

Research Article

Submersible Screw Pumps In Oil Industry

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Abstract The process of extracting oil and gas resources, processing them and delivering them to the final target represents a vital process in oil industry. It depends on many factors among which a set of pumps and associated equipment. In this study, an analysis of oil well production extracted from the earth's interior to the surface is performed. Oil pumps used for lifting oil products from wells are investigated. The advantages of an oil two-rotor submersible pump over centrifugal and sucker rod pumps are noted.

Introduction

Oil production extracted from oil reservoirs to the surface can be either in the form of a gas-oil mixture, or in the form of a gas-oil mixture with a gas-oil ratio varying in a wide range. It can be also in the form of water cut oil with a water content in oil up to 50% or more, and in the form of high-viscosity oil.

The main goal of oil field development is economically feasible and the most complete recovery of oil and other valuable components from oil reservoirs. Of the many tasks in the development of oil fields, the most significant are the lifting of high-viscosity, high-water-cut and highly gas-saturated oils from an oil well to the surface, as well as preparation of the produced well products to meet the quality requirements of commercial oil and petroleum gas.

One of the most important characteristics of crude oil is its viscosity. Oil products can contain a large amount of oil gas, and with a certain increase in the saturation pressure, an increase in the viscosity of the liquid occurs. When water is mixed with high-viscosity oil, even more viscous emulsions of the "water in oil" type are formed. To prevent the formation of high-viscosity oil-water emulsions, it is necessary to separate oil-water mixtures into oil and water [1 , 2 , 3].

It is impossible to solve the problem of well production preparation with minimal costs, which exists due to the remoteness of oil fields from head structures and Central collection points, without using highly efficient oil equipment. Such equipment should provide effective destruction of water-oil emulsions in turbulent and low-turbulence modes, oil degassing, separation of the flow into water and hydrocarbon phases, oil purification from water, as well as partial neutralization of hydrogen sulphide during the joint collection of crude oils of Devonian and carboniferous horizons. This is achieved by selecting the supply type of supply of demulsifiers to the oil gathering system for the preliminary destruction of the armor shells on the formation water globules and their enlargement, reducing the viscosity of emulsions and removing the backpressure in pipes, destruction and enlargement of fine particles of emulsions in linear and sectional droplets of oil treatment units [4 , 5].

All of the above is a consequence of the influence of the method of production and exploitation on the degree of oil emulsification and the quality of the emulsions formed. Gas-containing emulsions that are most resistant to spontaneous separation are obtained from wells equipped with centrifugal electric pumps. When sucker rod and screw pumps are used in the same range of water content, less stable emulsions are formed. The spontaneous decomposition of such emulsions into oil and water occurs in a shorter period of time, since these pumps have less dispersing effect. Therefore, the casing of the well (below the intake of the deep pump) does not contain fine emulsions, which is confirmed by the withdrawal of liquid from the lifting strings of the well [6 , 7].

Emulsions with water content from 35 to 75% are of particular interest. In this range of water content, the time spontaneous separation of emulsions significantly increases in wells equipped with ESP and slightly less in well with sucker rod pumps. Screw pumps do not increase the time required for separation of the emulsion. For oil production, these pumps appeared in the 30s of the twentieth century in France. Today they are actively used in Canada, Kazakhstan and China. In general, in the global oil industry, the use of screw pumping units is 8% [8 , 9].

Sucker rod pumps are widely used by oil companies in Tatarstan. For example, in Tatneft -33%, in Idel oil -21%, in Sheshma oil -18%, in Tatekh -12%. The scope of application of screw pump units with submersible drive in Tatneft is very small - 45 wells (about 0.2% of the current Fund of 216 producing wells). Mainly imported screw pumping units from KUDU (Canada), NETZSCH (Germany), Weatherford (USA), and Schoeller-Bleckmann (Austria) are used in the fields.

Among the presented screw pumping units, these are mainly single-screw pumps. The main elements of a screw pump are the stator and rotor-a movable internal part, which is a single-pass helicoid (for a single-pass pump), formed as a simple screw surface. The rotor rotates from a submersible motor and by means of a sucker rod string from a surface motor.

The main disadvantage of pumps with a single-pass rotor is the need to extend the working bodies to ensure high pressure, especially at a reduced speed, which imposes additional requirements and complicates the manufacturing technology.

The most promising direction is the use of pump-compressor units, namely, twin-screw pump compressors capable of pumping oil-and-gas mixtures [10 , 11]. Twin-screw pumps contain two metal screws located in a common casing with a parallel position of the screw axes, and are positive displacement pumps.

The two-rotor submersible oil pump-compressor of the NDPN type developed in Tatneft is intended for oil production from low-pressure well. The compressor pump is used as part of installations for pumping reservoir fluid from oil wells.

A distinctive feature in comparison with the known submersible pumps, the NDPN is more technologically advanced in manufacturing; it is characterized by small dimensions in length, reliability in operation, and lower power consumption at the same feeds and pressures of the pumped oil.

The most effective application of NDPN is observed in the production of extra-viscous oil, characterized by high emulsion stability.

The technical characteristics of one-two and three-screw pumps of type 1B, 2BB and 3B as well as the NDPN pump are shown in Table-1, [12].

Table1: Specifications and requirements

№	Characteristic	Pump type						
		2B1.5/5	1B10/5	2BB 1,6/16	BB 4/4	BB /25	3BB 1.5/100	NDP-20/6
1	Oil flow rate. m ³ / h	1,6	10,0	1,6	4,0	0,2	1,5	1,25
2	Outlet pressure. MPa	0,16	0,5	0,4	0,4	1,0	10	18
3	Viscosity of the pumped liquid, cSt	46·10 ³	20-300	60	37,0	610-2260	38-90	1.0Pa . s
4	Support , m	0,5÷2,5	-	7,0	7,0	-	-	-
5	Power. kW. not more	1,0	6,1	1,35	1,6	0,5	8,0	20
6	Coefficient of performance,%	34	56	20	37	40	40	10
7	Efficiency m ³ / h kW	1,6	1,6	1,2	2,5	0,4	0,2	0,06

Conclusions

Installation with twin-rotor screw pump-compressors are efficient means of operation for both vertical and directional wells with submersible electric.

This installation unit also effective in water-cut wells (with a water cut of 30 ÷ 80%) with high viscosity products tend to form highly viscous stable oil-water emulsions. Moreover, it is quite effective when applied thermal methods of increasing oil recovery and in low-pressure wells.

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