Radical New Design In Casing Plungers Proves Successful

Robert L. Moore, PE PAL PLUNGERS

Windel Mayfield, PAL PLUNGERS, Lone Star Rubber

PAL PLUNGERS, Brownwood, Texas
RECENT INNOVATIONS

NEW DESIGN CONCEPT

• CUPS ACTUATED AT BOTTOM OF CASING

• DESIGN COMBINES MECHANICAL AND PNEUMATIC CONCEPTS

• CONCEPT OF PRESSURE AS LIFT MECHANISM RATHER THAN VELOCITY

• IMPROVED ELASTOMERS FOR BETTER PERFORMANCE
TYPICAL TUBING PLUNGER
Typical Field Assembly

4.5 ″ System
Auto Catch
Simple Timer
LPG Supply
WIRELINE ACCESS TO WELL

• Access to lubricator with std. hammer unions
OLD CUP AND NEW CUP DESIGN
Lower cup profile showing expansion of major diameter of cup due to the weight of plunger compressing the spider ring at the bottom of the cup.
UPPER CUP INFLATES
Casing had sqz cmt leak repairs.

Fixed diameter cups hung up on descent.

No remedy
GAS PRODUCTION RESTORED

BOATES GAS SALES

Install Casing Plunger

Production Loss Due To Bacteria
PUMP JACK REPLACED

Oklahoma well
Completed Oct 2003
Perfs 7546-7772
Produced with rods and 228 pump jack
Frequent mechanical failures
Decision to try casing plunger in 2005
Collar stop @ 7507
GAS SALES

MARLIN RUTH 1-36

DATE
Nov 03 Dec 03 Jan 04 Feb 04 Mar 04 Apr 04 May 04 Jun 04 Jul 04 Aug 04 Sep 04 Oct 04 Nov 04 Dec 04 Jan 05 Feb 05 Mar 05 Apr 05 May 05 Jun 05 Jul 05 Aug 05 Sep 05 Oct 05 Nov 05 Dec 05 Jan 06 Feb 06 Mar 06 Apr 06 May 06 Jun 06 Jul 06

GAS SALES, MCF/MO
0 1000 2000 3000 4000 5000 6000 7000 8000 9000

Install PAAL Casing Plunger
SIMPLIST WELL HEAD TO DATE
CASING PLUNGER INSTALLED
REPLACED TUBING PLUNGER

• Pumper protested
• Csg @ 180 psi
• About 14 hrs/day
• Csg @ 80 psi
• Line @ 30 psi
GAS SALES

CARNAGEY GAS SALES

MCF PER MONTH

Install Casing Plunger
FLUID (OIL + WTR) PRODUCTION

CARNAGEY FLUID PRODUCED

BARRELS PER MONTH

Install Casing Plunger
HYBRID CASING PLUNGER

- MANY WELLS PRODUCE FROM MULTIPLE ZONES; CBM; AND NOW HORIZONTAL
- CASING PLUNGERS LIMITED TO TOP OF ZONES
- TUBING PLUNGERS CAN WORK LOWER
- MOST COMMON SOLUTION—ROD PUMP AND JACK– OFTEN NOT COST EFFECTIVE
- PRODUCERS NEED SOLUTIONS
PART OF THE SOLUTION

- ADAPTED CONVENTIONAL CASING PLUNGER TO HYBRID ARTIFICIAL LIFT
- SET CASING PACKER ABOVE TOP PERF AND SMALL ID TUBING OVER ALL PERFS
- UTILIZED RESERVOIR PRESSURE TO LIFT FLUID ONLY TO PACKER
- HELD FLUID WITH BALL AND SEAT
- REMOVED FLUID WITH CASING PLUNGER FROM PACKER TO SURFACE
PATENTED DESIGN CONCEPT

USE CUP
Packer
Add valve
Hollow stop
Small Dia.
Tbg
Gas flow will lift fluid
Remove with plunger
HYBRID FOR MULTIPLE ZONES

4½" 11.6 #/FT CSG.
CONVENTIONAL
PERF 6026-6038
CSG STOP 6012
HYBRID PAL
PERF 6026-6038
PERF 6342-6346
CSG STOP 5966
STANDARD COLLAR STOP
HOLLOW COLLAR STOP
TAIL PIPE WITH P/T RECORDER
HYBRID PACKER, VALVE ASSY.
HYBRID PACKER ON TAIL PIPE
HYBRID PACKER RELAXED
HYBRID PACKER COMPRESSED
P/T DATA FIRST TEST 17 DAYS
P/T DATA 2\textsuperscript{ND} TEST 11 DAYS
**MECHANICAL ASPECTS**

- All downhole tools were set and retrieved by standard wire line equipment.
- Location stop was purchased.
- Custom packer seal was designed.
- Small diameter tubing, ball and seat, optional pressure recording probes were run on standard wire line.
- Data obtained and evaluated for most efficient design parameters.
- Hybrid effectively removes fluid.
REDUCED GRADIENT

• INITIAL GRADIENT AT BOTTOM PERF WAS 0.229 PSI/FOOT

• AVERAGE PRESSURE DIFFERENTIAL BETWEEN TOP AND LOWER RECORDER WAS 2.25 PSI

• EFFECTIVE GRADIENT BETWEEN PERFS OF 0.007 PSI/FOOT

• GRADIENT ABOVE FLUID 0.0348 PSI/FOOT
3 YEAR GAS PRODUCTION

Elliott 1-23 Gas Prod, 3 Years

Install Std. PAL, stop above top perf.
Install HYBRID PAL, with 350 ft. tail pipe to remove fluid from bottom perforations.
APPLICATION FACTORS

- SIZE AND CONDITION OF CASING AND ANY CASING RESTRICTIONS
- DEPTH OF TOP PERF RELATIVE TO ALL PERFS
- SHUT IN BHP AND LINE PSIG
- FLUID VOLUME AND COMPOSITION
- GAS FLOW RATE
- HISTORICAL PRODUCTION DATA
AVAILABILITY OF TOOLS

- 4 ½ "PAL" SYSTEMS, 9.5, 10.5, 11.6 #/FT
- 5 ½ "PAL" SYSTEMS, 14, 15.5, 17, 20 #
- HYBRID SYSTEM FOR 4.5 AND 5.5 csg
- MANUAL AND CONTROLLER OPTION
- CUSTOM SIZES CAN BE CONSIDERED
- SPECIALIZED TOOLS AVAILABLE
- CUSTOM RUBBER MOLDING SKILLS TO MEET ANY DOWNHOLE NEED
CONTACT DATA

- PAAL, LLC PAL PLUNGERS
- P.O. BOX 2329
- BROWNWOOD, TEXAS 76804
- 325-624-5460
- Robert L. Moore, 817-694-9807
- Windel Mayfield, 325-624-5460
CONCLUSIONS

• RADICAL NEW CASING PLUNGER DESIGN PROVES SUCCESSFUL IN MANY GAS WELL DELIQUIDIFICATION APPLICATIONS OVER BROAD RANGE OF PRODUCTION CONDITIONS.

• CASING PLUNGERS ARE AN IMPROVEMENT IN MANY TUBING PLUNGER WELLS.

• HYBRID DESIGN ENABLES FLUID REMOVAL FROM MULTIPLE ZONES.

• HYBRID OFFERS GREAT POTENTIAL FOR FLUID REMOVAL FROM CBM AND HORIZONTAL WELLS.
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 Gas Well Deliquification Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the Gas Well Deliquification 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 Gas Well Deliquification 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 warranties of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.
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 Gas Well Deliquification 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 Gas Well Deliquification Workshop where it was first presented.