

Artificial Lift Technique (VI Semester)

Q.1. What do you mean by artificial lift technique in Petroleum industry?

Answer. Artificial lift is a means of overcoming bottomhole pressure so that a well can produce at some desired rate, either by injecting gas into the producing fluid column to reduce its hydrostatic pressure, or using a downhole pump to provide additional lift pressure downhole.

We tend to associate artificial lift with mature, depleted fields, where P_{avg} has declined such that the reservoir can no longer produce under its natural energy. But these methods are also used in younger fields to increase production rates and improve project economics.

Q.2. What are the different types of artificial lift techniques used in oilfields?

Answer. Pump-Assisted Lift – Hydraulic Pump-With a *reciprocating hydraulic pump*, the injected power fluid operates a downhole fluid engine, which drives a piston to pump formation fluid and spent power fluid to the surface.

A *jet pump* is a type of hydraulic pump with no moving parts. Power fluid is injected into the pump body and into a small-diameter nozzle, where it becomes a low-pressure, high-velocity jet. Formation fluid mixes with the power fluid, and then passes into an expanding-diameter diffuser. This reduces the velocity of the fluid mixture, while causing its pressure to increase to a level that is sufficient to lift it to the surface. Used at depths from 1000 to 17,000 feet and are capable of producing at rates from 100 to 10,000 B/D. They can be hydraulically circulated in and out of the well, thus eliminating the need for wireline or rig operations to replace pumps and making this system adaptable to changing field conditions. Another advantage is that heavy, viscous fluids are easier to lift after mixing with the lighter power fluid.

Disadvantages of hydraulic pump systems include the potential fire hazards if oil is used as a power fluid, the difficulty in pumping produced fluids with high solids content, the effects of gas on pump efficiency and the need for dual strings of tubing on some installations

Pump-Assisted Lift – ESP-Advantages:

- The most efficient lift methods on a cost-per-barrel basis.
- High rate: 100 to 60,000 B/D, including high water-cut fluids.
- Work in high-temperature wells (above 350°F) using high-temperature motors and cables.
- The pumps can be modified to lift corrosive fluids and sand.
- ESP systems can be used in high-angle and horizontal wells if placed in straight or vertical sections of the well

Disadvantages:

- ESP pumps can be damaged from “gas lock”. In wells producing high GOR fluids, a downhole gas separator must be installed. Another disadvantage is that ESP pumps have limited production ranges determined by the number and type of pump stages; changing production rates requires either a pump change or installation of a variable-speed surface drive. The tubing must be pulled for pump repairs or replacement.

Gas Lift-Gas lift involves injecting high-pressure gas from the surface into the producing fluid column through one or more subsurface valves set at predetermined depths

Advantages: Gas lift can be used in deviated or crooked wellbores, and in high-temperature environments that might adversely affect other lift methods, and it is conducive to maximizing lift efficiency in high-GOR wells. Wireline-retrievable gas lift valves can be pulled and reinstalled without pulling the tubing, making it relatively easy and economical to modify the design.

Disadvantages: the availability of gas and the costs for compression and injection are major considerations. Lift efficiency can be reduced by corrosion and paraffin. Another disadvantage of gas lift is its difficulty in fully depleting low-pressure, low-productivity wells. Also, the start-and-stop nature of intermittent gas lift may cause downhole pressure surges and lead to increased sand production.

Pump-Assisted Lift – Reciprocating Rod Pump-Beam pumping is the most common artificial lift method. It can be used for a wide range of production rates and operating conditions, and rod pump systems are relatively simple to operate and maintain. However, the volumetric efficiency (capacity) of a rod pump is low. its initial installation may involve relatively high capital costs. Its application is very limited for deep, inclined and horizontal wells.

Pump-Assisted Lift – PCP-As the rotor turns, cavities between the rotor and stator move upward.

Progressive cavity pumps are commonly used for dewatering coalbed methane gas wells, for production and injection applications in waterflood projects and for producing heavy or high-solids oil. They are versatile, generally very efficient, and excellent for handling fluids with high solids content. However, because of the torsional stresses placed on rod strings and temperature limitations on the stator elastomers, they are not used in deeper wells.

Q.3. What are the selecting characteristics for the artificial lift technique?

Answer. Selecting an Artificial Lift Method – Reservoir Characteristics

IPR: A well’s inflow performance relationship defines its production potential

Liquid production rate: The anticipated production rate is a controlling factor in selecting a lift method; positive displacement pumps are generally limited to rates of 4000-6000 B/D.

Water cut: High water cuts require a lift method that can move large volumes of fluid

Selecting an Artificial Lift Method – Reservoir Characteristics

Gas-liquid ratio: A high GLR generally lowers the efficiency of pump-assisted lift

Viscosity: Viscosities less than 10 cp are generally not a factor in selecting a lift method; high-viscosity fluids can cause difficulty, particularly in sucker rod pumping

Formation volume factor: Ratio of reservoir volume to surface volume determines how much total fluid must be lifted to achieve the desired surface production rate

Reservoir drive mechanism: *Depletion drive reservoirs*: Late-stage production may require pumping to produce low fluid volumes or injected water.

Water drive reservoirs : High water cuts may cause problems for lifting systems

Gas cap drive reservoirs : Increasing gas-liquid ratios may affect lift efficiency.

Selecting an Artificial Lift Method – Hole Characteristics

Well depth: The well depth dictates how much surface energy is needed to move fluids to surface, and may place limits on sucker rods and other equipment.

Completion type: Completion and perforation skin factors affect inflow performance.

Casing and tubing sizes: Small-diameter casing limits the production tubing size and constrains multiple options. Small-diameter tubing will limit production rates, but larger tubing may allow excessive fluid fallback.

Wellbore deviation: Highly deviated wells may limit applications of beam pumping or PCP systems because of drag, compressive forces and potential for rod and tubing wear.

Selecting an Artificial Lift Method – Surface Characteristics

Flow rates: Flow rates are governed by wellhead pressures and backpressures in surface production equipment (i.e., separators, chokes and flowlines).

Fluid contaminants: Paraffin or salt can increase the backpressure on a well.

Power sources: The availability of electricity or natural gas governs the type of artificial lift selected. Diesel, propane or other sources may also be considered.

Field location: In offshore fields, the availability of platform space and placement of directional wells are primary considerations. In onshore fields, such factors as noise limits, safety, environmental, pollution concerns, surface access and well spacing must be considered.

Selecting an Artificial Lift Method – Field Operating Characteristics

Long-range recovery plans: Field conditions may change over time.

Pressure maintenance operations: Water or gas injection may change the artificial lift requirements for a field.

Enhanced oil recovery projects: EOR processes may change fluid properties and require changes in the artificial lift system.

Field automation: If the surface control equipment will be electrically powered, an electrically powered artificial lift system should be considered.

Availability of operating and service personnel and support services: Some artificial lift systems are relatively low-maintenance; others require regular monitoring and adjustment. Servicing requirements (e.g., workover rig versus wireline unit) should be considered.

Q.4. What do you mean by continuous and intermittent gas lift?

Answer. There are two main types of gas lift:

Continuous gas lift, where gas is injected in a constant, uninterrupted stream. This lowers the overall density of the fluid column and reduces the hydrostatic component of the flowing bottomhole pressure. This method is generally applied to wells with high productivity indexes.

Intermittent gas lift, which is designed for lower-productivity wells. In this type of gas lift installation, a volume of formation fluid accumulates inside the production tubing. A high-pressure “slug” of gas is then injected below the liquid, physically displacing it to the surface. As soon as the fluid is produced, gas injection is interrupted, and the cycle of liquid accumulation-gas injection-liquid production is repeated.

Q.5. What do you understand by IPR?

Answer. Inflow Performance Relationship-A well never actually attains its absolute flow potential, because in order for it to flow, P_{wf} must exceed the backpressure that the producing fluid exerts on the formation as it moves through the production system. This backpressure or *bottomhole pressure* has the following components:

- Hydrostatic pressure of the producing fluid column
- Friction pressure caused by fluid movement through the tubing, wellhead and surface equipment
- Kinetic or potential losses due to diameter restrictions, pipe bends or elevation changes.

IPR vs. OPR

