

2021 International Sucker Rod Pumping Virtual Workshop February 8-12, 2021

Use Dynamometer Data to Identify Solids Impacting Pump Operation

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Introduction



- Dynamometer data can be used to identify sucker rod pumped wells producing liquid with solids impacting the operation of the sucker rod pump.
- Foreign material in the pump can cause erratic pump behavior due to the delay in the valve(s) going on seat
- On the up or down stroke when solids hold the ball off the seat the concaveoutward shape of the pump card can be used to diagnose excessive pump/plunger assembly leakage.
- The standing or traveling valve stuck open condition occurs when trash, sand, scale, asphaltene, or some other foreign material lodged in the valve assembly causes the ball to stick in the cage and/or rest off of the seat.
- When one ball is continually stuck off the seat during the stroke, then a constant load (0 or fluid load) is applied to the rods and pump action of transferring the fluid load between the rods and the tubing ceases.
- "Spikey" loads can also occur when solids are dragging between the plunger and the barrel.
- Solids can sometimes stick the plunger in the barrel.
- Field dynamometer data acquired on 10 different wells will be used to show the symptoms of solids/foreign material impacting the performance of the sucker rod pump.

Restricted Pump Intake OR Blockage

Do not use a device that causes resistance to liquid flow and low pump fillage if blocked by well debris. Some examples of devices where liquid flow into the pump can be blocked from solids from the Wellbore or from inside the Tubing are screens, filters, or strainers.



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Blocked Strainer NO Flow at Surface

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Trash in Strainer Screen Can Stop Liquid Flow

- The debris shown was pulled out of the interior of a separator.
- The Teflon tape and rubber wiper parts can collect on a strainer screen and completely block liquid flow into the pump.
- Letting debris get into the pump so the valves and plunger pulverize the debris, may be better plan having a blocked intake requires the tubing to be pulled in order to clean out solids.
- Damage due to sticking and/or stuck plunger is costly, Clean out the well if you have issues with foreign material, sand size or small sized particles usually from the formation.



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NO Production to Surface(Collision with Liquid)



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Lost Fluid Load Acting on Plunger on Upstroke



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Why was Stroke #12 Due to Solids and NOT a Rod Part?

- 1. Usually Rod Parts occur at or near peak PR load.
- Deep Rod Part Load Ended Near Load = Wrf.
- 3. Shallow Rod Part Measured Load Ends Near the Zero Load Line.
- 4. Since PRL drops to Zero during Failure due to Acceleration Force, then both Polished Rods came off the carrier bar.
- 5. Shallow Rod part releases more energy and usually results in more damage to Surface Equipment and Rod String.



<u>Solids in TV</u> Notice normal appearing Surface Dynamometer Card, on the 13th stroke TV became stuck open due to trash. Same type of surface loads could occur, if Pump unseated, Pull Rod became unscrewed or parted, or rods parted at the pump.

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Not Trash, TV Ball is Pitted ~ Issues Seating.





Event View to Examine/Select many Dynamometer Cards.



Field View Overlay of many Dynamometer Cards shows each stroke is different.

Worn pump plunger/barrel cards usually overlay.

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Solids can come from Weird Chemical Reactions or Unfiltered Waters Batch Treated down Casing Annulus



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Chemical Batch Treatment Created Gunk in Pump and Suspend Solids Creating Erratic Pump Action





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Sticking While Pumping Solids







Sand Scored Barrel and Plungers

Note that the pin is smaller diameter than the plunger



Problems:

- Grooving of the plunger due to solids
- Plungers stuck in pump barrel

Actions:

- 1. Use QRod to Increase pump clearance
- 2. Use a "Radial Grooved" Plungers or Sand Shields
- 3. Cleanout Well to Prevent or reduce the amount of solids entering the pump.

The "problem" with increasing the clearance between barrel & plunger? Increased Pump Slippage/Inefficiency ! ! Artificial Lift

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Download QRod - Free Slippage Calculator from https://www.echometer.com/Software/QRod

Account for Increased Slippage if Clearance Opened

Qriou inputs			
Pump Diameter (D)	2.250	in	S.
Pump Depth	7,156	ft	33%
Tubing Pressure	250.00	psi	3. 4 0
Pump Intake Pressure	229.00	- psi	(*)
Stroke Rate (SPM)	9.47	SPM	
Pump Displacement	534.00	BBL/D	
Fluid Specific Gravity	0.99	Sp.Gr.H	20 +
User Inputs			
Clearance (C)	0.009	in	
Fluid Viscosity (µ)	0.76	ď	÷
Plunger Length (L)	48.000	in	S.
		Calcul	ate



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Horizontal wells frac sand can be pumped out as flumping fluctuates BHP. Sand between the plunger and barrel causes Sticking and sometimes a Stuck Plunger.



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Recommendations

- Do NOT tag it to pump it!
- For wells that have solids problem, then plan to clean out the wellbore each time tubing is pulled.
- When "Spikey" loads are occurring as solids drag between the plunger and the barrel, recommend to take and analyze produced fluid to identify a possible treatment. Evaluate opening pump clearances, remember slippage increases.
- Be cautious using a strainer screen or filter cloth that can have sand, scale, paraffin restricting or blocking flow into the pump. Often only method to clean/clear is to pull tubing. Back flush usually is ineffective.
- Understand the pump card load value when the TV or the SV sticks Open then a constant load (0 or fluid load) is applied to the rods by the pump.
- On the up or down stroke when solids hold the ball off the seat the concaveoutward shape of the pump card can be used to diagnose excessive pump leakage, often this problem is caused by worn pump parts and NOT solids.
- Recommended practice for sucker rod pumping is to operate with the down hole pump filled with liquid, but the presence of solids in the pump can cause damage and create dramatic changes the typical rectangular full pump card shape.



Conclusions

- Many Different Wells Dynamometer Examples were used to show problems in sucker rod lifted wells producing liquid where solids impact the operation of the sucker rod pump.
- Trash/Solids in a strainer, screen, or filter can stop liquid flow into the pump.
- On the up or down stroke when solids hold the ball off the seat the concaveoutward shape of the pump card can be used to diagnose excessive pump/plunger assembly leakage.
- Valve stick open or stick close usually occurs at the beginning at the top of the stroke, where rod failures are violent and usually occur near peak load.
- "Spikey" loads can also occur if solids are dragging between the plunger and the barrel.
- Foreign material in the pump can cause erratic pump behavior due to the delay in traveling valve, SV or TV, ball going on seat and can cause severe shock loads which result in increased rod string and pump failures.
- Standing or traveling valve stuck open condition occurs when trash, sand, scale, asphaltene, or some other foreign material lodged in the valve assembly causes the ball to stick in the cage and/or rest off of the seat.
- When solids stick the plunger in the barrel, the surface dynamometer card can just show rod stretch, tubing movement if unachored, plus no down hole stroke



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