Lucas Rojek
UMATAC Industrial Processes, Division of AECOM Canada

Lucas Rojek is a process engineer at UMATAC Industrial Processes where his work focuses on the recovery and quality of the oil and gas products extracted using UMATAC’s Alberta Taciuk Process (ATP) technology. Lucas is involved in all phases of development, design, and commissioning of ATP facilities for oil shales and oil sands processing. He has experience with bench scale and pilot plant evaluations, conceptual design and feasibility studies, and the process design and development of commercial facilities.

UMATAC is a division of AECOM, a leading global provider of design, engineering, and technical and management services to major infrastructure projects worldwide. The UMATAC division is focused on the development and commercial application of the Alberta Taciuk Process (ATP) technology.

*speaker note: UMATAC is pronounced “you-ma-tack”

UMATAC Industrial Processes, Division of AECOM Canada
200 – 6708 Railway Street SE
Calgary, Alberta T2H 2V7 Canada
Phone: 403 270 4885
Fax: 403 270 9191
Email: Lucas.Rojek@aecom.com
Website: www.aecom.com
The Alberta Taciuk Processor (ATP System) for Direct Thermal Processing of Oil Sands, Oil Shales and Heavy Oil

Steven Odut and Lucas Rojek
UMATAC Industrial Processes

The Alberta Taciuk Processor offers a compelling technology for the extraction and primary upgrading of bitumen and heavy oils. Mineable oil sands are directly processed to pipelineable, low viscosity crude oil without the need for tailings ponds. This presentation will provide an overview of the ATP System and key milestones achieved during 34 years of research and development of the technology by UMATAC Industrial Processes. Attention will be given to major scale up achievements of the past 10 years and processability of the oil products.

The ATP process is based on thermal cracking of the hydrocarbons using a solid heat carrier (e.g. sand) in an innovative rotating process vessel. The ATP was invented to improve oil recovery, reduce water consumption and eliminate the need for tailings ponds necessary in the water based oil sand extraction process. The ATP also generates much of its own fuel, minimizing the need to import valuable supplies of natural gas.

These characteristics have made the technology attractive for a number of applications which have been demonstrated at various scales. UMATAC maintains test facilities in Calgary which include a 5 t/h portable ATP unit. Over 15,000 tons of various grades of oil sands feeds have been processed using this unit, capable of roughly 60 bbl/day. Heavy oil upgrading and other applications have also been demonstrated on this scale.

Since 1988, the ATP technology has been adapted to the processing of oil shales in Australia and in China. Current oil shale units are constructed at sizes of 250 t/h, with a 500 t/h unit being developed. For oil sand applications, similar size machines would have capacities of roughly 400 and 800 t/h due to the higher density of oil sand compared to oil shale. The synthetic crude oil production of these units corresponds roughly to 5,500 bbl/d and 11,000 bbl/d per unit. Elevated environmental concerns and recent Alberta Government legislation about water consumption, phased elimination of tailings ponds and residual bitumen in the tailings disposal areas has served to focus attention on improved environmental performance. ATP System provides a viable technology to meet these challenges.
UMATAC Industrial Processes
Alberta Taciuk Process (ATP) Technology – Application to Oil Sands, Oil Shales, and Heavy Oils

PRESENTATION TO:

NCUT Upgrading and Refining Conference 2009
Edmonton, AB

September 14-16, 2009
UMATAC Industrial Processes

Overview:
- Based in Calgary, Canada
- Engineering Offices
- Pilot Plant Facility, Laboratory
- Field Technical Services

UMATAC Offers:
- Oil Shale Project Engineering
- Alberta Taciuk Process (ATP) Technology
- Oil Sand, Oil Shale, and Heavy Oil Evaluations
- Specialist Process and Mechanical Engineering
ATP Processor - Schematic

The ATP Processor
Stuart Australia Plant - 250 t/h ATP Processor Unit
Flow Scheme – ATP System and Related Facilities

- **Common Facilities**
- **Flue & Preheat Gas Treating**
  - Flue & Preheat Gases
- **Upgrading (if Required)**
  - Oil & Gas
  - Steam
- **Storage & Distribution**
  - Products:
    - Off Gas
    - Naphtha
    - Distillates
    - Fuel Oils
    - Sulphur
  - - Steam
  - - Heat
- **Feed Preparation**
  - Oil Sand/Shale
- **ATP**
  - Spent Solids
- **Oil Recovery**
  - Steam
- **Power Plant**
  - Off Gas, Fuel Oil, Steam
  - - Electricity
  - - Heat
- **Mine**
  - Oil Shale or Coke
- **Dashed Lines Indicate Optional Flows**
- **Gold Colour Indicates Core ATP Technology Blocks**
ATP Technology Development – 34 Years of Experience

1978 to 1994 Oil Sand Piloting
- over 15,000 t, various grades
- over 8,000 h & 500 start ups
- Joint Industry Task Force

Developing Commercial Plant Concepts and Cost Estimates

1986 to 1991 Australia Oil Shale Piloting and Engineering

First Steps Towards Stuart Oil Shale Demonstration Plant

Preheat Zone Fouling During Oil Sands Piloting, 1982
ATP Mobile Plant – Hazardous Waste Facility

ATP Processor at a Superfund Clean up Site in Michigan

10 t/h unit was used from 1989-1995
ATP Technology Development – 34 Years of Experience

1996 to 2004
Stuart, Australia, 250 tph ATP Demonstration Plant
Constructed in 1999 and Operated Until 2004

ATP Processor and Hydrocarbon Recovery Plant - Australia
ATP Technology Development – 34 Years of Experience

1999 to 2009

Major ATP60 Pilot Plant Test Operations and Commercial Studies for Oil Shales Deposits in:
- USA
- Jordan
- Estonia
- Australia
- China

2009

ATP Facility Currently Under Construction in China

Feasibility Study for ATP Plant Located in Jordan

ATP Processor Erection in China September 2008
Fushun, China, Construction Photos

ATP Processor Scale-up 1977 to 2010

1977 Pilot Plant 5 t/h, Shell 2.8 m dia. x 6.7 m long, 3.1 dia. Tyre

1989 Waste Treatment Plant 10 t/h, Shell 3.7 m dia. x 15 m long, 4.3 dia. Tyre

1991 ATP60 Pilot Plant 5 t/h, Shell 3.1 m dia. x 9.3 m long, 3.7 m dia. Tyre

1999 Stuart Demonstration Plant 211 t/h, Shell 8.3 m dia. x 65 m long, 11.1 m dia. Tyre

2008 Fushun Commercial Plant 230 t/h, Shell 8.4 m dia. x 63 m long, 11.1 m dia. Tyre

2010 Jordan ATP Scale-Up 500 t/h, Shell 11.5 m dia. x 76 m long, 15.5 m dia. Tyre
ATP Technology – Advantages for Oil Sands and Heavy Oil

ATP System Achieves High Yield

- Yield consistent with low, medium, and high grade oil sands.
- Process not sensitive to connate water chemistry, bitumen conditioning, and clays.

Oil Products are Low Viscosity, Bottomed, and Hydrotreatable

- Pumpable without requiring diluent or upgrading

ATP System Produces Dry Tailings

- Direct disposal of tailings as backfill in mine (no tailings ponds)
ATP Technology – Advantages for Oil Sands and Heavy Oil

Low natural gas and water requirements
- By-product coke used as primary fuel source (no coke piles).
- Off gas is available as fuel to balance of plant
- ATP water use limited to controlling tailings moisture and process cooling

ATP System Scalable & Versatile
- Satellite or central facility options
- Can be constructed in increments and oil products pipelined to a regional upgrader.

Cost Effective
- ATP System capital and operating costs are favourable compared to existing HWE systems.
## Athabasca Oil Sand – Liquid Products Compared

<table>
<thead>
<tr>
<th></th>
<th>Bitumen</th>
<th>Fluid Coker TLP</th>
<th>ATP TLP, typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>API gravity</td>
<td>8.0</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>S, wt%</td>
<td>4.9</td>
<td>3.5</td>
<td>3.3</td>
</tr>
<tr>
<td>N, wt%</td>
<td>0.4</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>IBP-204°C</td>
<td>1.6</td>
<td>21.5</td>
<td>23</td>
</tr>
<tr>
<td>204-343°C</td>
<td>13.8</td>
<td>32.7</td>
<td>33</td>
</tr>
<tr>
<td>343-525°C</td>
<td>37.5</td>
<td>45.8</td>
<td>44</td>
</tr>
<tr>
<td>525+°C</td>
<td>47.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HYCAL H2, SCF/BBL</td>
<td></td>
<td>886</td>
<td>900-950</td>
</tr>
</tbody>
</table>

- **Not pumpable without diluent or upgrading**
- **Pumpable, low viscosity, thermally cracked, bottomed. Hydroprocessing can control stability, S, N**

Source: 1982 ATP Test Program
Oil Sands Yield vs. Grade

![Graph showing Oil Sands Feed - ATP Processor Yield](image-url)
Secondary Upgrading Experience

Oil sands
Gulf & CANMET testing

Stabilization of total liquid product with partial heteroatom removal possible in single stage of hydrotreating

Removal of heteroatoms to WMSCO requires separate heavy and light oil hydroprocessing

ATP naphtha highly cracked, required staged temperature profile in reactors to prevent oligermization

Oil Shale
NCUT studies, Licensor studies, Stuart Operation

Heteroatom Challenge:
- Jordan S (>8% S, all fractions)
- Estonia O (>5% O, high in phenols)
- China N (>1.0% N, ammonia)
- Australia ~ 0.4% S, 0.9% N

Stuart plant produced Certified Jet Fuel using 3 stage hydro-treating with standard industrial catalysts
Stuart Demonstration Plant - Hydrotreating

Shale Oil: Diesel & Naphtha

Hydrotreated Fuel
< 1 ppm S
< 4 ppm N

Upgrading Facility
Current Major Activities

Jordan, Al Lajjun ATP Project Feasibility Study

✓ ATP System & Processor Engineering
✓ Two 500 t/h capacity ATP trains, 15,000 bbl/d SCO (hydrotreated)
✓ Reserves estimate, logistics, oil upgrading, power plant, and environmental studies

China, Fushun ATP Project

✓ ATP Processor fabrication and construction underway
✓ Detail engineering and plant construction in progress – commissioning Fall 2009

Ongoing Opportunities and Investigations

✓ Oil sands (oil and water wet), oil shales, heavy oil pyrolysis
ATP60 Processor – UMATAK Pilot Plant

ATP60 Processor at UMATAK pilot plant site in Calgary, Alberta
Summary

Developed for Oil Sands

✓ Fundamental ATP advantages: thermal processing to a pumpable distillate with dry tailings
✓ High recoveries independent of feed characteristics
✓ Extensive piloting experience

Proven in Oil Shale

✓ Scale-up methodology & new construction methods successful
✓ Processor mechanical design proven to be robust
✓ Learnings / advances incorporated into new designs

Ready for future opportunities

✓ Oil sands (oil and water wet), oil shales, heavy oil pyrolysis.
✓ Scalable for diverse applications
Acknowledgements

UMATAC and its staff take this opportunity to thank many members of AOSTRA and ADOE for their assistance in completion of UMATAC’s activities from 1977 through 1995. Without the financial support received from the Alberta Oil Sands Technology and Research Authority, the ATP Technology developed and described in this paper would not have been possible.
UMATAC Industrial Processes

UMATAC appreciates this opportunity to present the ATP Technology as it has been developed in the last 34 years. UMATAC is of the opinion that, based on our earlier oil sands test program successes, the ATP Technology could provide an efficient means of overcoming some of the concerns being raised with regard to expansion of the current oil sands industry.
ATP Technology Development – 34 Years of Experience

1975 UMATAC Inception
1977 AOSTRA Agreement
1978 First ATP Pilot Plant Built
1979
1980
1981
1982 Oil Sand Pilot Studies and
1983 Developing Commercial Plant
1984 Concepts and Cost Estimates
1985
1986
1987
1988
1989 Australia Oil Shale Pilot Studies
1990
1991 ATP60 Pilot Plant Built,
1992 Oil Sand Pilot Studies, and
1993 10 t/h Commercial
1994 Hazardous Waste Clean-up

Treatability Testing of Oil Sands and Shales from Numerous Locations
Stuart Stage I Oil Shale Demonstration in Australia - First Major Scale-up
USA, Jordanian, Estonian, and Chinese Oil Shale Pilot Testing and Studies
Commercial ATP Plant Design & Construction in China
ATP Technology Development – 34 Years of Experience

First ATP Pilot Plant Construction – 1977
(William Taciuk on Left)
ATP Technology – Stuart Demonstration Plant Summary

ATP Processor

- Scale-up (75:1) methodology was successful.
- Achieved process design throughput and oil yield.
- Operated at 200% of design water load.
- Mechanical design proven to be robust.
- Availability of ATP Processor was high.

Oil Recovery & Upgrading

- Vapour scrubber design and scale-up proven.
- Hydrotreating – industrial catalysts were adequate - high nitrogen removal achieved, unit worked as designed.
ATP Technology – Recent Process Developments

Scale-up

✓ 75 : 1 Stuart and China
✓ 2 : 1 Jordan design

Larger Capacity Plants Developed In Increments to Reduce Risk

Increased Thermal Performance

✓ ATP spent solids (heat recovery from 400 to 150°C).
✓ ATP flue gas (heat recovery from 365 to 150°C).

New Waste Heat Recovery options result in 15% Lower Fuel Consumption for ATP in China
ATP Technology – Recent Mechanical Developments

Mechanical Scale-up and Support Tyres

- mechanical reliability proven at Stuart Demonstration Plant
- new fabrication technique proved at FMG plant in China: segmented transport, field welding and machining technique for 11.1 m dia. Tyres – reduces fabrication and transport restrictions.

Scale-up Obstacle Removed For Larger Units
Single Piece (top) vs. Segmented (bottom) Tyre Transport – both 11.1 m Diameter
On-Site Tyre Welding & Machining – FMG China

Weld Preparation

On-Site Machining by Self Leveling Machines (SLM)
Oil Sands Yield vs. Grade

Oil Sands Feed - ATP Processor Yield

Yield - wt% of Bitumen in Feed

wt% Bitumen in Oil Sand

C3- Gas
Gross Coke
C4+ Liquid