Evaluating Consistent Hole Charges vs SDP Charges in Unconventional PNP

NAPS-45-18
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Agenda

- Summary of Field Trial
- Data Analysis on Stages Tested
- Conclusions from Field Trial
- Overview of Frac Pads Analyzed
- Data Analysis on Frac Pads
- Summary of Results and Conclusion
- Questions and Comments
Summary of Trial

- **Purpose:** Recent well construction and frac design changes have resulted in higher-than-normal treating pressures and therefore lower-than-desired treating rates during frac. This trial was conducted to determine if a different perforation charge type can help lower treating pressures and therefore increase achievable pump rates.

- **Justification:** The consistent hole charges do not cost any more than our standard PNP charges (non-consistent hole). Additionally, the charges are designed to create the same 0.37” hole diameter, which is aligned with the CTE’s recommendation based on limited entry. The benefit is that due to the charge design, it creates a more consistent hole size, regardless of eccentricity. The variation in hole diameter on the EH charge is <5%, while the variation in hole size for the conventional charge is 19%. If higher rates are achievable, pump times per stage and overall pad cycle time will decrease.

- **Trial Methodology:** Stages 8 to 12 on the My TB 6076-25H & 26H were alternated from the EHD charge to the non-EHD charge. Treatment design was kept as consistent as possible (same FR, acid, treating pressures, etc) to get a true determination if either of the charges resulted in higher achievable rates.
## Data per stage: Pressure

<table>
<thead>
<tr>
<th>Well - stage</th>
<th>CH max P</th>
<th>CH average P</th>
<th>SDP max P</th>
<th>SDP average P</th>
<th>Well - stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-8</td>
<td>12643</td>
<td>12443</td>
<td>12582</td>
<td>12402</td>
<td>26-9</td>
</tr>
<tr>
<td>25-8</td>
<td>12678</td>
<td>12463</td>
<td>12832</td>
<td>12126</td>
<td>25-9</td>
</tr>
<tr>
<td>25-10</td>
<td>12791</td>
<td>12354</td>
<td>12611</td>
<td>12398</td>
<td>26-11</td>
</tr>
<tr>
<td>26-12</td>
<td>12633</td>
<td>12473</td>
<td>12577</td>
<td>12288</td>
<td>25-11</td>
</tr>
<tr>
<td>25-12</td>
<td>12945</td>
<td>12372</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>12738</td>
<td>12421</td>
<td>12650</td>
<td>12303</td>
<td></td>
</tr>
</tbody>
</table>

Treating pressures are very similar for both charges.

Average pressure are more consistent with the CH charges.
### Data per stage: Rate

<table>
<thead>
<tr>
<th>Well-stage</th>
<th>CH max rate</th>
<th>CH avg rate</th>
<th>SDP max rate</th>
<th>SDP avg rate</th>
<th>Well-stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-8</td>
<td>70.4</td>
<td>67.2</td>
<td>70.2</td>
<td>67.0</td>
<td>26-9</td>
</tr>
<tr>
<td>25-8</td>
<td>72.9</td>
<td>70.3</td>
<td>67.7</td>
<td>60.6</td>
<td>25-9</td>
</tr>
<tr>
<td>25-10</td>
<td>72.5</td>
<td>64.8</td>
<td>71.1</td>
<td>68.6</td>
<td>26-11</td>
</tr>
<tr>
<td>26-12</td>
<td>73.7</td>
<td>70.3</td>
<td>74.7</td>
<td>71.9</td>
<td>25-11</td>
</tr>
<tr>
<td>25-12</td>
<td>75.0</td>
<td>71.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>72.9</td>
<td>68.8</td>
<td>70.9</td>
<td>67.0</td>
<td></td>
</tr>
</tbody>
</table>

Max Rate and Average Pump Rates are higher for CH charges

Max Rate and Average Pump Rates are more consistent with the CH charges
1. For the stages analyzed, on average, the CH charge resulted in 1.8 bpm increase compared to SDP charge.

2. Since there is no increase in cost for this charge, it is recommended to continue to use the CH charges for future wells.
Overview of Frac Pads Analyzed

- Lingle 1102 and My TB 6076
- Water quality: 32,800 vs 46,500 ppm Chlorides
- Same Total Prop Design
- Utica, similar BHT, BHP, # of stages, clusters
- Frac with gas fleet
- Only a small knob was changed, Charges
  - Both have an average hole size of 0.37”
Full Pad Data Analysis: Treating Pressure

Reconfirms that treating pressures are similar due to max rate completion design

1% delta in average treating pressures
Observed reduce breakdown pressures

On average 3.44% reduction
Full Pad Data Analysis: Pump Rate

Observed increase average pump rate

On average 6.42% increase
### Full Pad Data Analysis: Other Observations

<table>
<thead>
<tr>
<th></th>
<th># of stages</th>
<th>Ave Fluid Frac/stage bbls</th>
<th>Total Fluid Frac bbls</th>
<th>% Prop Placed</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDP</td>
<td>Lingle 1102</td>
<td>104</td>
<td>10083</td>
<td>1048614</td>
</tr>
<tr>
<td>CH</td>
<td>My TB 6076</td>
<td>106</td>
<td>8981</td>
<td>952016</td>
</tr>
<tr>
<td></td>
<td>Delta</td>
<td>2</td>
<td>1102</td>
<td>96598</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>10.93%</strong></td>
<td>9.21%</td>
</tr>
</tbody>
</table>
Summary of Results and Conclusion

- From Field Trail data on selected stages
  - Treating Pressures are similar due to completion designed to max rate
  - “On average, the CH charge resulted in 1.8 bpm increase compared to SDP charge”

- From post job Frac Pad data analysis
  - Reconfirms Treating Pressures similarity
  - 3.44% reduction in Breakdown Pressures
  - 6.42% gain in Ave Pump Rates
  - 10.93% reduction in fluids per stage
  - 2% gain in proppant place

- Conclusion CH has displace current charge for the whole asset
  - My TB 6076 deliver expected production vs Lingle 1102 was under
  - Moved away from max rate design due to increased maintenance
  - Using benefits to reduce pump maintenance
    - Set new record on pumped fracs per day
    - Decrease days to deliver pad
QUESTIONS? THANK YOU

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