CHATTANOOGA PROCESS

synthetic crude oil
changing the technology

27th Oil Shale Symposium
Colorado School of Mines, Golden CO
October 15, 2007
Chattanooga Process Features

- Fluid Bed Reactor
- Hydrogen Environment
- No combustion in Reactor (no emissions)
- Proven sub-processes
- Continuous Operation
- Multiple Feed stocks: Shale, Sands, Heavy Oil
Fluid Bed Reactor

• Temperature less than 1000°F / 537°C
• 600 psig operating pressure
• Low velocity through reactor zone
Hydrogen because …

- Fluidizing medium
- Reactant
- Heat transfer
  - High heat capacity
  - High conductivity
  - Low viscosity
The Chattanooga Process

Diagram of the Chattanooga Process flowchart, showing various components such as Hot Gas Filler, Recycle Gas Compressor, Reactor with Inlet + Outlet, and Acid Gases, among others.
Patents

• Five Issued
  • Four United States
  • One Canadian
• Wholly Owned by CC
• Additional Patents Pending
Why Chattanooga Process for Oil Shale?

• “For all oil shales, major yield increases can be obtained only by adding more hydrogen to the organics.

• Fluid bed reacting gives oil yields of 125% to 200% higher than standard Fischer-Assay.

• Optimal temperature for process: under 1000°F”

The above are the conclusions of Dr. Burt Davis, Center for Applied Energy Research, U of Kentucky
Environmental Benefits over Other Shale Processes

• Negligible Water Required
• No process Waste Water Discharge
• No $\text{SO}_2$, $\text{NO}_x$ or $\text{CO}_2$ Produced in Reactor
• Low Emissions
• Immediate Reclamation of Mined Area
Why Chattanooga Process for Oil Sands?

- 50% reduction in CO$_2$ emissions
- Elimination of process generated S0$_2$, NO$_x$, NH$_3$
- Lower capital and operating costs
- Complete elimination of tailing ponds and ground water contamination
Chattanooga Process Economic Advantages

- High Product Quality (Reactor outlet)
  - 28° – 30° API from Oil Sands
  - 20° - 25° API from Oil Shales
  - 50% reduction of sulfur content

- Lower capital and production costs per bbl
- Reduced energy requirements
- Smaller capacity facilities are feasible
- Self generates fuel and hydrogen plant make up
Chattanooga Process Pilot Plants

- National Center for Upgrading Technology
- Located in Alberta
- Pilot Plant I commissioned in 2000
- Pilot Plant II commissioned in 2004
Results of Tests Conducted at NCUT

PILOT PLANT I:

• Proved reaction kinetics for bitumen
• Produced 32° – 36° API oil

PILOT PLANT II:

• Achieved fluidization
• Extracted ~100% of kerogen contained in oil shale
### Results of Tests Conducted at NCUT

**PILOT PLANT II:**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado Oil Shale</td>
<td>51.5 gal./US ton *</td>
</tr>
<tr>
<td>Kentucky Oil Shale #1</td>
<td>15.4 gal./US ton **</td>
</tr>
<tr>
<td>Kentucky Oil Shale #2</td>
<td>12.6 gal./US ton ***</td>
</tr>
</tbody>
</table>

* Fischer Assay - 28.4 g/t
** Fischer Assay - 7.7 g/t
*** Fischer Assay - 6.3 g/t
The company: Chattanooga Corp

The direct Team:
M.J. Karpenski, President/CEO,
31 yrs Div. P/CEO Foster-Wheeler
J.A. Doyle, Chairman,
37 yrs EVP, WR Grace Corp
C.G. Kirkbride, Director
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Chem. E Dept Head
Dr. B Davis, Professor, U. Kentucky
Center for Applied Energy Research

The Portfolio: 4 US and 1 CA Patents, 3 US and 3 CA Applications
Patent Counsel: Morgan & Finnegan

Key Partners: Alberta Research Council / National Center for Upgrading Technologies (NCUT), PSRI, CAER / UK, DOE
Chattanooga Process Summary

• Proven Technology
  • Ready to move to Demonstration Plant
  • Multiple Feed stocks
  • Patent Protection

• Sound Economics
  • Higher Yield = Higher Profitability
  • Superior Product Quality
  • Upfront Hydrogen Use = Greater Cycle Efficiency
  • Minimal Reclamation Cost

• Environmentally Beneficial
  • Minimal Emissions
  • Minimal Water Requirements and Impacts
  • Shorter Permitting Cycle
Chattanooga Corp
Martin J. Karpenski, CEO/President

Thank you.

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