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Artificial Gas Lift, a Superior Method for Enhancing Oil Production

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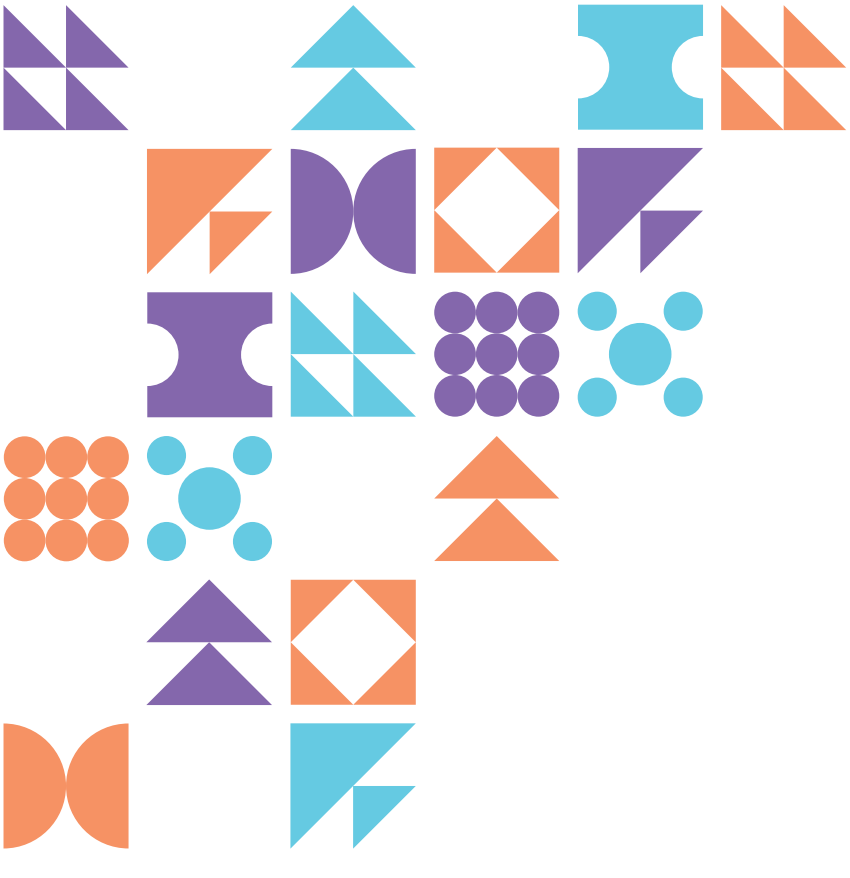


In today's rapidly evolving landscape, the term "artificial" has become synonymous with advancements in technology, particularly with the rise of artificial intelligence. Yet, the concept of artificial solutions has long been pivotal in various industries, including oil and gas. One such innovative technique is "Artificial Gas Lift," a process that enhances oil recovery by using gas to reduce fluid density in production wells. This method not only optimizes production efficiency but also addresses environmental concerns, making it a critical tool in modern oil and gas operations. As we delve deeper into the benefits of Artificial Gas Lift, we uncover how this technology can drive sustainable practices while maximizing output in an ever-challenging market.

What is Artificial Gas Lift?

Artificial Gas Lift is the process of the injection of Lean Gas (Pure Methane Gas) into the Oil production Tubing of a production well to increase the oil flow rate.

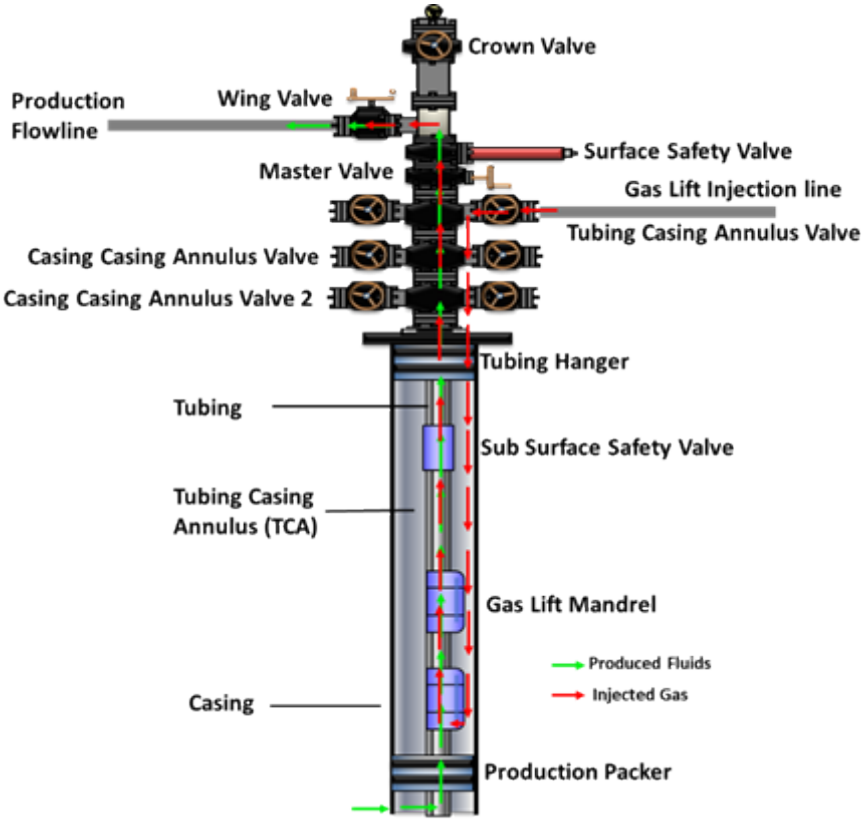
How Artificial Gas Lift Works?

Artificial Gas Lift operates by injecting Lean Gas (CH4) into the annulus between the production tubing and casing of the production well as shown in the 'General Gas Lift Well Schematic (typical)' (below). The injected gas then enters the production tubing through gas lift valves, forming bubbles that mix with the fluid column. to reduce the density of the fluid mixture. This process reduces the fluid density, lowering the hydrostatic pressure needed to lift oil to the surface, thus improving flow rates and enhancing production of the produced fluid.

What are the Major components of a Gas Lift system?

•Gas lift Mandrels: Installed at Engineered depth locations in the well production tubing at lower, middle and upper levels at different set pressure to lift oil in three stages
•Gas Lift Valves: Operate at set flowrates of gas injected into the well tubing, crucial for optimizing the Oil Lift process.
•Injection Gas System: Supplies the required flow and pressure of gas from an external Gas supplying facility to each well of the offshore production platform.
•Other maintenance tools: Required to install or dismantle Gas injection valves on an as-needed basis but are not discussed in this article.

Graphical illustration of Gas Lift Injection Schematic



General Gas Lift well schematic (typical)

Why is Gas Lift the preferred option?

•***Environmental Compliance:*** The gas lift system is closed, producing zero carbon emissions and eliminating flaring or release of associated gases to the atmosphere, making it significantly more environmentally friendly compared to other methods.

•***Circular Economy:*** Injected gas can be recycled through the GOSP plant, supporting Circular Economy goals.

•***Accommodating Changes:*** Gas Lift Systems are easily adjustable to accommodate changes in reservoir conditions and production rates.

•***Flexibility:*** The flexibility in operating the Gas Lift Flow can optimize the operating condition by amending the injection rate input and therefore Oil production yield.

•***Resource Efficiency:*** As the gas is injected into the production tubing (as opposed to the vast reservoir), minimal gas volume is required for significant lift.

•***Low Maintenance Costs:*** Reduced need for workover rigs makes maintenance more cost-effective. Gas lift valves can be retrieved without an extensive rig operation.

What are the Key Parameters for an Efficient Gas Lift System?

•***Reservoir Analysis:*** Requires a thorough analysis of the Reservoir parameters, such as pressure, temperature, fluid composition & fluid properties to enable the selection of the appropriate Gas Lift system design.

•***Well Depth:*** The depth of the well impacts the placement of injection valves/nozzles at appropriate depths to synchronize the lift column to efficiently boost flowrates from reservoir to topside.

•***Gas Composition:*** The composition of the injected gas is a significant factor. Lean Gas is the optimal option to overcome any hydrocarbon compatibility or contaminant removal issues further downstream. As lean gas is a byproduct of Oil it is the ideal choice of injection medium.

•***Production Rate:*** The intended production rate influences system design, with higher required rates potentially necessitating multiple gas lift stages and higher gas injection rates.

•***Cost-Benefit Analysis:*** Conducting a thorough cost-benefit analysis of gas injection and maintenance relative to the expected increase in production is essential to ensure a net benefit from the system.

What is the operating edge over other Artificial Lift methods?

•***Indigenous Gas Utilization:*** The major Gas Lift 'edge' is the utilisation of indigenously produced lean Gas. Once the producing well is Gas lift enabled, no further external dependencies are required other than the routine operation and maintenance of the Gas Lift System. As the reservoir pressure declines over time, gas lift helps maintain production rates by changing the parameters of the gas injection to lift the hydrocarbons. Artificial Gas Lift is highly flexible with easily adjustable injection rates to suit current reservoir conditions and operating limitations.

•***No Power Generation Infrastructure:*** Gas Lift technology require much less power demand in comparison with Electric Submersible pumps and water injection system. It also doesn't need huge power generation and transmission to offshore fields/ wells.

•***Reduced Equipment Maintenance:*** The reduced viscosity/density can reduce rotating equipment maintenance when compared to heavier fluids.

•***Effective in Various Conditions:*** Gas lift technology can be more effective in differing operating conditions and provides improvements in downstream conditions when compared with Water Injection secondary oil recovery technique. Artificial Gas Lift is also suitable for wells with high gas-to-oil ratios. Although ESPs are best suited for high production wells, they can be less effective in environments with high Gas contents, abrasive and corrosive fluid conditions

•***Lower Operating Costs:*** Electrical Submersible Pumps (ESPs) are less flexible, can be prone to poor runlife, high maintenance and replacement costs and often require longer down time, leading to increased operational costs.

What are the Pros & Cons?

•Evolving developments in Gas Lift Technology continue to enhance efficiency and reliability further.

•Lower maintenance and operating costs compared to other lift methods.

•Advanced sensors and digital control systems proven for real-time monitoring, fine adjustment, and optimizing gas lift performance.

•New material and coatings for gas lift equipment have increased durability and reduced maintenance downtime further.

•Other Oil Lift technologies such as Electrical Submersible Pumps (ESPs) are effective but limited to well depth and operating issues in wells with high Gas-to-Oil ratios or corrosive fluid.

•Leaves wellbore fully accessible, the gas lift valves are installed in side pocket mandrels allowing for all well intervention operations.

Despite the aforementioned advantages, Gas lift technology does present several challenges, such as;

•High initial capital cost of gas injection compression facility

•The need and requirement of high-quality injected gas.

•The fine adjustment of all Gas Injection Parameters is complex and time consuming to reach optimum parameters to gain maximum production.

•The operation resources learning curve determines the optimization of Gas Lift Injection Parameters to be within Vendor proposed operating Curves.

•As this is first in kind of Gas Lift Technology being implemented by Aramco at the offshore oil field, there will be higher maintenance cost due to utilization of the Offshore Maintenance Vessel spread.

•Gas lift technology depends on a regular supply of required volume, flow and pressure of gas to avoid operational production disturbances.

•Close monitoring of the injection valves performance is essential to ensure optimal performance of Gas Lift System.

Which Artificial Lift is more cost effective?

Artificial Gas Lift is typically more cost-effective than ESPs, with lower operational and maintenance costs due to reduced downhole failures. The static mechanical components of gas lift systems lead to fewer operational disruptions compared to the rotating components of ESPs.

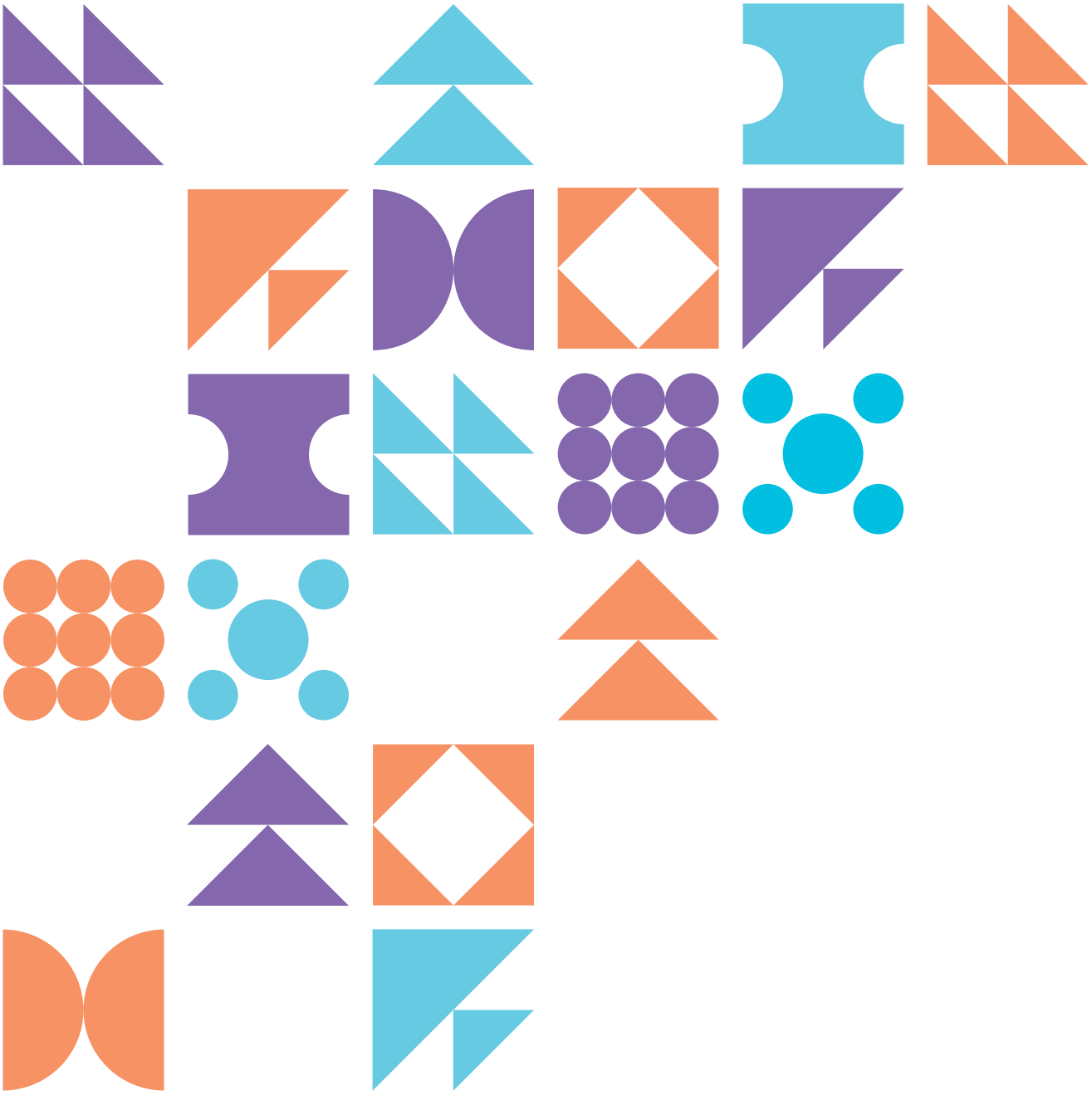
What is the Impact on Reservoir Formations?

•***Minimized Formation Damage:*** Artificial Gas Lift reduces the risk of impairment in delicate reservoirs.

•***Compared to ESPs:*** ESPs may cause formation changes over time, especially in challenging environments or wells with large quantities of sand and/or corrosive fluids.
•Water Injection Risks: Excessive use can also harm reservoir integrity.

Conclusion

Based on the above analysis, Artificial Gas Lift is an advanced, environmentally compliant method that produces zero Carbon Emissions, boosts the Circular Economy by recycling the lean gas, requires low dependency on external resources & equipment vendors, uses an indigenous gas supply, has low maintenance costs due to the absence of rotating components, produces minimal impact on reservoir formations, requires low input gas volume & flow rate and reduces the operating risk of lean gas (Pure Methane). The system offers clear advantages over other widespread recovery techniques using Electric Submersible Pumps or even a Water Injection system. Gas Lift enhances production rates, provides flexibility, cost–effectiveness with no impact on varying reservoir conditions. Notwithstanding this, it does require a consistent gas supply, a robust design & maintenance strategy and the adoption of ongoing technology enhancements to optimize production performance. By adopting Gas Lift Technology, we can enhance production rates, maintain flexibility, and improve cost-effectiveness, thereby maximizing operational efficiency in our offshore facilities.



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