Problem Solving using Fluid Levels and Dynamometer Data

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Trouble Shooting Problems

1. Time Requirement is about 45 minutes per well.
2. Analyze collected data at the well.
3. Make recommendations to fix problems discovered.
4. Record work necessary to fix problem as notes.
5. When recommended changes are completed, new data should be collected once the well has stabilized.
6. Notice if well performance changed as planned.
7. Follow-up on recommendations to learn from successes and failures.
8. Role changes from a data collector to a knowledgeable well analyst and problem solver.
Discussion

• Solving “difficult problems” of pumping systems is helped by studying the behavior of other measured and computed data and seeing their corresponding relationship.

• Many combinations of analysis plots for pumping system analysis are possible and only a few are shown in this Presentation.

• Need to use our imagination to develop additional diagnostics and start thinking “out of the dynamometer box” to fully understand pumping system performance.
Too Low Fluid Load should match Fo From Fluid Level. The net lift, H, is assumed to be from the fluid level to the surface.

Split Tubing Joint 4000’
Fluid Level 6583’
Pump Depth 6975’
Net Lift 2583’

Hole in Tubing is detected using dynamometer, because Net Lift shown by the pump card Fo is much less that Fo required by fluid level and full pump card’s valves are OK.
Hole in the tubing about 1’ Above SN

Pump is OK
Count Rod Couplings Down Tubing

See Distance to LL in Tubing. Should Stabilize at Hole?

Only if Hole above Liquid Level
What is Going on with the TV

Loop in Pump Card
What is Going on with the TV

Plunger Velocity - + -
At the Top of the Stroke the Plunger is Moving Up – Down – Up

Plunger Velocity - + -
What is Going on with the TV

Loop in Pump Card is from the Plunger Moving Up & Down Due Rod Harmonics at the Top of the Stroke
Tag on the Down and Up Stroke?
You can hear the bang & a rattle on down stroke and rattle on upstroke

(Often caused by Scale in Pump Barrel) Plunger Sticking at the Top and Bottom of the Pump Stroke
High Fluid Level A Problem?

- Often caused by scale in the pump barrel.
- Plunger sticking at the top and bottom of the pump stroke.

**Well State:**
- Producing
  - Annular Gas Flow: 11 Mscf/D
  - % Liquid: 80

**Liquid Below Tubing**
- Oil: 0%
- Water: 100%
- % Liquid Below Tubing: 84%

**Pump Intake Pressure**
- 1224.3 psi (g)
- PBHP: 1258.5 psi (g)

**Acoustic Test**
- Total Gaseous Liquid Column HT (TVD): 4521 ft
- Equivalent Gas Free Liquid HT (TVD): 3602 ft
Pump is Unseating and Reseating

Impact Loads
Stops at Zero Plunger Velocity

Plunger Stops

Polished Rod Velocity (In/sec)

Plunger Velocity (In/sec)

Elapsed time (Sec)
Slope of Kr due to Rod Stretch

Rods Stretching
Plunger Stopped
**Polished Rod Stretch 100.9 Inch**

**Plunger Stopped until Polished Rod Moves Up 100.9 In Stretching Rods 69 Inches**
Leaking Seating Nipple and Hold Down
Production Has dropped by 75%

Production Has dropped by 75%
Plunger Stopped until Plotted Rod Moves
Rods 69 Inches

Well State:
Producing
Annular
Gas Flow
321 Mscf/D
% Liquid
27

Well State:
Producing
Annular
Gas Flow
78 Mscf/D
% Liquid
61

Casing Pressure
52.3 psi (g)
Casing Pressure Buildup
0.8 psi 1 min
Gas/Liquid Interface Press.
58.8 psi (g)
Liquid Level Depth
MD 3827.14 ft
Pump Intake Depth
MD 10166.63 ft TVD 10166.63 ft
Formation Depth
MD 9964.00 ft
Reservoir Pressure (SBHP)
806.5 psi (g)

Casing Pressure
49.0 psi (g)
Casing Pressure Buildup
0.2 psi 1.00 min
Gas/Liquid Interface Press.
57.3 psi (g)
Liquid Level Depth
MD 5646.09 ft
Pump Intake Depth
MD 10166.63 ft TVD 10166.63 ft
Formation Depth
MD 9964.00 ft
Reservoir Pressure (SBHP)
1247.3 psi (g)

04/17/08
05/05/08
Leaking Seating Nipple and Hold Down

Pumped Up Tubing Pressure to 550 Psi, Pressure/Load Leaked Off

Load Range
Increased Back Pressure to 260

<table>
<thead>
<tr>
<th>Load (K-Lbs) vs Position (in)</th>
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<tbody>
<tr>
<td>PRT1206</td>
</tr>
<tr>
<td>PPRL 13075</td>
</tr>
<tr>
<td>MPRL 9065</td>
</tr>
<tr>
<td>PPUMPL 1809</td>
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<tr>
<td>MPUMPL -206</td>
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</tbody>
</table>

- Calculated Fluid Load Max: 4579 lb
- Polished Rod Power: 4.3 HP
- Polished Rod / Motor Eff.: %
- Strokes Per Minute: 7.73
- Pump Card HP: 2.6 HP
- Pump / Motor Eff.: %
- Pump Displacement: 143.3 BBL/D
- Pump Intake Pressure: 1204.5 psi (g)
- Damp Up: 0.03
- Damp Down: 0.03
- Tubing Head Pressure: 260.0 psi (g)

Fluid Load Increases

- Effective Plunger Stroke:
  - Left
  - Right
- Approx. Best Pos.
- 43.74 %
- 51.9 in

Stroke: 79
There is more information about well performance and sucker rod system operation than conventional LOAD vs. POSITION card analysis can give.

Need to explore other Analysys plots of various measured and calculated variables as a function of time, polished rod or plunger position.
To be a Successful Troubleshooter

- Must Use Data to Determine the Solution to Well Problem’s...

- Needs to look 10,000 feet down a 3 inch diameter black hole and “SEE” what is happening ......

- People often think you are a Wizard
QUESTIONS?
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