Problems - Investigation of Sucker Rod Lift Problems

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Introduction

1. Investigate Operational Problems

2. In Different Wells

Using:

- Dynamometer Instrument
- Fluid Level Instrument
Investigation of Well Problems

1. Drop in Production
2. Pump Is Starving
3. Well is Pounding Fluid and Tagging Hard
4. Pump Displacement & in-Tank Not Close
5. 83% of Surface Stroke lost to Rod Stretch
6. Hole in Tubing
7. Sticking Downhole on Upstroke
8. Damaged Pumping Unit
Investigation of Well Problem: *Drop in production*

Upon Arrival

- Well had High tag somewhat like a Fluid Pound
- Shot Fluid Level ~ Fluid Above Pump Intake
- Dynamometer Indicated Well was Pumping Off, but another Fluid Level Showed Fluid Above Pump
- Shut Well down for 3 hours
- Higher Fluid Level
- Pump still pounding fluid
This fluid level was acquired after leaving the unit down 2 hours and 45 minutes. Shot fluid level just before turning the well back on.

2078 Ft Fluid Above Pump
Load Data Shows: NO PUMP FILLAGE
NO Flow Into Pump, Conclusion: Pump Is Starving; Mud Anchor Probably Full

Pump Is 13.5% full, most of liquid fillage from tubing fluid slippage between Plunger and Barrel

3000 Lbs Tag
Investigation of Well Problem:
Well is Pounding Fluid and Tagging Hard
Tagging Hard for longer than 1 second
Well is Pounding Fluid and Tagging Hard

94\% Pump Fillage
1000 Lbs Tag
Well is Pounding Fluid and Tagging Hard

May want to change the sampling speed from the default 30 samples per second to 240 samples per second to 240 samples per second.

@ Default 30 samples per second sampling speed the tag is smoothed out ~ -2000 lbs

Notice that this tag occurs 6.0 inches from the bottom of the stroke.

Well should be re-spaced and 10.47 SPM reduced!
Found Well Running And With A Severe Fluid Pound, Producing Severe Vibration In The Rod String.
Investigation of Well Problem: Pump Displacement not close to BBLS in Tank

40 BPD in Tank?

129 BPD

88% Pump Fillage
Pump Displacement 129.3 BPD not close to 40 BBLS measured in Tank

Too Low, TV Leakage Rate 17.5 BPD
More Research Needed in Pump Slippage Calculations

\[ Slippage = \left[ (0.14 \cdot SPM) + 1 \right] 453 \frac{DPC^{1.52}}{L\mu} \]

**Inputs to Pump Slippage Calculations**

- D = Plunger Diameter (inches) 1.5
- P = Pressure Differential 1587
- C = Clearance (inches) 0.005
- \( \mu \) = Fluid Viscosity (centipoise) 1
- Plunger length (inches) 48
- Strokes per Minute 8.07

**Traveling Valve Test Leakage:**
Leakage Rate 17.5 BPD

**Patterson HF Calculates:**
Slippage Rate 15.2 BPD

**Pump Displacement – Production in Tank:**
129.3 – 40 = 89.3 BPD
Slippage Rate 89.3 BPD
Investigation of Well Problem: 83% of Surface Stroke lost to Rod Stretch
After Hot Water Treatment +100 BPD

- Calculated Fluid Load Max: 9194 lb
- Polished Rod Power: 8.4 HP
- Stroke Per Minute: 5.83
- Pump Card HP: 7.5 HP
- Pump Motor Eff.: %
- Pump Displacement: 137.5 BBL/D
- Pump Intake Pressure: 904.3 psi (g)
- Damp Up: 0.07
- Damp Down: 0.07
- Tubing Head Pressure: 100.0 psi (g)
- Effective Plunger Stroke: % 66.1 in
- Stroke: 33
Investigation of Well Problem:
Hole in Tubing & Sticking During Upstroke

Load to Lift Fluid to Surface?
Load Spike as Plunger Stops
Shot Fluid Level Down Tubing
Hole in the Tubing Below Liquid Level

1) Shot well 3 times, 1 down casing, 2 down tubing
2) All three shots same depth within 150 feet
3) Pump running entire 44 min. while shot down tubing
4) Tubing and Casing Psi equal and liquid level equal
Sticking Downhole or Damage Pumping Unit

Plunger Stops for 1 Second while Polished Rod moves up 17.15 inches. Applying a 2315 Lb Force, before plunger starts to move. Plunger Position MUST become Flat OR Pump not Sticking!

Move Up 17.15 “

1 Sec.

Plunger Position MUST become Flat OR Pump not Sticking!
Investigation of Well Problem: Sticking Downhole or Damage Pumping Unit

Load Spikes Due to Damaged Pumping Unit
Sticking Downhole or Damage Pumping Unit

Instantaneous SPM Spikes match Polished Rod Load Spikes, IF changing speeds are due to Surface Problem
Conclusions

1. Dynamometer and Fluid Level Analysis Used to Identify Many Problems

2. Identifying the Cause and Solution to the Problem can be Difficult to Determine

3. Experience Helps Trouble Shoot the Well

4. Must Spend Time to Get Representative Data (Office and Field)

5. Effective Communication with Operator is Critical in Correcting Problem
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Plunger Velocity Should be used to Calculate Pump Slippage

- $\text{Vel}_B = 17.57 \text{ in/sec}$
- $\text{From A to B}$
- $\text{Plunger Moved } \sim 8''$
- $\text{Vel}_C = 9.14 \text{ in/sec}$
- $\text{From C to D}$
- $\text{Plunger Moved } \sim 6''$

From B to C?