SUSTAINABILITY ASPECTS OF PROGRESSIVE CAVITY PUMPS USED IN OIL PRODUCTION

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Abstract: Pump, sucker rod and tubing string wear is directly proportional to the number of revolutions, therefore the use of larger displacement pumps operated at lower speeds can significantly extend equipment life. In order to reach the scope of paper is to have analyzed provided well data, well condition and well construction and propose PC Pumping System to meet the applications production and lift requirements.

Keywords: analysis, pump, sustainability, methods, modeling, reliability

1. INTRODUCTION

One of the most important mining industry is the exploitation of deposits of hydrocarbon fluids through wells.

The use of these natural resources as a source of energy, fuel, petrochemical feedstocks or in the pharmaceutical industry has made a fluid hydrocarbon extraction industry of prime importance.

Labour productivity growth in the oil industry called centralized monitoring wells in the pumping operation, computer-aided data transmission to remote processes automation and control devices adaptation of stopping and starting of electric motors, test probes, detection and diagnosis of faults. Also in this area is remarkable development of complex computer programs for optimization of the choice of equipment and operation of facilities.

Oil and gas industry is characterized generally by conveying large amounts of fluids: oil and gas accompanied by salt water and sometimes hard particles (sand) which are extracted from the wells productive strata, then separated and stored installation surface. [12]. The material they are made of deep and surface equipment for extraction of oil wells are subjected to wear caused by fluids inside and outside the vehicle. Often these processes are produced with high intensity and leads to considerable difficulties such as:

• Premature wear and decommissioning of equipment before normal time;
• sudden interruption of processes that lead to loss of production due to accidents or technical, requiring large expenditures for remediation;
• breakage of tubular material (tubing, oil pipelines and salt water) that generates high production and investment losses supplimentare. [8]

The main difficulties that characterize the work of the probe are: abrasion, corrosion, paraffin deposition, gas, oil viscosity, scale deposition and the drill hole.

2. DESIGN FEATURES AND MANUFACTURING OF SCREW PUMPS (PCP)

As described in the previous section helical pumps consist of two parts: stator and rotor. The stator: it is made of steel in the form of a thick-walled tube within which is Vulcanized an elastomer which is performed helical grooves along its length with two or more
beginnings. Steel pipe can be treated by nitriding the probe when conditions require.

The elastomer of which is padded stator is usually made from a single piece. At the bottom stator is provided with a stop which serves to position the rotor in the stator (window pump) and not allow the rotor fall when loosening or breakage sensor gasket sucker rods. In practice great site helical pump manufacturers have tested a wide variety of elastomers. [5]. Most elastomers used are basic components composed of a number of acrylonitrile (ACN) in various concentrations to which is added a variety of additives and treatments in order to increase their performance characteristics.

The main components of elastomers manufactured in the world today contain low concentrations acrylonitrile, medium and high such as Buna N, High NITRILES (HN), Highly Saturated Hydrogenated NITRILES (HSN) and a few components based florr-Vitons.

These elastomers are limited by the specific gravity of oil (<0.825 = 8.093 N/dm3 kgf/dm3), temperature (< 175 °C), the concentration of CO2 (<15% in solution), as well as their compatibility with the chemical treatments used in some stimulation operations.

In Table 1.1, the types of elastomers and their characteristics used in the construction of corporate screw pumps Weatherford.

Table 1.1. Elastomer compatibility with the fluid extract.

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>ELASTOMERICS TYPE</th>
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<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Soft</td>
<td>NBRM 55 / NBRM 64</td>
</tr>
<tr>
<td>Medium</td>
<td>590-55 / 590</td>
</tr>
<tr>
<td>Mechanical properties</td>
<td>Excellent</td>
</tr>
<tr>
<td>Abrasion resistance</td>
<td>Very good</td>
</tr>
<tr>
<td>Aromatic resistance</td>
<td>Good</td>
</tr>
<tr>
<td>Resistance H₂S</td>
<td>Good</td>
</tr>
<tr>
<td>Water resistance</td>
<td>Very good</td>
</tr>
<tr>
<td>Temperature</td>
<td>95°C (203°F)</td>
</tr>
</tbody>
</table>

The best way to test elastomer which is practiced throughout the world is immersed in it in different samples and study the behavior of fluids.

Each manufacturer offers different elastomers that may have different reactions to the same site conditions. Most manufacturers use nitrile component in maintaining the main
To make a correct choice of the type of elastomer, screw pump manufacturing companies came to help its customers by providing them using the available samples of elastomers for use in oils that will work.

These samples are immersed in small containers of oils of application data (the probe to be equipped with screw pumps) for a certain period of time prescribed by the manufacturer. After this time, the samples are returned for analysis, and that the manufacturer recommends appropriate type of elastomer. Impeller is made of alloy steel, chrome plated stainless steel were hardness of 200-240 units Brinel.

From the experiments of the site obtained by the moment it was found that the choice of the best materials for construction pump impeller must take into account the fluid pH have been abrasive corrosive nature of the fluid from the well.

If the fluid has a pH between 5 and 8 can successfully use a stainless steel rotor hard chrome coated. On the other hand, if the pH is less than 5, should be used to rotors made of stainless steel. It should be borne in mind that in the case in which the use of stainless steel impeller characterized in that it is soft compared to alloy steels, to take into account the nature of the abrasive particles and the percentage of fluid in the fluid. In some cases more special characterized by abrasion and corrosive conditions of the rotors borates are used which can have a lifetime in the site 3 to 5 times the rotor plated for the same application.

However rotor chrome alloy steel, hard on the outside, has a lower cost price and offers a fairly good wear resistance. The rotor can be easy and inexpensive, and recromat dechromemat if the metal cover was damaged. Manufacturers of screw pump rotors available to beneficiaries in a stainless steel high Varita thickness of chromium.

Experience has shown that the thickness of the chrome size allowed increasing the lifetime of the rotor in abrasive and corrosive environments. Wear on chrome layer on the surface of the pump impeller leading to the sharp decline in operating efficiency of the pump.

A thickness of the chromium loss of only 0.10 mm of the surface of the rotor, decreased pump efficiency is insignificant and the rotor does not have recromat. A wear layer of chromium of between 0.16 mm and 0.20 mm from the surface of the rotor, leading in most cases to recromarea rotor which creates the possibility to increase the service life in most applications.

Due to its construction, the pump can convey oil containing suspended solids as a particle driven by spiral rotor is pressed it more rounded stator surface which synthetic rubber is deformed and clog, making sealing and wear by avoiding abrasion of the rotor.
After remoteness rotor stator, the area where sand particles interposed, it falls under its own weight into the lower cavity. How to make the seal rotor - stator and sand particle retention is illustrated in Fig. 1.

3. PROBLEMS ENCOUNTERED IN PUMPING HELICAL

The presence of free gas at pump suction directly affects its efficiency by reducing the volume of fluid pumped through the pump. [9,10]

Spiral pump can pump the fluid in limited quantities of product gas is taken to the surface, thus overcoming the friction pressure loss.

The lack of adequate amounts of fluid gives rise to conditions of "dry run", which results in burning of the surface of the elastomer and the occurrence of cracks, cracks, etc..

In Figure 2 is shown that one can suffer wear elastomer under "dry run".
Sand probe

The presence of solid particles in the fluid pump products reduce the battery usage and efficiency of the pump coil.

The rotation of the rotor inside the stator rough and smooth soft and elastic leads to a very good tolerance to pump sand and abrasive particles. Solids are suspended in cavities and forward through the pump once the fluid displaced. Any particle of sand trapped between the rotor and stator is pressed within elastic elastomer without damaging the pump. Figure 3 are the wear on careo data may suffer rotor abrasion conditions.

![Image: Rotor wear due to abrasion](image_url)

Fig.3 Rotor wear due to abrasion

Because elastic stator-rotor torque are cleared of any problems related to seizure and excessive wear, given the presence of sand in the fluid.

As you increase the solids content (sand) to increase proportionally fluid friction between the rotor and stator and the impeller so when necessary.

During initial operation much more wear occurs in the probe due to its high content of sand of up to 70% compared with probes which are operated for over a year in which the sand is stabilized at a concentration of 5% or less.

The sand can cause many problems such as:
- Accelerate equipment wear;
- sucker rods increase torque and energy consumption;
- restricting flow at pump suction pump and tubing.

Deviation probe

Deviated wells are vertical Started with a growth sector followed by a sector angle of tangent intersecting vertical tank with a depth projected.

Design parameters include depth inflection point, the intensity of increasing inclination (0/30 m) target coordinates and the maximum curvature.

Probes inclined angles are switched between 150 and 450 on the surface and are drilled straight at the target, although some probes include a small section of increasing inclination to get displacements larger than allow the angle was opened.

An important issue that occurs during pump operation is winding pipes of pumping friction tubing direct contact between them. This friction occurs because the probe is not perfectly vertical with some almost vertical trajectory.
Because of friction sucker rods seal the tubing appears to wear them and tubing. Rubbing sucker rods generally occurs in their sockets. Places that have the greatest wear correspond to sudden changes of inclination of the wellbore. Reversals of curvature (slope changes wellbore profile from positive to negative values of angle) are associated with strong rod and tubing wear regardless of their position both deflected and inclined wells. In Figure 4 is presented again by friction wear-tubing plug.

4. CONCLUSIONS

For proper operation of pumping equipment helical pump is recommended to use the following procedures:

The optimum speed of the pump have to be rigorously determined by the production capacity of the well. Most of the times, the literature recommends choosing the optimum speed of the pump operation does not exceed half the maximum speed. This is confirmed by rotating machines that wear is proportional to 1/3 of the power input to achieve this speed.

It is best to avoid frequent starts especially in sandy wells difficulties. Tendency for sand driving if system shutdown at its settling above and restart the pump rotor torque occurrence of excessively high.

If the formation fluid has a high content of sand, it is necessary to prevent the operation of the pump on the depth of the top of the velocity field. For highly abrasive fluids will consult manufacturers for such equipment. Do not start the machine again without fluid in the pump probe. Usually it is good to follow for such pumps a minimum of approximately 90 m submergency.
A dominant feature of helical pumps that should never be skipped when using this extraction system, is the compatibility of the materials used in the construction of wells pump circulating fluids. Work are presented in a series of articles comprising the helical pumps and indicate the type of application they can be used.

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