Gas Locking and Gas Interference Solutions for Sucker Rod Pumps

Benny J. Williams
Harbison-Fischer
Sucker Rod Pump Basic Parts

- Only 5 basic parts
  - Barrel
  - Plunger
  - Traveling valve
  - Standing valve
  - Hold-Down Seal
Operation of Sucker Rod Pump

- **Start of Up Stroke**
- **Start of Down Stroke**
- **Plunger Falls Through Fluid**
- **Fluid Lifted Toward Surface**

Copyright 2010 Harbison-Fischer
Operation of Sucker Rod Pump

- Fluid Pound
- Gas Pound
- Gas Interference
- Gas Locking
"Poor Boy" Separator

Formulas for Gas Anchor Calculations
For Poor Boy and Oversize Gas Separators

\[ V = \frac{(P^2)(S)(L)}{(60)(M^2-G^2)} \]
\[ X = \frac{(1.5)(L)(P^2)}{(M^2-G^2)} \]

- \( P \) = Plunger diameter, inches
- \( S \) = Strokes per minute
- \( L \) = Stroke length (Downhole), inches
- \( M \) = Mud anchor inside diameter, inches
- \( G \) = Dip tube outside diameter, inches
- \( V \) = Calculated velocity of fluid/gas mixture in dip tube / mud anchor annulus, inches/second, (should be less than 6 inches/second)
- \( X \) = Calculated length between upper perforation on dip tube to lower perforation on mud anchor. This gives a gas separation volume of 1.5 times the pump volume. A ratio of 2:1 can be used but should not be exceeded, replace the 1.5 with 2.0 in the formula for \( X \).
Sucker Rod Pump Compression Ratio


Unswept Vol.

Example: 1-1/4” plunger
134” downhole stroke length
9.5 cubic inches unswept volume

\[
\frac{164.4 + 9.5}{9.5} = 18.3
\]

Discharge Pressure = (Intake Press) times (C R)

Example:
400 psi Intake Pressure
18.3 compression ratio, C R
400 times 18.3 = 7,320 psi
Gas Compression Between Valves

Pump almost gas locked

- Note gas compression on downstroke before traveling valve opens
- Not much work being done by pump, very little fluid being pumped
Increasing the Compression Ratio

Modifications to Standard Pumps

- Longer stroke length, close valve spacing & spaced low (w/o tagging) at well site
- Zero clearance seat plug
- High comp. standing valve cage
Sanding Valves

Standard Standing Valve

High Compression Standing Valve
Tagging the Sucker Rod Pump

Tagging

- Can help break gas lock or dislodge particulates from valves
- Use as temporary solution or diagnostic tool
- Tough on the pump, sucker rods and tubing
Gas Problem or Solids Problem?

Gas Locked Pump or Solids Keeping a Valve Open?

• Symptoms are similar: None or intermittent fluid production, possibly some gas production

• Tagging the pump seems to help

• How to tell the difference? Wrongly identified can cost a lot of $$.
Special Pumps and Accessories
High Compression Ratio Sucker Rod Pump

- Gas Chaser Pump
- Compound compression ratio to achieve high compression ratio
Two Stage Hollow Valve Rod Pump

- Similar to Gas Chaser Pump
  - Handles solids better
  - Rugged pull tube
  - Top valve excludes solids
Sucker Rod Pump for Gas Locking

Variable Slippage Pump®

- No Gas Lock or Fluid Pound
- Smooth load reversal
- Reduces tubing & rod wear
- Extends sucker rod life (raises MPRL)

Sept. 14 - 17, 2010 2010 Sucker Rod Pumping Workshop 15

Sept. 14 - 17, 2010

Copyright 2010 Harbison-Fischer

Patent #6,273,690
Sucker Rod Pump for Gas

Gas Vent Pump®

- No gas lock or gas interference
- Separates the gas
- Pumps well down further than any pump

Sept. 14 - 17, 2010

2010 Sucker Rod Pumping Workshop

Patent #7,458,787

Copyright 2010 Harbison-Fischer
Sucker Rod Pump Accessory for Gas Locking

Sliding Top Valve®

- Holds back hydrostatic head to allow traveling valve to open with less pressure
- Cushions fluid pound and gas pound
- Closes during shutdown to keep sand out of pump

Copyright 2010 Harbison-Fischer
Back Pressure Regulator

For wells that “Flump” (flow off and pump)

- Adjustable back pressure for tubing
- Helps sucker rod pump by minimizing flowing off
- Extends time between stuffing box packing changes (flumping well causes dry packing box)
Summary

Review:

• Gas interference cannot be helped with a sucker rod pump (the pump is working!) although gas locking can be helped

• High compression pumps can help with gas locking

• Special pumps can help with gas locking or gas interference due to their not relying on compression

• “Gas locking” is often actually trash in the valves

• Separation of gas before the sucker rod pump is the best solution
Questions?
Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Sucker Rod Pumping Workshop, they grant to the Workshop, the Artificial Lift Research and Development Council (ALRDC), and the Southwestern Petroleum Short Course (SWPSC), rights to:

- Display the presentation at the Workshop.
- Place it on the www.alrdc.com web site, with access to the site to be as directed by the Workshop Steering Committee.
- Place it on a CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other use of this presentation is prohibited without the expressed written permission of the author(s). The owner company(ies) and/or author(s) may publish this material in other journals or magazines if they refer to the Sucker Rod Pumping Workshop where it was first presented.
Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the front page of the Sucker Rod Pumping Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the Sucker Rod Pumping Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Training Course and their company(ies), provide this presentation and/or training material at the Sucker Rod Pumping Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warrantees of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.