PRODUCTION ACCELERATOR - JET PUMPING WITH GAS LIFT

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Overview: The flexibility of gas lift to efficiently lift a well over its lifetime is unequaled by any other means of artificial lift. With the development of a new product called the production accelerator, gas lift is now even more flexible and can efficiently produce wells that would previously have been candidates for other types of lift. The purpose of this paper is to describe how the production accelerator works and where it can be utilized to accelerate production.

Introduction: The production accelerator is a cost effective product that utilizes the proven concept of jet pumping to increase production above that of standard constant flow gas lift operations. The accelerator achieves its pumping action by means of momentum transfer from its power source (high pressure gas) to the well's produced fluid.

How It Works: (see figure 1) The production accelerator can be installed with wireline across the operating gas lift mandrel or any other flow control device. High pressure gas is injected at the surface and travels through the gas lift mandrel to the nozzle of the accelerator. The high pressure gas exits the nozzle and is entrained with the produced fluids in the mixing chamber before entering the throat section of the accelerator. Mixing of the gas and fluid occurs in the throat. During this process, the high pressure gas loses some of its momentum while produced fluid gains momentum and energy. As this momentum transfer occurs, a pressure drawdown of the produced fluids occurs below the accelerator which reduces the flowing well bore pressure. Above the accelerator, a traditional gas lift operation occurs where the compressed gas expands on the way to the surface and reduces the flowing gradient of the produced fluid.

Applications:

Low Reservoir Pressure: In the early stages of a reservoir's life, gas lift is often the most efficient type of artificial lift because it closely resembles the characteristics of a flowing well. The reservoir pressure contributes significantly to the energy required to efficiently produce the well. In some reservoirs, the formation pressure will deplete over time to the extent that continuous flow gas lift is no longer efficient and other forms of lift may be more attractive. In these cases, where low reservoir pressure is limiting the efficiency of gas lift, the production accelerator can be installed to provide additional drawdown and increase production.

Wells gas lifting from the bottom gas lift mandrel: For gas lift wells that are already lifting from the bottom gas lift mandrel and additional drawdown is desired, the production accelerator can be installed.

Wells that are flowing in an unstable flow regime. For wells with an unstable flow pattern which causes problems in the gas lift system (such as venting gas during heading or buying make-up gas between heads), the production accelerator can be installed to stabilize flow. By ensuring a stable gas injection rate and efficiently mixing produced fluids and gas lift gas in the mixing chamber, the most efficient flow

regime is obtained resulting in a more stable flow pattern and lower FBHP.

Dewatering of gas wells: In gas wells that produce so much water that a plunger lift system cannot produce efficiently, a production accelerator can be installed to keep the flow rate at its maximum.

Reduce Flowline Pressure: The production accelerator can be installed horizontally in a flowline to reduce the back pressure against pressure sensitive wells. The power source (high pressure gas) can be supplied by the gas lift system or a gas well that has an adequate flowing pressure.

Features and Benefits:

1. Low cost - A 2-7/8" production accelerator assembly costs approximately $10,000.
2. Quick pay out - Most installations pay for themselves within the first month.
3. Ease of installation - The production accelerator can be installed and retrieved with wireline. Complete installation can be done in less than one day.
4. Long life expectancy - There are no moving parts that can wear out or fail and special materials are available for corrosive and abrasive environments.
5. Design changes can be performed easily with wireline by changing the throat or nozzle size.
6. More efficient use of the energy stored in compressed gas - In production accelerator installations, all of the pressure drop occurs at the nozzle where the energy stored in compressed gas can be used to create a drawdown.
7. Can produce efficiently when large amounts of formation gas are present.

Case History:

1.Low Reservoir Pressure: In a large oil field in West Africa, all of the wells that require artificial lift are currently utilizing gas lift. In this field, production rates are limited because the reservoir pressure has fallen to the extent that gas lift is no longer as efficient as it once was. Alternatives to gas lift were being evaluated to increase production rates from these wells. To determine if the production accelerator could help improve the efficiencies of gas lift in this field, a production accelerator was installed. Test information before and after installation is listed below:

Producing Depth: 2,710' - 2,777'
Reservoir Pressure: 477psi
Productivity Index: +65
Production Test before installation: 1,127B/D with 570MCF injection gas.
Production Test after installation: 1,616B/D with 990MCF injection gas.
Production Test after accelerator removed: 1,182B/D with 1,150MCF.

2. Unstable Flow: In a central Texas Austin Chalk gas lift well, severe heading was causing problems in the small gas lift system. Between heading, make-up gas was purchased to keep the well producing and during heads, large amounts of gas were vented. In addition, the large tubing heads made it difficult to accurately read the gas sales chart. A production accelerator was installed in this well to increase the efficiencies of the gas lift operation and to stabilize flow pattern to avoid the purchasing of make-up gas. Fluid production increased from 28 to 58B/D, produced gas increased from 250 to 366MCF/Day and the

purchase of make-up gas was completely eliminated. The well is now producing with a consistently stable flowing pressure.

3. Dewatering of Gas Wells: In a Northeast Louisiana gas field, the reservoir pressure had fallen to the extent that neither plunger lift nor gas lift could keep the well producing at its maximum rate. A production accelerator was successfully installed in this well to allow a lower FBHP and higher production rate. The production rate increased from 244MCF to 404MCF and from 36B/D to 64B/D.

4. Reducing Flow Line Pressure: In Lake Maracaibo, Venezuela, a production accelerator was installed in the flow line of a high PI well that was producing into a system with excessive back pressure (l60psi). With an injection rate of 500MCF, the flowline pressure was reduced to 80psi. With an injection rate of l,000MCF, the flowline pressure was reduced to l0psi. With a flowline pressure of l0psi, the production increased by 200B/D.

Conclusion:

In the proper applications, a production accelerator can be a useful tool to achieve additional drawdown, increase production and stabilize flow patterns for constant flow gas lift operations. The production accelerator now allows gas lift to be a more versatile means of artificial lift than ever before.

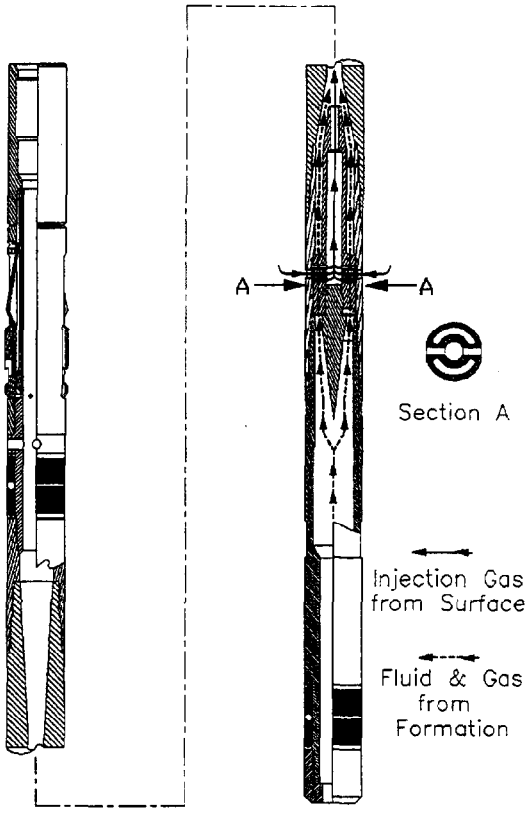

Figure 1