Geomechanical Models Integration for Perforating Optimization in Weak Sands – Casimena Block

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Contents

- Field Location
- Background
- Sanding Analysis Summary
- Case Studies
- Conclusions
- Questions
• Casimena Block is located at SE Casanare Department
• Number of active wells: 10
• Number of wells with sand control: 5
• Producing formations: Mirador
# Geomechanical Model – Sanding Analysis

<table>
<thead>
<tr>
<th>Well</th>
<th>Interval</th>
<th>Pore Pressure</th>
<th>Drawdown</th>
<th>Perforating System</th>
<th>Average UCS</th>
<th>Min. UCS in the interval</th>
<th>Average DD applied (psi)</th>
<th>SMA*</th>
<th>Critical Drawdown Pressure (for initial reservoir pressure)</th>
<th>Min UCS in the rock for no sanding</th>
<th>Comments*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well B</td>
<td>7526-7531</td>
<td>3033</td>
<td>17</td>
<td>4.5” DUB, 5 spf, DP charges</td>
<td>2200</td>
<td>2091</td>
<td>515.61</td>
<td>0</td>
<td></td>
<td>2491</td>
<td>Needs sand control because of the low strength of the rock in all interval.</td>
</tr>
<tr>
<td>Well 1</td>
<td>7932-7937</td>
<td>3097</td>
<td>26</td>
<td>4.5” DUB, 5 spf, DP charges</td>
<td>2040</td>
<td>1044</td>
<td>805.22</td>
<td>0</td>
<td></td>
<td>2376</td>
<td>Needs sand control because of the low strength of the rock in all interval.</td>
</tr>
<tr>
<td>Well 1</td>
<td>7946-7948</td>
<td>3097</td>
<td>26</td>
<td>4.5” DUB, 5 spf, DP charges</td>
<td>1901</td>
<td>1658</td>
<td>805.22</td>
<td>0</td>
<td></td>
<td>2376</td>
<td>Needs sand control because of the low strength of the rock in all interval.</td>
</tr>
<tr>
<td>Well C</td>
<td>7962-7966</td>
<td>3074</td>
<td>25</td>
<td>4.5” DUB, 5 spf, DP charges</td>
<td>3672</td>
<td>2690</td>
<td>768.5</td>
<td>1888</td>
<td>2300</td>
<td>Rocks with UCS lower than 2300 psi may start presenting sanding problems. Selective perforation and smaller perforating diameter could improve perforating interval to avoid sanding problems.</td>
<td></td>
</tr>
</tbody>
</table>
Sanding Analysis – Conclusions

- For Well B and Well 1 there is not a safe drawdown window for any flow condition.

**Well B**
- Perforations’ diameter: 1.815”
- UCS: 2,000 psi

**Well 1**
- Perforations’ diameter: 1.845”
- UCS: 1,000 - 2,000 psi
Sanding Analysis – Conclusions

- Rock strength for Mirador formation presents a wide variation

Damp Sand

Weakly Cemented
Sanding Analysis – Conclusions

• For Well B and Well 1 there is not safe drawdown window for any flow condition

• Rock strength for Mirador formation presents a wide variation

• Oriented perforation analysis indicates no improvement by using this technique due to the small stress’ contrast

• Sand production is controlled by tunnel stability

• Reducing the perforation diameter in the formation will improve the perforation tunnel stability

• Rocks with UCS > 2,400 psi support 600 psi of drawdown (20 to 25% of reservoir pressure)

• Rocks with DTCO < 85 us/ft are not prone to sanding at any drawdown value
Sanding Analysis – Recommendations

- Guns with smaller holes and/or higher shot density could be tested on future wells to increase tunnel stability (UCS between 2500 and 3500 psi / around DTCO between 90 – 85 us/ft)

- Keep drawdown below CDD pressure for wells with safe window

- Avoid many multiple shutdowns and high picks of drawdown, which can produce sudden failure of the rock

- Keep a continuous monitoring of bottom hole pressures, flow rates and sand production

- **Update the model** according to field results for new completions systems suggested
Well B: 5 spf – 39 gr – DUB - Gravel Pack

- Very weak sand
- No safe drawdown window
- Opened interval: 13’
Well 1: 5 spf – 39 gr – DUB - Stim Pack

- Very weak sand
- No safe drawdown window
- Opened interval: 7’

![Diagram of Well 1 with key points and timelines]

**Chart Details:***

- **Solids (PTB) vs Date**
  - BFPD - PIP
  - Sand Production: peak occurrence
  - Stim Pack: intervention point

**Key Dates:**
- 1-Jan-11
- 11-Apr-11
- 20-Jul-11
- 28-Oct-11
- 5-Feb-12
- 15-May-12
- 23-Aug-12
- 1-Dec-12
- 11-Mar-13

**Legend:**
- BFPD
- PIP (psi)
- Solidos
- Hz
Well C: 5 spf – 39 gr – DUB – No Gravel Pack

- ft Open: 4’
- % drawdown: 25%
- Opened zone is the strongest
- Average solids: 1.62 PTB

dtCO: 80 – 95 usec/ft

Sand Production as predicted with the MEM
Well D: 6 spf – 16 gr – No Gravel Pack

- % of drawdown ≈ 10%
- ft Open: 8’
- Perforations diameter: 0.86”
- Production rate is within average for the area
- Average solids: 2 PTB
Well E: 5 spf – 39 gr – No Gravel Pack

- % of drawdown ≈ 4%
- ft Open: 9'
- Perforations diameter: 1.4”
- Average solids: 2.64 PTB
Well 3: 12 spf – 22 gr – No Gravel Pack

- ft Open: 7.5’
- % drawdown ≈ 8.5%
- Opened interval is between no-sanding / optimization region
- Perforations’ diameter: 0.9”
- Average solids: 9.5 PTB
ERROR: stackunderflow

OFFENDING COMMAND: ~

ERROR: stackunderflow