RECIROCATING ELECTRIC SUBMERSIBLE PUMP (RESP)

REVOLUTIONARY NEW FORM OF ARTIFICIAL LIFT

Linear Motor

Plunger Pump

Motor & Pump
At present beam pumping units (Pump jack) are the most common type of artificial lift system used worldwide accounting for about 90% of all installed artificial lift on oil wells. It has several drawbacks:

- **Obtrusiveness (Height)**
- **Leaking Stuffing Box**
- **Rod Wear**
- **Tubing Wear**
- **Gas-locking**
- **Inefficient if Not Balanced**

**OLD TECHNOLOGY**

The linear motor replaces the pumpjack and sucker rods to drive the reciprocating pump end to lift production to surface. The pump and linear motor are run on end of tubing with motor landed at or above perforations so that production cools motor. The power cable is directly connected to the linear motor and banded to tubing as in ESP installations. The controller energizes the motor only when travelling up or down and the motor is off between strokes which saves energy.

The frequency of the stroke is adjustable between 1.0 - 20.0 strokes/min. by changing the controller parameters. This can be monitored and controlled through SCADA system.

This has entirely changed the conventional reciprocating pump oil extraction method that has been used in the industry for over a century.

- **Installs on tubing**
- **Can be run in directional or horizontally completed wells**
- **Can Eliminate Gas Locking**
- **Lower Power Consumption**
- **1.0 - 20 Strokes Per Minute**
- **Rates Up to 1500bbls/day**
- **Motor Tested to Over 300 Degrees Celsius**
- **Up to 6500 PSI discharge pressure**
The product weighs 1 ton versus an average 30 tons of steel used in manufacturing a beam pumping installation.

At an annual production rate of 10,000 units, it can then save: 29 tons of steel/unit *10,000 unit/year = 290,000 tons of steel/year.

If calculated, producing 1.8 tons of Carbon Dioxide, per 1 ton of steel, it can achieve emission reductions of: 290,000 tons of steel/year *1.8 tons Carbon Dioxide = 522,000 tons Carbon Dioxide emissions/year.

**TYPICAL RESP SYSTEM APPLICATIONS**

- Replace Beam Pumping Units
- Deviated Wells
- Gassy Wells
- Gas Well Dewatering

**RESP SYSTEM ADVANTAGES**

- Low Profile
- No Leaks at Wellhead
- No Rod Wear
- No Tubing Wear
- Eliminates Gas-locking
- Improved Efficiencies
- Highly Variable Stroke Rate
- Easily Optimized

**ENVIRONMENTAL IMPACT**
CURRENT INSTALLATIONS

Hundreds of RESP units have been installed and are operating in Chinese oilfields. The first RESP was installed almost seven years ago, with longest run time being over three years and average maintenance free runtime is more than one year. PetroChina, China Petroleum and Chemical Corp (Sinopec), and China National Offshore Oil Corporation have all experienced success with this product.

RESP SIZING

<table>
<thead>
<tr>
<th>Motor and Pump Model</th>
<th>Motor Voltage</th>
<th>Rated Lift</th>
<th>Plunger Diameter</th>
<th>Rated Depth¹</th>
<th>Stroke Length</th>
<th>Pump Speed</th>
<th>Theoretical Displacement @100% eff.</th>
<th>Theoretical Displacement @80% eff.</th>
<th>Minimum Casing ID</th>
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Notes: Rated depth is based on lift, plunger size and fluid column pressure, assuming the s.g. is 1. Intake pressure, wellhead pressure and other factors are not included. These models have had their rated depth reduced to 15000 ft and are not limited by lift. These are limited by the barrel strength.

RESP ADVANTAGES

- **Minimal Surface Equipment**
- **Deviated Wells**
- **No Rod Wear**
- **No Tubing Wear**
- **Improved Efficiencies**
- **Tolerant to Corrosive Environments**
- **Compact, Easy to Handle/Ship**
- **Tolerant to Higher GOR’s**

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