produced condensate 36° API
# THAI™ Upgraded Oil

**Sales Oil Quality**

<table>
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<tr>
<th></th>
<th>Bitumen*</th>
<th>Partially Upgraded Production</th>
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<tbody>
<tr>
<td>Viscosity at 20°C, centipoise</td>
<td>555,000</td>
<td>1,550</td>
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<tr>
<td>Oil Sulfur content, wt %</td>
<td>3.2</td>
<td>2.6</td>
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<tr>
<td>API Gravity</td>
<td>7.9</td>
<td>12.3</td>
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</table>

**“SARA” ANALYSIS**

<table>
<thead>
<tr>
<th></th>
<th>Bitumen*</th>
<th>Partially Upgraded Production</th>
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</thead>
<tbody>
<tr>
<td>Volatile organics, 40°C mass %</td>
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<td>25.5</td>
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<tr>
<td>Saturates</td>
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<td>23.5</td>
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<tr>
<td>Aromatics</td>
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<tr>
<td>Resins</td>
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<td>17.2</td>
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<tr>
<td>Asphaltenes</td>
<td>16.9</td>
<td>11.2</td>
</tr>
</tbody>
</table>

*revised analysis
Where does THAI™ work best?

- The Athabasca oil sands provide an excellent example
- The in situ resources are estimated to be 1.4 TBO
Canadian Oil Sands

- 20% Mineable
  - 350 BBO

- 80% In Situ
  - 1.4 TBO
In Alberta’s oil sands commercial in situ projects are focused in very thick pay.

Projects with thinner or discontinuous pay are not advancing. Have the popular recovery methods reached a crossroads?

This is where THAI™ can contribute significantly.
THAI™ Resource Estimate

In Situ Projects are currently exploiting very thick pay
Oil Sands Reservoirs

Massive Sand
Sand with thin shale
Sand with thick shale
Sand with clasts
THAI™ Technology

• Technology is the key to unlocking the world’s enormous resources of heavy oil and bitumen

• The THAI™ process is a step change in thermal in situ recovery methods for you to consider
THAI™ Technology

• Thank you

WHITESANDS

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