Current Status of the Commercial In Situ Combustion (ISC) Projects and New Approaches to Apply ISC

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Note: With 2 slides from Sammi Salam, 2012 presentation
Philosophy of Commercial ISC Operation

- Two ways to apply ISC: Patterns system and peripheral line drive starting from the uppermost point of the reservoir
- The line drive system has more advantages in most cases. Most important advantages: easier to operate and to evaluate, while at the pilot and semi-commercial stage
- At Suplacul de Barcau, the line drive was applied for commercial exploitation. The “pattern” system was applied just for the ISC piloting phase.
## Commercial ISC Processes: Main Reservoir Properties

<table>
<thead>
<tr>
<th>Field, Company, Country</th>
<th>Formation</th>
<th>Oil viscosity (mPa.s)</th>
<th>Permeability (mD)</th>
<th>Res. Pressure Initial / @ start of ISC (psi)</th>
<th>OOIP (MMbbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suplacu de Barcau (SB), Petrom, Romania</td>
<td>Sand</td>
<td>2,000</td>
<td>5,000-7,000</td>
<td>140/80</td>
<td>310</td>
</tr>
</tbody>
</table>
# Suplacu de Barcau: Reservoir Properties

<table>
<thead>
<tr>
<th>Field</th>
<th>Depth</th>
<th>Gross pay</th>
<th>Oil viscosity</th>
<th>Permeability</th>
<th>Res. Pressure Initial / @ start of ISC (psi)</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suplacu de Barcau</td>
<td>115-720</td>
<td>27-290</td>
<td>2,000</td>
<td>5,000-7,000*</td>
<td>140/80</td>
<td>Depth &amp; thickness increase East to West &amp; North to South</td>
</tr>
</tbody>
</table>
Suplacu de Barcau Field

LEGEND

- WATER OIL CONTACT
- FAULTS

Panonian - Cross section
Suplacu de Barcau - Experimental Stage
(1964-1971)

I\textsubscript{1} - ISC patterns
I\textsubscript{2} – Steam drive pattern
Suplacu de Barcau - Thermal Methods: Semi-Commercial Stage

Steam Drive (4ha/pattern)

Initial ISC pattern
Suplacu de Barcau. Position of the in-situ combustion front as of July 1\textsuperscript{st}, 2004

- Burnt out area
- Injection wells (111)
- Initial water/oil contact
- Burnt out area
- Major Fault
Current Status of Suplacul De Barcau exploitation by ISC and CSS as of 2012

Cyclic steam stimulation of wells ahead of the ISC front to accelerate prod.

In-situ combustion front moving from South to North to heat up reservoir

Burned zone behind the In-situ combustion front (no production in this area)

Sammi Salam, 2012
Performance of the Suplacu de Barcau ISC Project
(as of 2004)
Suplac Field Production

Suplac Field Production as of 2012
Date: September 9th, 1971
Oil rate: 1.2 m³/day
Gas rate: 14,200 sm³/day

Temperature profile of the well 486 Suplacu de Barcau
**Suplacu de Barcau ISC Project (as of 2004): Results.**

Dry combustion in a line drive, for a very shallow reservoir

<table>
<thead>
<tr>
<th>Field</th>
<th>Start of commerc. operation</th>
<th>Inj. press.</th>
<th>No. of inj. wells</th>
<th>No. of prod. wells</th>
<th>Daily oil prod. by ISC Bbl/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suplacu de Barcau</td>
<td>1971</td>
<td>150-200</td>
<td>111+</td>
<td>736+</td>
<td>9,000++</td>
</tr>
</tbody>
</table>

**NOTES**
+ At any time, there are, also, 24 production wells under cyclic steam stimulation (CSS)
++ It includes the contribution of CSS, estimated at 18% to 25% of the daily oil production
Suplacu: Essential Results/Problems

Results

- Ultimate oil recovery: >50%
- Air-oil ratio (AOR) in the range of 6,000 to 18,000 scf/bbl (1,100-3,300 sm³/m³), increasing in time
- At the low inj. pressure., even the AOR of 18,000 scf/bbl is economical
- Water cut increased slowly, up to 82%

Operational Aspects

- Burning out of some producers
- Hot well workover challenges; special killing drilling mud needed
- Dehydration/desalting coupled with a stripping unit for processing of crude oil
- Leakage to the surface of some combustion gases/air