2024 GAS LIFT WORKSHOP

The Success Story of High Pressure Gas Lift In Onshore Unconventional Production

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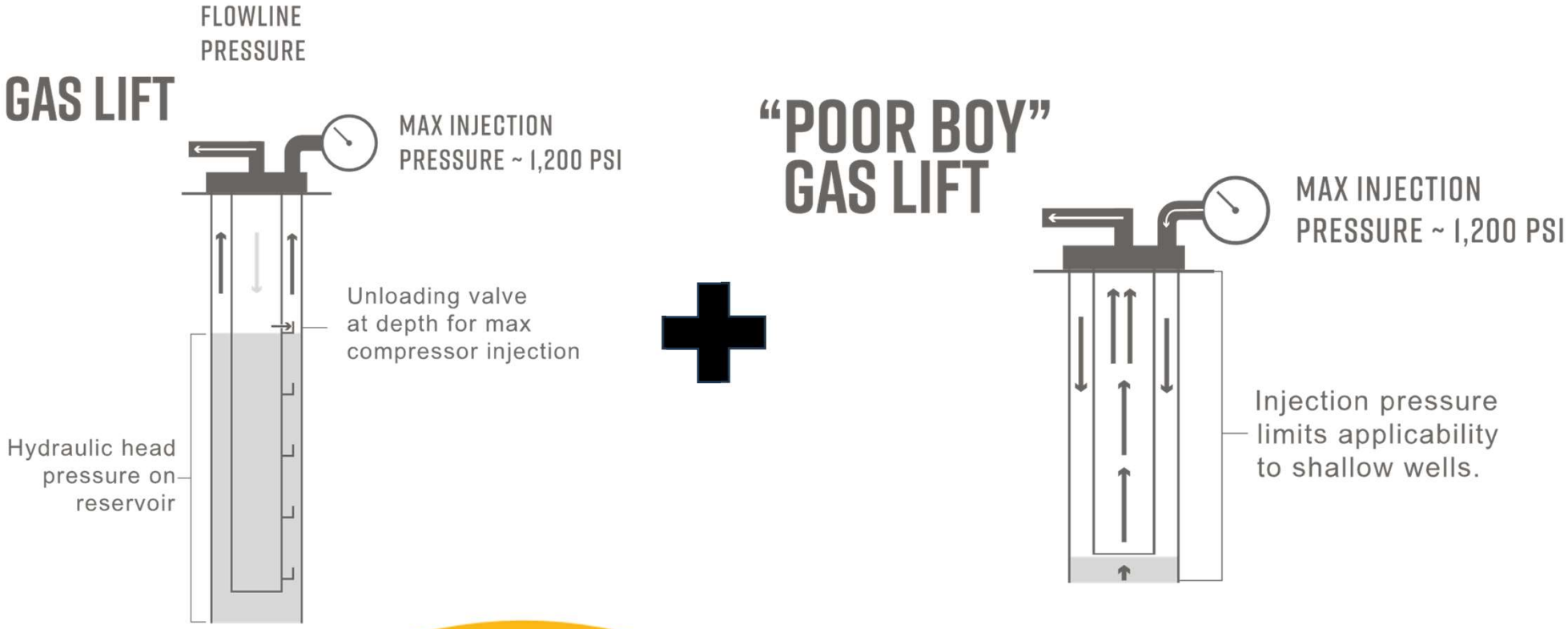
What is High Pressure Gas Lift?



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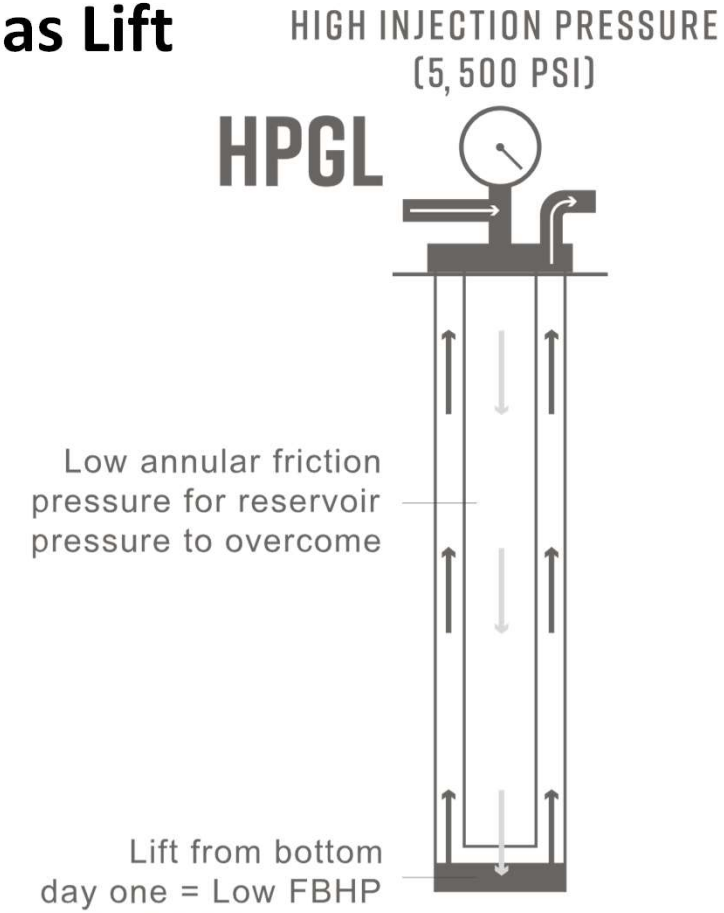
High Pressure Gas Lift

- “HPGL”
- Single Point Injection
- Lift Around End Of Tubing
- Produce Up Annulus



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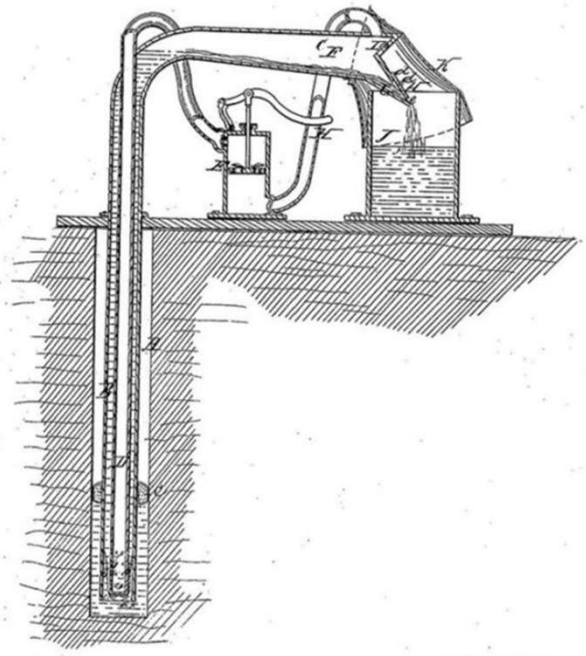
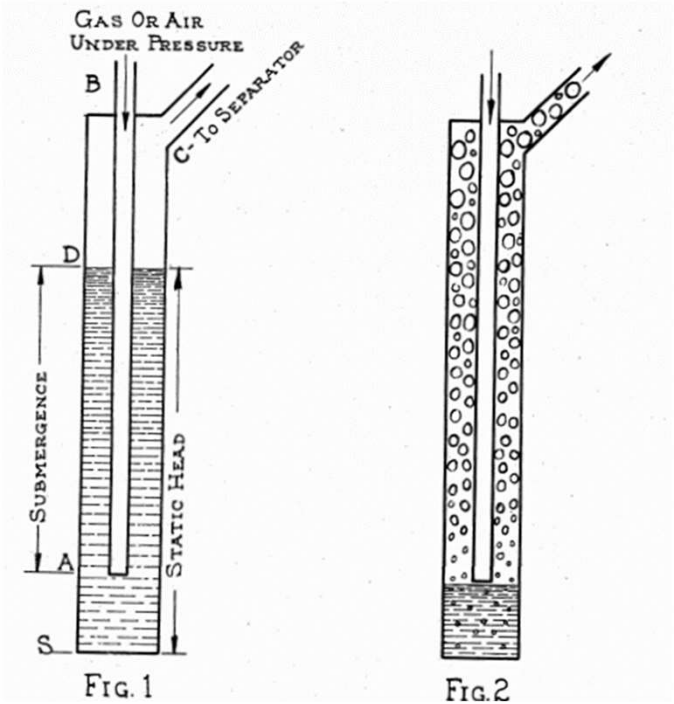
Early HPGL History

1864 Patent



1926 Book: Something About Gas Lift

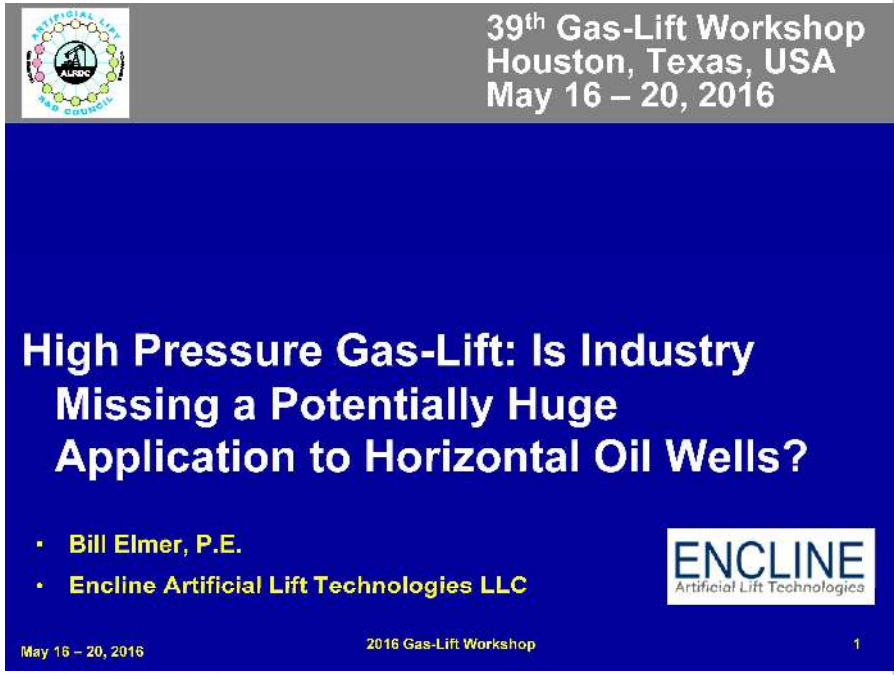


Modern HPGL History

- 2003 SPE Paper: Comparative Evaluation of Single Vs. Multi-Mandrel Gas Lift System for an India Offshore Field
  - "Single point gas injection is an age-old concept"
  - Cites SPGL case histories as early as 1985

- 2015 Private Presentation: Bill Elmer to EOG Resources
  - First proposal of modern-day HPGL

- 2016 ALRDC Presentation: HPGL: Is Industry Missing A Potentially Huge Application to Horizontal Oil Wells?
  - First proposal of idea to industry publicly



Modern HPGL History

- 2016: First HPGL Booster Compressor Purchased and Designed

- 2017: Kickoff of first well on HPGL
  - Ross Draw 8 Federal 7H, EOG Resources
    Permian Basin, New Mexico, USA

Modern HPGL History

- 2017 SPE Paper: High Pressure Gas-Lift: Is Industry Missing a Potentially Huge Application to Horizontal Wells?
  - Broader call to action for use of modern-day HPGL.
  - “It is the author’s hope that this will spur interest in HPGL.”

- 2018: First rental HPGL compressors become available

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HPGL Leaves A Mark!

Society of Petroleum Engineers

SPE-195180-MS

Single Point High Pressure Gas Lift Replaces ESP in Permian Basin Pilot Test

Branden Pronk, SM Energy Company; William Elmer, Encline Artificial Lift Technologies LLC; Larry Harms, Optimization Harmsway LLC; Will Nelle, Estis Compression; James Hacksma, Hacksma O&G LLC

This paper was prepared for presentation at the SPE Oklahoma City Oil and Gas Symposium held in Oklahoma City, Oklahoma, USA, 9-10 April 2019.

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HPGL Use Expands Rapidly

Nations, Tom, Harms, Larry. "High Pressure/Single Point Gas Lift Applications." Presented to Artificial Lift Research and Development Council Gas Lift Workshop, Virtual, **June 2021**.

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Jordan, Victor. "The Versatility of High Pressure Gas Lift." Paper Presented at the Southwestern Petroleum Short Course, Lubbock, Texas, USA, **April 2023**.

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Learnings: HPGL is NOT New!

Single Point Gas Lift System

Single point gas injection is an age old concept and is nothing but a simple means of injecting gas through one point in the string down below a liquid column to lift from the desired depth.

(Kumar, 2003)

High Pressure Gas-Lift History

- Apparently has been used offshore with large tubing diameters
  - Conventional flow direction used due to safety valves
  - Schlumberger Xlift Valve developed for High Pressure
    - Originally designed for deepwater gas-lift
    - Provide deeper injection points, 5000 psi injection
- Literature scan showed injection pressures of 1600 to 1850 psig, but hearsay says up to 5000 psi common offshore
- This is nothing new…

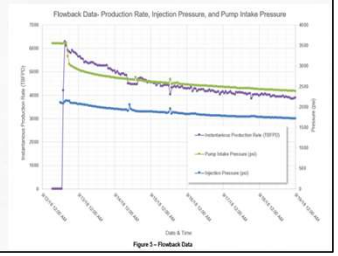
(Elmer, 2016)

Learnings: HPGL is NOT New!

FINALLY, SOMEONE WILL LET US PUBLISH…

- SPE 195780 - Brandon Pronk (SM Energy), Bill Elmer, Larry Harms, Will Nelle, Jim Hacksma, "Single Point High-Pressure Gas Lift Replaces ESP in Permian Basin Pilot Test.“, April 2019

Growth Accelerated
Early 2016 – Zero
April 2024 – 3,000+



(Harms etal, 2024)

Learnings: High Pressure Compressor Availability *was* a limitation

It is proffered that there are three reasons for this, the first being simply the lack of available rental compressors that can deliver discharge pressures above 1315 psig (there is a cost increase when increasing discharge piping and coolers from the maximum ANSI 600 rating of 1315 psig at 300 F to the next

(Elmer, 2017)

(Nations etal, 2021)

Learnings: High Pressure Compressor Availability *was* a limitation

Summary

Low primary and secondary recoveries of original oil in place from modern unconventional reservoirs beg for utilization of tertiary recovery techniques. Enhanced oil recovery (EOR) via cyclic gas injection ("huff 'n' puff") has indeed enhanced the oil recovery in many fields, and many of those projects have also been documented in industry technical papers/case studies. However, the need remains to document new techniques in new reservoirs. This paper documents a small-scale EOR pilot project in the eastern Eagle Ford and shows promising well results.

In preparation for the pilot, full characterization of the oil and injection gas was done along with laboratory testing to identify the miscibility properties of the two fluids. Once the injection well facility design was completed, a series of progressively larger gas volumes were injected followed by correspondingly longer production times. Fluids in the returning liquid and gas streams were monitored for compositional changes, and the learnings from each cycle led to adjustments and facility changes to improve the next cycle.

After completing five injection/withdrawal cycles in the pilot, a few key observations can be made. The implementation of cyclic gas injection can be both a technical and a commercial success early in its life if reasonable cost controls are implemented and the scope is kept manageable. The process has proved to be both repeatable and predictable, allowing for future economic modeling to be used to help determine timing of subsequent injection cycles. A key component of the success of this pilot has been the availability of small compressors capable of the high pressures required for these projects and learning how to implement cost saving facility designs that still meet high safety standards.

(Bozeman etal, 2021)

Learnings: HPGL Fluid Lift Rates Competes With ESPs

Conclusions

1. SPHPGL can produce at rates comparable to ESPs.

(Pronk etal, 2019)

WHY DID IT GROW?

- Rates competitive with ESPs at lower costs
- Gas lift is well suited to unconventionals
- Simple
- Reliable
- Flexible
- Promoted and word of mouth

(Harms etal, 2024)

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Learnings: HPGL Fluid Lift Rates Competes With ESPs

Abstract

Making high rates reliably with low costs from unconventional wells remains challenging. In 2017, SPE 187443 asked whether there was an opportunity to do this with high pressure gas lift (HPGL). In 2019, HPGL showed rates comparable to ESP's (SPE 195180). This paper presents results/learnings from HPGL installations in production, costs vs. ESP, modelling, kickoff and operating pressure, tubular/BHA/facilities design, installing tubing day one, slugging mitigation and electric vs. gas units.

Despite an estimated 3000 HPGL installations in the last 7 years, no results on field performance have been documented except those previously reported for a single well in 2019. Extensive design, modelling, and field data from 5 wells are analyzed and shared along with related economics. Additionally, general observations are provided from operations at hundreds of HPGL installations on many important aspects of HPGL design, implementation and continuing operations to help other operators to apply this useful artificial lift method more efficiently and effectively in the future.

The results show that HPGL wells can be produced at high rates comparable to ESP's (dependent on well and reservoir conditions) with less complexity, failures and downtime. Also, economics for HPGL are attractive compared to ESP's. Further significant results and conclusions are that well tubulars are readily modelled to predict/optimize rates, facilities can easily be designed to allow maximum flow rates/ mitigate slugging, HPGL wells are simple to optimize using changes in injection rates while monitoring surface pressures and electric units are found to have substantial benefits when good line power is available.

(McNeilly etal, 2024)

Learnings: HPGL Is More Cost Effective Than ESPs

ESP	HPGL
• $200K+ downhole equipment	• Tubing, no additional downhole
• High failure rate/ replacement cost	• Basically zero failures, cheap
• High monthly power bill	• No power bill
• Monthly ESP rental/ well	• Monthly compressor rental divided between wells on a pad (Normal compressors + temporary booster) • Increased up front capital cost (Injection lines, 1,440 psi gas busters, instrument air, control valves, etc)
• Little bit lower capital up front	• Little bit higher capital up front
• High LOE	• Super Low LOE

SM ENERGY

(Pronk, 2017)

Learnings: HPGL Is More Cost Effective Than ESPs

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(McNeilly etal, 2024)

Learnings: HPGL Is More Reliable Than ESPs

Compressor reliability is KEY!!!

- In L48, Cold weather has been a challenge for GL in general and HPGL has even more compression
- Proper Designs can handle
- One data point says HPGL compression had equal and usually better run time than the ESP's even with "old" compressor design

(Nations etal, 2021)

Due to the operational failures with ESPs at 2 wells across the field, in both Reeves and Culberson County, and taking into consideration the operational and production performance of HPGL in Well 2, it was decided to replace the ESP systems in Well 1 & 3 with HPGL. One major difference between Wolfcamp A (Well 1 & 2) & B (Well 3) wells are the reservoir PVT and production properties as presented in Table 1. Well 3, because it had higher GOR and lower water rates/ratio was considered a better candidate for HPGL.

(Dalamarinis etal, 2024)

Learnings: HPGL Is More Reliable Than ESPs

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Benefits of HPGL

1. End of Tubing **installed deeper** allowing increased drawdown from deep gas injection
2. **Annular Flow** allowing reduced friction
3. Improved **Sand handling** ability (vs. ESP)
4. Improved **Free Gas handling** ability (vs. ESP)
5. **No prolonged downtime** for 1st ESP install
6. Reduction in OPEX cost due **to less frequent workovers** to replace downhole equipment
   - **ESP:** Workover ~12 to 18 months
   - **SPHPGL:** Workover ~5 years

(McNeilly etal, 2024)

Summary

- HPGL is a proven and mature technology
  - 3000+ applications North American
- HPGL is an attractive alternative to ESPs
  - HPGL fluid lift rates compare with that of ESPs
  - HPGL is much more cost effective than ESPs
  - HPGL is more reliable than ESPs
- HPGL optimization is installations call for a

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Contact Me

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Innovator | Technology Leader | Change Cat...

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