Lifting methods are used to transport fluid from a point of highest pressure to the point of lowest pressure.

Are divided into:

**Natural lift**

The natural elevation usually occurs at the beginning of productive life of the reservoir.

**Artificial lift**

Does not occur by natural processes.
FACTORS THAT AFFECTS PRODUCTION BY NATURAL LIFT:

- Fluid properties
  - Viscosity
  - Density
- Productivity index of the well
- Skin factor
- Stimulation techniques
- Control of the pressure drop into the reservoir
- Are used wells low pressure
- Increase production

Main Techniques

- Gas-lift
  - continuous (GLC)
  - intermittent (GLI)
- Electric Submersible pump (ESP)
- Sucker rod pump
- Progressing Cavity Pumps
ARTIFICIAL LIFT METHODS

Selecting an Artificial Lift Method – Reservoir and well characteristics

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

**Viscosity:** High-viscosity fluids can cause difficulty

**Formation volume:** Reservoir volume determines how much total fluid must be lifted – Production Rate

**Well depth:** The well depth dictates how much surface energy is needed

**Well deviation:** Highly deviated wells may limit applications on some lift methods
ARTIFICIAL LIFT METHODS

1. Gas-lift

Principle
Injecting high pressure gas into the production column

Gasify oil

Reduces pressure gradient

Decrease the pressure in the production column

Increase flow
ARTIFICIAL LIFT METHODS

1. Gas-lift

**Continuous gas-lift**
- Continuous gas injection

**Intermittent Gas lift**
- Displacing liquid slugs with high-pressure injection gases by well-defined timings
  - Controlled by controlling the valve at the surface

---

Selection:
- **Yes**
- **No**

Diagram:
- Production vs. Injection of gas-lift
  - Tangente econômica
  - Produção económica vs. Caudal de Óleo
  - Produção Máxima
ARTIFICIAL LIFT METHODS

1. Gas-lift

Fonte: Adaptações de SILVA, 2002.
ARTIFICIAL LIFT METHODS

1. Gas-lift

Advantages:

• Can be used offshore and onshore
• High sand content
• High ratio gas/oil
• Lowcost for deep wells
• Deviated wellbores;
• Most commonly method used in the oil industry

Disadvantages:

• The gas can not be corrosive
• Low distance between the well and compressors
ARTIFICIAL LIFT METHODS

2. Electric submersible pump

Source: Adapted from SILVA, 2002
ARTIFICIAL LIFT METHODS

2. Electric submersible pump

Advantages:

- Low investment
- High flow
- High-temperature wells (above 180°C)
- High-angle and horizontal wellbores

Disadvantages:

- Does not applied for wells that produce sand;
- Low rate gas/oil
- It is not appropriate for wells that produce H₂S;
- Changing production rates requires either a pump change
ARTIFICIAL LIFT METHODS

3. Sucker rod pump

![Image of Sucker Rod Pump]

**FIG. 1** (PRIOR ART)

**FIG. 2** (PRIOR ART)
ARTIFICIAL LIFT METHODS

3. Sucker rod pump

Advantages:

- Low operating cost
- Used in well average production or low production to High depth

Disadvantages

- Can not be used:
  - Highly deviated wells;
  - Offshore
- Well low sand content
- Wells low gas content
- Low viscousity fluids
ARTIFICIAL LIFT METHODS

4. Progressive Cavity Pump

- BCP – Bombeio por Cavidade Progressiva
- Electric motor
- Rods
- Tubing
- Casing
- Rotor
- Camisa
- Estator
- Motor

Transformador
Caixa de redução
Quadro de comando
4. Progressive Cavity Pump

Advantages:

- High efficiency for
  - viscosity fluids
  - Abrasive fluids

Disadvantages:

- Well – low depth;
- Not recommended for
  - Deviated wells;
  - Wells produce Sand;
- Low temperatures
### Top artificial lift methods in Brazil

<table>
<thead>
<tr>
<th>ARTIFICIAL LIFT METHODS</th>
<th>NUMBER OF APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>238</td>
</tr>
<tr>
<td>Continuous Gas Lift</td>
<td>538</td>
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<tr>
<td>Intermittent Gas Lift</td>
<td>543</td>
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<tr>
<td>Sucker rod pump</td>
<td>5,849</td>
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<tr>
<td>Electric submersible pump - ESP</td>
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<tr>
<td>Progressive Cavity Pump</td>
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<tr>
<td>Others</td>
<td>130</td>
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<td>Total</td>
<td>8,474</td>
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</table>

Source: Adapted from PETROBRAS (2010)
Thank you for your attention

João Ribeiro