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RESEARCH OF PROBLEMS AND PROSPECTS OF OPERATION OF ROD PUMPS

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Abstract

This article shows the current state of downhole rod pumping units. The main ways of reducing the costs of maintenance, selection and purchase of oil-producing deep pumps are substantiated. One of the most effective methods of increasing the service life of pumps is to increase their wear resistance. It is established that the main direction for increasing the pump life is the modeling of its design solutions.

Key words: Rod borehole deepwater pumps, reliability, wear, service life.

ШТАНГАЛЫҚ ТЕРЕҢДІК СОРҒЫЛАРЫНЫҢ ПРОБЛЕМАЛАРЫ МЕН ЖҰМЫС ПЕРСПЕКТИВАЛАРЫН ЗЕРТТЕУ

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Андатпа

Бұл мақалада штангалық ұңғыма сорғы қондырғыларының қазіргі жағдайы көрсетілген. Мұнай өндіретін тереңдік сорғыларына қызмет көрсету, іріктеу және сатып алу шығындарын азайтудың негізгі жолдары негізделген. Сорғылардың қызмет ету мерзімін ұзартудың ең тиімді әдістерінің бірі-олардың тозуға төзімділігін арттыру. Сорғы ресурсын арттырудың негізгі бағыты оның құрылымдық шешімдерін модельдеу болып табылады.

Түйінді сөздер: Штангалық ұңғымалық тереңдік сорғылары, сенімділігі, тозуы, жұмыс ресурсы.

ИССЛЕДОВАНИЕ ПРОБЛЕМ И ПЕРСПЕКТИВЫ ЭКСПЛУАТАЦИИ ШТАНГОВЫХ ГЛУБИННЫХ НАСОСОВ

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Аннотация

В настоящей статье показано современное состояние штанговых скважинных насосных установок. Обоснованы основные пути сокращения расходов на обслуживание, подбор и приобретение нефтедобывающих глубинных насосов. Одним из самых эффективных методов увеличения срока службы насосов является повышение их износостойкости. Установлено, что основное направление на повышение ресурса насоса является моделирование его конструктивных решений.

Ключевые слова: Штанговые скважинные глубинные насосы, надежность, износ, ресурс работы.

Introduction

The oil industry is one of the main spheres of Kazakhstan's economy. Oil-producing pumps are successfully used all over the world for the extraction of heavy and light oil, methane from coal seams, as well as pumping viscous, abrasive liquids. Strict requirements are imposed on oil-producing pumps, since increasing the efficiency of pumps affects the reduction of the cost of oil produced, however, there is a problem of a low level of reliability of producing pumps [2].

The decrease in the reliability of submersible equipment is caused by such factors as the content of free gas at their reception, salt deposition, an increase in the temperature of the pumped liquid and components of the submersible equipment, removal of mechanical impurities, the presence of asphalt-resin-paraffin deposits in pumping pipes and on pumping rods, significant curvature of the wellbore, high-viscosity emulsions and high-viscosity oils.

The main direction in the protection of metal materials from erosion is the development of special coatings. In particular, metallization in the form of application of an anticorrosive alloy to the workpiece ensures the chemical and mechanical properties of the surface. Also, an increase in the wear resistance of pumps is provided by gas thermal spraying.

Oil pumps are technically complex units designed to operate in the most severe operating conditions. A reasonable choice of the type of oil pump and compliance with operating requirements can ensure reliable operation of this equipment.

The main problems that arise during the operation of pumping equipment:

1. Corrosion and erosion of pump elements having direct contact with the pumped medium. The most serious damage was observed on the working surfaces of pumping and compression pipes and valve mechanisms, bearings and pump housings as the most loaded elements of the equipment. The influence of aggressive media led to a decrease in the thickness of the walls and deterioration of the parameters of the entire unit;
2. Cavitation processes cause shock and vibration loads during the operation of pumps, reducing the service life of bearings, increasing the wear of structural elements, reducing the thickness of the walls of the housing;
3. The presence of solid inclusions in the pumped medium leads to abrasive wear of the interfaces in the flow part, reducing the service life of the pump;
4. Operation of pumping units in underloaded (0.5...0.7 Qopt) and non-rated modes (below 0.5 Qopt). As a result, the vibrodynamic characteristics of centrifugal pumps deteriorate significantly and, accordingly, their performance decreased;
5. The operation of the pump at non-optimal modes led to uneven heating of the shaft and the walls of the housing due to different expansion coefficients of the materials used and methods of fastening the equipment, which led to a decrease in the normalized gaps in the pump and an increase in loads on it [3].

Preventing sand from entering the pump can be done by using filters installed at the pump intake. Sand separation at the pump reception is carried out using special protective devices (sand separators), the operation of which is based on gravitational and inertial principles. Rod pumps are one of the types of industrial installations widely used in the field of oil production. The manufacture of such pumps is regulated according to GOST R 51896-2002 [1].

Rod pumps for oil production are a complex of devices consisting of underground and aboveground installations. Rod pumps (SHGN) – such devices are used for high-viscosity media in oil production and refining enterprises. The design of the rod pump includes a wellhead oil seal, a rotary column and a surface drive (fig. 1).

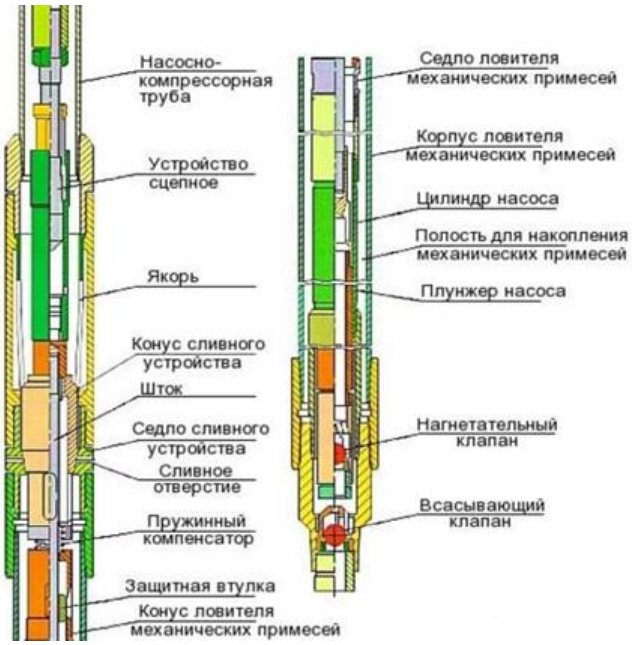

Figure 1. Rod pump design

Units of this type are characterized by high performance, efficiency, reliability and a fairly high cost. SHGS are designed for pumping liquids from wells with a temperature of no more than 130 degrees, a water content of no more than 99% by volume, a viscosity of up to 0.3 Pa·c, a content of mechanical impurities up to 350 mg/l, free gas at reception of no more than 25% [4].

The rod pump consists of a single fixed cylinder, a movable plunger, suction and discharge valves, a lock (for plug-in pumps), connecting and mounting parts. The main components of the downhole rod pump (SSH) are a cylinder and a plunger with suction and discharge valves installed in them, respectively. The reliable operation of the entire SSHN installation depends on the reliable operation of these nodes.

One of the main causes of valve wear is abrasiveness caused by the presence of sand in the extracted liquid. This liquid flows at a considerable speed through the annular space between the ball and the seat, causing metal corrosion. The wear rate of the plunger cylinder pair is affected by the concentration of mechanical impurities and their fractional composition. As practice shows, the inter-repair period of wells with installations of rod borehole pumps (SHSN) strongly depends on the correctness of the choice of plant designs and their operating mode [5].

The variety of methods of equipment selection and operating mode allow solving issues of improving the efficiency of well operation with varying degrees. Significant complications during the operation of wells (including deformation of the column of rods and tubing) place special requirements on the design of pumping equipment.

Factors that reduce the performance of the rod pump: free gas entering the cylinder, the presence of harmful space, loss of stroke from stretching and compression of the columns of rods and tubing, fluid leakage through the discharge valve and through the contact of the cylinder and plunger, fluid shrinkage [6, 7].

During the extraction of reservoir fluids containing mechanical impurities, abrasive wear of these units occurs, which leads to a decrease in the filling coefficient of the SRS and a

decrease in the efficiency of the entire installation, which in turn requires repair of downhole equipment and large material costs. The following methods can be proposed to reduce equipment wear: the use of a special tread for tubing in wells with corrosion–active reservoir products, the use of a bottom-hole cleaning device, the use of hinged rod joints, the use of additional centering couplings on the rod column, the use of rod guides made of less wear-resistant material than tubing metal, carbide spraying on the surface of the couplings. [8]

One of the important technical tasks with an increase in the inter-repair period of the USGN is the fight against asphalt-resin-paraffin deposits (ASF). The practice of oil production in the fields shows that the main areas of accumulation of ASF are borehole pumps, pumping compressor pipes (HKT), discharge lines from wells, reservoirs of field assembly points. The most intense ASPs are deposited on the inner surface of the HKT. In the discharge lines, their formation increases in winter, when the air temperature becomes significantly lower than the temperature of the borehole fluid. With an increase in the speed of oil movement, the intensity of deposits initially increases, which is explained by an increase in turbulence of the flow and, consequently, an increase in the frequency of formation and separation of bubbles from the surface of the pipe, floating suspended particles of paraffin and asphalt-resin substances. One of the solutions to the presented problem is the development of an optimal composition of inhibitors that reduces the process of formation of asphalt-resin paraffin deposits.

Conclusion

Since the number of high-flow wells is rapidly falling, it is important to use rod pumps that work well in medium and low-flow wells. The dynamics of the initial values of the characteristics of the SSNU decrease as the equipment wears out and the operating conditions change. The main ways of reducing the costs of maintenance, selection and purchase of oil-producing deep pumps are substantiated. One of the most effective methods of increasing the service life of pumps is to increase their wear resistance. It is established that the main direction for increasing the pump life is the modeling of its design solutions. Consequently, there is a growing need for constant search for solutions to improve the rod pump, which will increase the service life, productivity and the repair period of the pump in complicated operating conditions.

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