THE USE OF GAS LIFT IN HORIZONTAL WELLS TO STABILIZE AND INCREASE PRODUCTION

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Gas lift is a form of artificial lift where natural gas is injected downhole to aerate and lift a well's fluid to the surface. This form of artificial lift is very popular along the Gulf Coast and offshore especially for high rate wells that are unable to flow on their own.

A gas lift installation consists of a series of valves set at calculated depths and operating pressures. These depths and pressures are calculated based on lift gas pressure, lift gas volume available, tubing size, flowline pressure, production rate, water cut, perforation depth and temperature. The valves act as pressure regulators and transfer from one valve to the next until they reach a depth that will sustain the optimum production rate.

To determine the optimum production rate, the well's gas liquid ratio (GLR) is very important. The most efficient operation is with a GLR that achieves the maximum drawdown for a given rate. Exceeding these minimum gradient GLR's will not achieve any additional drawdown and is, in effect, wasted energy.

Horizontal wells are often an exception to this rule, with many that load up and die with extremely high GLR's. It is not uncommon for wells making as much as 1.5 million cubic feet of gas per day with 2 7/8" tubing to load up and require artificial lift. Most vertical wells under the same conditions would easily maintain natural flow.

Many horizontal wells being drilled today are completed with large diameter casing such as 7 5/8", allowing for horizontal sections with diameters in excess of 6 inches through the producing zone. The tubing is then landed with a packer in the 7 5/8" casing leaving several thousand feet of open hole for the formation fluid and gas to flow through. As fluid rates decline, the lower velocity in the horizontal section of the well allows the gas and fluid to separate. When this occurs, the wells begin heading and eventually the slugs of liquid from the large diameter horizontal section will load up the production tubing, killing the well. (See Figure 1)

Gas lift is becoming accepted as the best form of artificial lift in horizontal wells with high gas liquid ratios. The flexibility to produce high rates early in the life of the well, then adjust to lower rates as the well declines, makes gas lift an efficient and economical solution. Other forms of artificial lift available are not as rate flexible, are adversely affected by formation gas and solids, and generally require a much larger operating and capital expenditure. A comparison of producing rates with various forms of artificial lift can be seen in the case histories.

The gas lift design installed in a depletion drive horizontal well should be flexible enough to unload the well under static conditions, lift high rates from the upper valves, and be valved to the bottom to maintain the lowest flowing bottom hole pressure possible as the well declines. Compression requirements for 2 3/8" tubing is generally a minimum of 250-300 MCF/day and in 2 7/8" tubing, a minimum requirement of 400-500 MCF/day.

A closed rotative gas lift system can easily be installed to produce into either a low or high pressure sales line. In most cases an agreement with the pipeline company to purchase gas for startup is possible, facilitating the initial 'kick off' of the well. When hooking up on a low pressure sales line it is helpful to have a back pressure regulator on the sales line to maintain a steady pressure on the system. On the buy line, a pressure reducing valve is needed to feed the system gas if the system pressure is pulled down to a critical level by the compressor. With high pressure sales, all of the gas returning from the well is compressed. A portion of this gas is re-injected into the well with excess going into sales. (See figures 2 and 3)

Gas lift can be effectively used in horizontal wells to maintain and or increase production by aerating the fluid heads as they come into the tubing. The result of this is stabilized tubing pressure and lower average flowing bottom hole pressure which results in increased production.

CASE HISTORIES

Case 1 - This well was on rod pump producing 400 BPD with a 30% oil cut and 500 MCF/day from 9000' TVD. Gas lift increased production to 1100 BPD with a 30% oil cut and 1000 MCF/day of gas.

Case 2 - This well was erratically producing 400 BPD with a 30% oil cut and 1-2 MMCF/day from 8800' TVD. On gas lift the well increased to 600 BBL/day at a 30% oil cut with 2.5 MMCF/day.

Case 3 - This 8400' TVD well was pumping 200 BPD at a 95% oil cut and a 100 MCF/day of gas. On gas lift the well increased to 400 BPD of oil with 200 MCF/day.

Case 4 - This well was flowing erratically from 9500' TVD at 300-400 BPD and 400 MCF/day. On gas lift the production increased to 800 BPD of oil and 1.7 MMCF/day.

Case 5 - This 8800' TVD well was rod pumping 285 BPD at 70% oil cut and 600 MCF/day. On gas lift the well increased to 950 BPD and 1300 MCF/day.

Case 6 - This 7500' TVD well would not flow initially and was immediately put on gas lift. On gas lift the well produced 1200 BPD with a 75% oil cut and 800 MCF/day.

Case 7 - This rod pump well was producing 400 BPD and 400 MCF/day. On gas lift the production increased to 1000 BBL/day and 1000 MCF/day.

Case 8 - This 8500' well was rod pumping 150 BPD with a 50% oil cut and 150 MCF/day. On gas lift it consistently produced 300 BBL/day at a 50% cut with 400 MCF/day.

Case 9 - Initially this well was put on jet pump and was producing 1200-1300 BBL/day with a high water cut and 800 MCF/day. The operating cost were extremely high and they decided to put the well on gas lift. On gas lift the well continued to produce 1200-1300 BPD, but there was a problem getting start up gas when the compressor would go down. At that point they decided to put the well on ESP, which caused production to drop to 800 BPD on a good day. After 30 days and 2 burned up pumps they put the well on rod pump and it is currently producing 550 BPD.

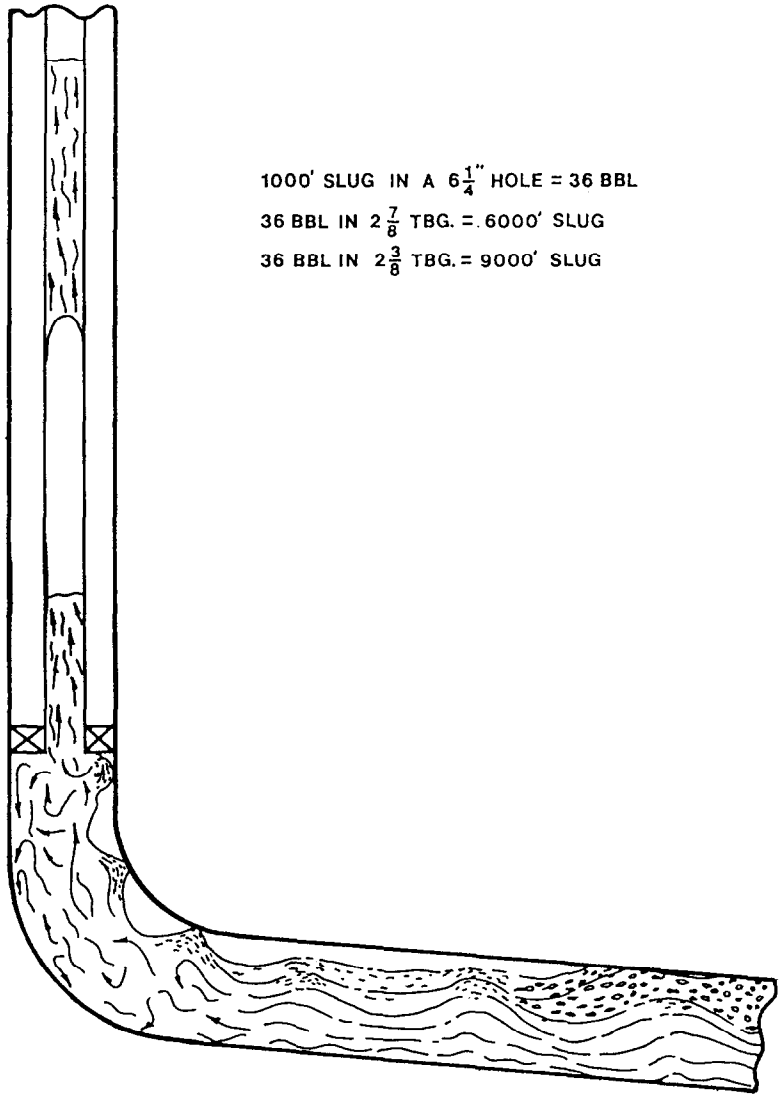

Figure 1 - Loading problems associated with horizontal wells

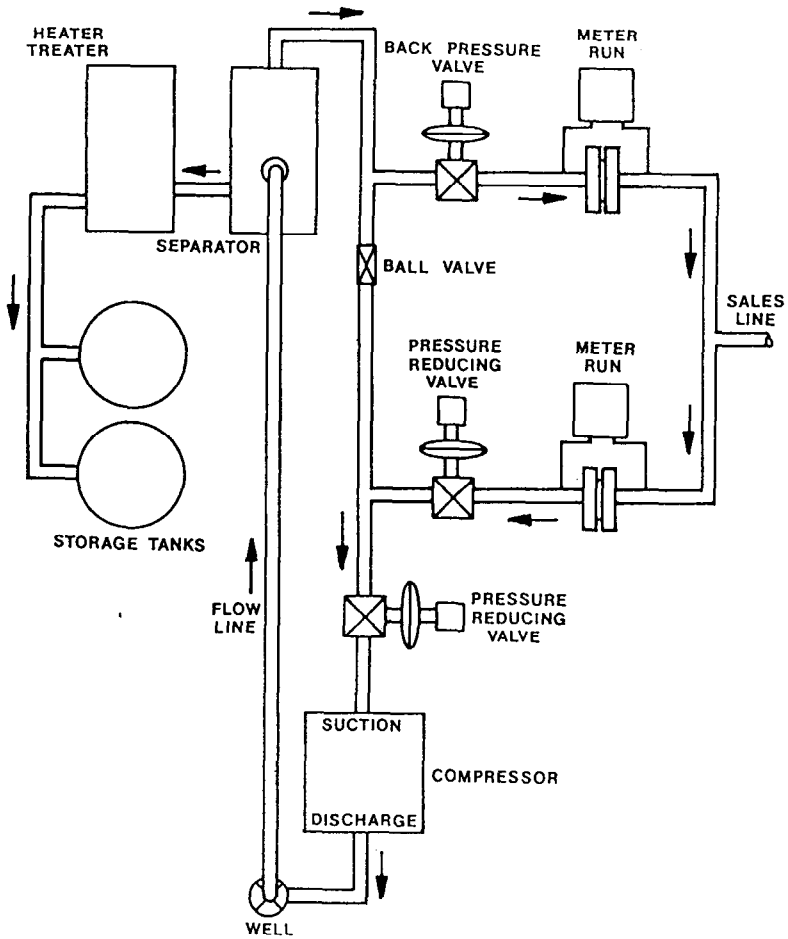

Figure 2 - Typical gas lift system for low pressure gas sales

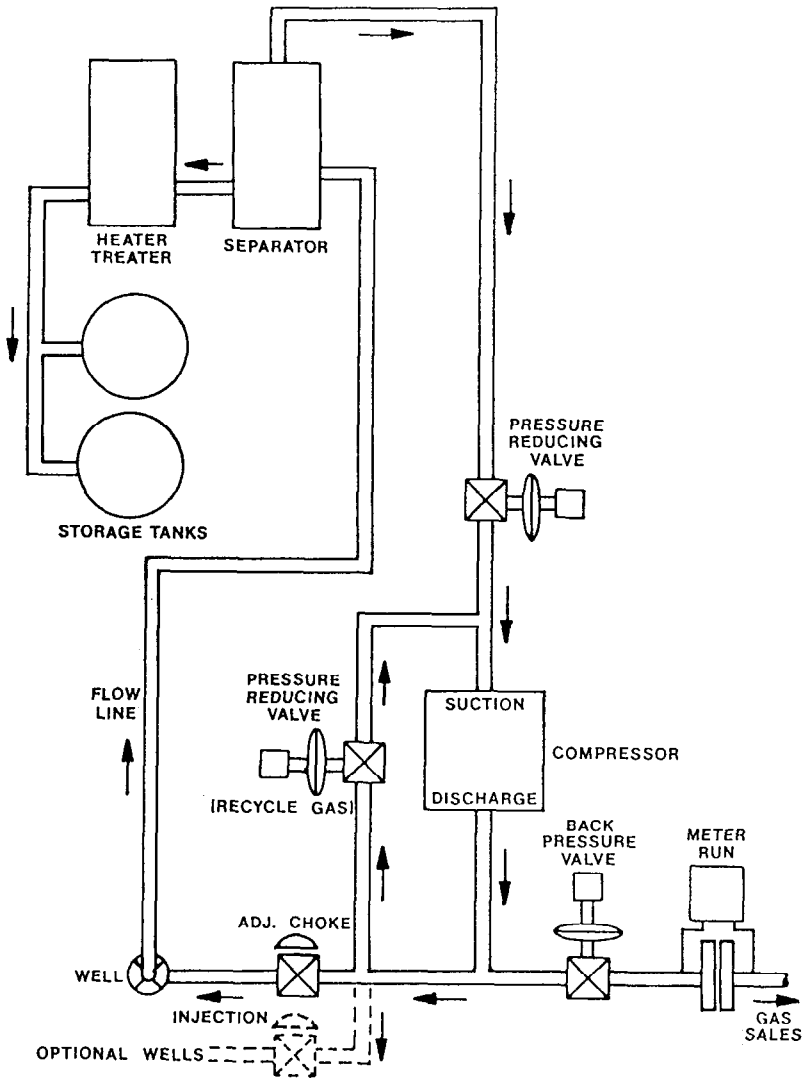

Figure 3 - Typical rotative gas lift system for high pressure gas sales