Gas Lift Systems

Gas is injected continuously or intermittently at selected locations, resulting in the lifting of the produced fluids to the surface. This is accomplished by lowering the hydrostatic load in the tubing by the addition of the gas. The lowering of the bottom hole pressure is also accomplished.

The lifting of well fluids is accomplished by one of two methods:
  1) Continuous – Continuously injecting gas into the tubing or casing at a predetermined depth to reduce the pressure opposite the producing formation.
  2) Intermittent Flow – Injection of high pressure gas into the tubing at sufficient volume and pressure to lift the fluid head accumulated above the valve with maximum velocity. (De-watering gas wells)

Advantages of Gas Lift

  1) Low initial and operating costs
  2) Flexibility of production, can produce at high and low rates
  3) Effectively produce high GOR and WOR wells
  4) Deep wells, deviated wells
  5) Subsurface equipment can use wireline workover techniques
  6) Dual completed wells

Factors that limited effectiveness of gas lift

  1) Sour gas
  2) Wet gas subject to freezing
  3) Paraffin
  4) Low viscosity crudes

The four well categories considered for gas lift

  1) High PI – High BHP       continuous
  2) High PI – Low BHP        intermittent
  3) Low PI – High BHP        continuous
  4) Low PI – Low BHP         intermittent
Continuous Gas Lift System

Design Factors

1) Gas injection depth, pressure and GLR for desired production
2) Principles of unloading operations
3) Well gradients
4) Gas lift valve spacing principles
5) Types of gas lift valves
6) Mechanics of gas lift valve operation
7) Factors that affect efficiency

Determination of gas injection depth and pressure along with the GLR can be obtained using the PI of the well.

Unloading is the process by which the valves in the casing are uncovered, the fluid is pushed below the valve, and the effects in the tubing as this happens.

There are two distinct gradients used here, one for the valve spacing and one for ultimate gas lift production design. The gradient across from a valve just before it opens is made up of the tubing head pressure, aerated flowing gradient above the valve and the Non-aerated flowing gradient up to the valve above it. These gradients change, as more valves become uncovered down to the kick off valve.

Valve Spacing Principles require knowledge of 1) Well unloading characteristics; 2) well gradients, and 3) types of valves and the mechanics of their operation.

Types of Gas Lift Valves

I) Type of service
   A. Continuous flow
      1. Fixed orifice
      2. Variable orifice
   B. Intermittent flow
      1. With minimum tubing pressure control
      2. With maximum tubing pressure control

II) Type of loading
   A. Gas charged bellows chamber
   B. Gas charged piston chamber
   C. Gas charged rubber diaphragm chamber
   D. Spring
   E. Spring, pilot loaded
   F. Combination spring and gas charged bellow
   G. Liquid charged diaphragm chamber
To understand the mechanics of the valves, the operating pressure of the valves must be known. This pressure is set by different methods depending on the type of the valve used. The pressure to open a valve is equal to 1) Pressure necessary to overcome the pressure charge inside the bellows, 2) Full pressure effect of the spring and 3) Minus the effective tubing pressure helping to the valve.
Intermittent Flow Gas Lift Wells

Types of Intermittent Installations
1) Conventional type
2) Gas Lift Plunger with outside gas source
3) Gas Lift Plunger without an outside gas source; use the gas from the well.

The Design Considerations
1) Kick off pressure
2) Continuous operating gas pressure
3) High or low fluid level
4) High or low PI
5) BHP build up rate
6) Available gas and the theoretical minimum requirement
7) Production desired
8) Valve setting and spacing for unloading and operating
These systems are used to remove slugs of fluid from the well. Very common in gas wells that makes a lot of water. The rate that the well builds up pressure is a major factor in the timing of the production cycles for the well.

FIG. 9. Progressive stages in intermittent flow. Producing rate is dependent upon fill-in and pressure of fluid column in tubing between slugs.

FIG. 13. Plunger lift with retrievable gas lift valve. Plunger reduces slippage per cycle encountered in conventional systems.