Integrated Oil Development Using OrCrude™ Upgrading and Shell Gasification Process

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Canadian Oil Sands

- 800 Billion to 1.7 Trillion Bbbls Bitumen
- 300 Billion recoverable with current technologies
- 26% of Canada’s oil production
- $17 Billion Cdn invested
- $54 Billion Cdn Planned
- Bitumen Characteristics:
  - 8.5 API density
  - 1,000,000 cp at 20° C
Bitumen Recovery Methods - Mining
Bitumen Recovery – SAGD Method

SAGD Process Diagram

Top of Oil Sands Reservoir

Steam Rises to Interface and Condenses

Heated Bitumen Flows to Well

Steam Injection

Heated Bitumen Flows to Well

Bottom of Oil Sands Reservoir

Horizontal Well Pair

Steam Rises and Heats Bitumen

Heated Bitumen Flows to Well

Heated Bitumen Flows to Well
Nature of the Bitumen:
- Native Bitumen is 8.5 API, 1,000,000 cp @ 20 °C
- Transportation and marketing requires either Diluent or bitumen processing - “Upgrading”
- Market for bitumen is limited

Current Bitumen Processing Methods:
- Coker-Based Field Site Upgraders
- Residuum Hydrocracking based Refinery Site Upgraders
Challenges for Production without Upgrading

Markets for Bitumen:
– Large and volatile Heavy/Light oil price differentials

Diluent requirements:
– Limited Infrastructure
– Quantity required
– Diluent Pricing Premiums

Natural Gas Requirements:
– \(\approx 1\) to 1.5 Mcf per bbl bitumen produced

Result is volatile, and often marginal netbacks
Challenges for Coker Based Field Upgraders

Product Quality Characteristics
– High amount of heavy components
– Transportation fuel quality characteristics

Natural Gas Requirements
– For Hydrogen production and Fuel
– Adds \( \approx 0.5 \) Mcf per Bbl Product

Coke Production in Large Quantities
– Negative Value, disposed of in mine
– If no mine – then what?

Operating Complexity and Cost
– Batch process with extensive solids handling
Challenges for Refinery Site Residuum Hydrocracking Based Upgraders

Does not solve transportation issue from field
  – Diluent supply, or dedicated specialty infrastructure

Product Quality
  – Generates some low quality products that are blended off

Natural Gas Requirements
  – For Hydrogen production and Fuel
  – Adds ≈0.5 Mcf per Bbl Product

High Operating Complexity and Cost
  – Ebulated bed hydrocracking processes required
The Long Lake Project

- 30 miles South of Ft McMurray
- Phase I
  - 70,000 bbl/day
- Phase II
  - 140,000 bbl/d +
- New Combination of Proven Processes to Solve Development Challenges
Long Lake Project Block
Flow Arrangement

1. Partially Upgraded Distillate
2. NGL for Blending
3. Premium SCO
4. NGL Sales
5. Refinery Fuel Gas
6. Sulphur
7. Hydrogen
8. Steam for SAGD
9. Syngas for SAGD
10. Asphaltenes
11. Oxygen from Air Separation Plant
12. Asphaltenes Gasification
13. Syngas Treating and Conditioning
14. Distillate Hydrocracking
15. Gas Treating and NGL Recovery
16. OrCrude Primary Upgrading
17. Bitumen from SAGD
OrCrude™ Upgrading

Primary Upgrading Step. Converts Bitumen to:
– ≈ 20 API partially upgraded synthetic crude
  • Metals free
  • Asphaltene free
– Heavy Liquid asphaltene carbon rejection stream.

Utilizes proven refining technologies, in new patented configuration
– Distillation
– Solvent Deasphalting
– Thermal Cracking

Units simplified and optimized for the specific application.

Integrated into a single robust, easily operated, predictable process.
Advantages:

- Lower Capital cost
- Simpler and less costly operation
- Better product quality  - ideal hydrocracker feed
- Scalable
- Rejected carbon in more useable form
- Final Yields comparable to coker based plants

Combines well with proven established technologies to generate premium sweet synthetic oil and clean fuel
Development of OrCrude™ Technology

Origin:
- Method to upgrade low value refinery bottoms and use by-products to fuel power generation

Concept developed initially through:
- Laboratory bench work
- Computer simulations
- Economic modeling of alternatives

1 bbl/d pilot plant:
- Typical process model scale, fully instrumented
  Operated on a variety of Canadian feedstocks

500 bbl/d commercial demonstration plant:
- Scale suitable to provide information for commercial facilities
The Demonstration Plant
Modules in place before Building walls were erected
Near Completion
OrCrude™ Demonstration Plant, Burnt Lake Alberta
Shell Gasification Process

Non-Catalytic partial oxidation of hydrocarbons, generating SynGas

SGP components:
- Gasification Reactor
- Syngas Cooling
- Carbon Handling System
- Sour SynGas processing

Generally installed in multiple trains

82 SGP reactors currently in use processing equivalent of 23,000 tons of residue per day.
Shell Gasification Process Diagram

Asphaltenes

Oxygen

HP steam

From parallel trains

Gas treating

HP Syngas

\( H_2 \) Production

\( H_2 \)

Claus gas

Stripped water

Steam

Filter cake

Feed pump

BFW

Steam
SGP at Long Lake Project

Feedstock:
- 3100 metric Tonnes/day liquid asphaltenes
- Relatively high metal/ash content

Capacity:
- 4 trains each with 33% capacity
- Steam generation at 1100 psi

Oxygen Plant:
- 2900 mt/day capacity

SynGas Processing:
- HCN/COS Hydrolysis, Amine Sweetening
  - Hydrogen co-production (using a portion of the SynGas)
    - High Temperature shift followed by PSA unit
Advantages in this application

- Generation of high pressure steam useable for resource recovery and shift reaction
- Tolerance of SGP equipment for sulfur and metals/ash content in feedstock
- Conversion efficiency
- Energy efficiency

Similar to the Pernis, Netherlands refinery SGP application.
Integration of Technologies

Bitumen 8 API
Distillates
Vacuum Resids
Asphaltenes

OrCrude™ Unit
Sour OrCrude™ 20 API
Asphaltenes

H-C Unit
H2

Sour OrCrude™ 20 API

SGP Unit

SynGas

Sweet OrCrude™ 42 API
Sulfur

Proprietary Information of OPTI Canada Inc.
Long Lake Product
– Premium Synthetic Crude
<table>
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<th>Current*</th>
<th>Future*</th>
<th>MSW/WTI</th>
<th>PSC “A”</th>
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<td>Sulphur wt%</td>
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<td>0.1</td>
<td>0.5</td>
<td>&lt;10 ppm</td>
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*P&G Report
Insulated through integration against all risks except WTI
Long Lake Project Status

Construction of SAGD pilot plant underway

Commercial Plant Front End Engineering Design
  – Processor Licensor design packages underway
    • OrCrude™ Upgrading
    • Shell Gasification
    • Chevron IsoCracking
  – Remainder of Plant primarily by Fluor Canada Ltd.

Regulatory Approvals
  – Applications submitted and questions answered
  – Expect approval in mid 2003

Transitioning to detailed design early 2003
## Long Lake Milestones

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<th>Event</th>
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<td>SAGD pilot approval/construction</td>
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<td>SAGD pilot start up</td>
<td>Q1 2003</td>
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<tr>
<td>Commercial project approval</td>
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<td>Phase 1 engineering design</td>
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<td>Upgrader start up</td>
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<tr>
<td>Phase 2 upgrader expansion</td>
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Discussion

Shell Gasification Process

OrCrude™