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NEW TECHNOLOGY AND ENGINEERING FOR WELL DRILLING WITH THE USING HYDRO-ACOUSTIC DEVICE

1. INTRODUCTION

The main problem for oil-extractors, working in old deposits and with low formation pressure, and also where high-viscous oil is extracted, is irreversible pollution of a productive formation during its primary unsealing with drilling. The high-quality and pure unsealing of the productive oil horizon is the most responsible stage of well construction. On cleanliness and quality of unsealing depends the level of primary debit, the duration of effective well operation and factor of oil extraction during deposit development completely. The specialized brigades in many foreign oil-extracting companies are engaged in a productive formation unsealing. The ways of unsealing and well completion using on the present are not perfect in technical and technological trends and do not provide optimum factor of formation efficiency and oil-extracting. Therefore, there is a worldwide effort to develop new technique and technologies in that area. Article is devoted to use of hydro-acoustic device for needs of a petroleum industry [2, 3].

2. THE PROBLEM REASONS DURING PRIMARY FORMATION UNSEALING

The main factor of oil inflow deterioration:

- a firm small-dispersant phase of a chisel liquid and drilled rock, clay globules, crystals of weighting compounds, polymers penetrate simultaneously with a filtrate in pores and collector cracks;
- filtrate penetration depth multiply exceeds depth of punched channels;
- discrepancy of physical and chemical structure and reological parameters of chisel liquid.

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The following reason of oil inflow reduction:

– the natural intense condition with deformation changes and occurrence of the shift pressure sometimes exceeding rock strength is broken, especially at anisotropy of rocks with various values of the elasticity module, strength and factor of volumetric expansion;
– anisotropism results to asymmetrical deformation pressure in near-well space, in zones of pressure concentration, in cracks and cavities;
– a deformation anisotropism of porosity and permeability.

3. HYDRO-ACOUSTIC ENGINEERING AND TECHNOLOGY FOR DRILLING AND UNSEALING OF PRODUCTIVE HORIZON

The hydroacoustic technology has been developed for the generation of high-power underwater sound for communication and echo location, and for such industrial uses as high-frequency, rotary-percussion rock drilling and pile driving [1].

The search for new methods of well performance increasing throughout the recent years have brought round untraditional technology. To solve this problems experts of Joint--Stock Company "Tatnefteprom" and Oil-Processing Firm "Timurneftegas" jointly develop hydro-acoustic engineering and technology for drilling and unsealing of productive horizon of a well and in 2006 the patent for the given invention is received. It includes a chisel with the hydro-acoustic generator and depression device [4, 5].

3.1. Field of application of hydro-acoustic device

The hydro-acoustic device with drilling tool can be used in following cases:

– in proces of rotary way of drilling, by bottom engines, including electro-drills for the inclined-directed and horizontal drilling in chisel diameter from 124 mm and higher (hydro-acoustic device for the inclined-directed and horizontal drilling by chisel diameter 149, 190 and 215.9 mm is shown in Fig. 1),

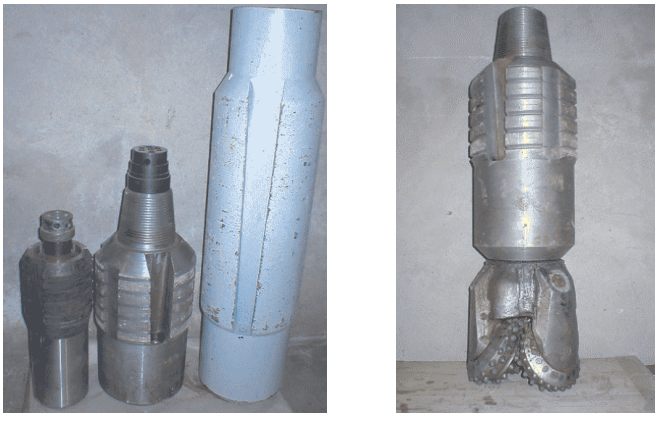

Fig. 1. Hydro-acoustic device for the inclined-directed and horizontal drilling by chisel diameter 149, 190 and 215.9 mm [4]

– with drilling mud density 900–2200 kg·m^{-3},
– with chisel outside diameter from 125 mm and higher,
– rock permeability 0.001–2.0 square micrometres,
– absorption intensity in drilling proces up to 30 cubic meter per hour,
– various types collectors, hydrosulphide content.

The basic parameters hydro-acoustic device is shown in Table 1.

Table 1

The basic parameters hydro-acoustic device [4]

Hydro–acoustic wave freguency	0.2–16 kHz
Pressure amplitude	1.5–6.0 MPa
Drilling mud consumption	0.015–0.035 m^3·sec^{-1}
Loss of pressure in generator	3.0–6.0 MPa
Amount of radiation	0.5–18.0 W·cm^{-2}
Dimensions:	
Diameter	120–295 mm
Height	350–800 mm
Weight	20–150 kg

3.2. Technology analysis

Experience of drilling and application of this technology in various deposits and regions have shown the following positive results:

– destruction efficiency of rock raises and drilling speed increases from 30% up to 80%.
– service life of a chisel in a well raises and passing-over on a chisel increases from 40% up to 70%.
– diametrical deterioration of a chisel, especially of gauged elements is essentially reduced.
– during the drilling the chisel solution is exposed to hydro-acoustic processing, homogenized and its reological qualities also raises.
– the thin filter around of the well wall is created and penetration of chisel and cement solutions is prevented in both productive and water formation and their pollution (the collector cleanliness is provided). (Speed conversion of filtration (colmatage) with time by using static condition , dynamic condition and hydro-acoustic action is shown in Figure 2. Hydro-acoustic action accelerate the creation of filter around of the well wall from 100 and more times).
– small (up to 20 m^3/hour) absorption in drilling process is prevented.
– formation of over-gouged omentums, landslides seizing at drilling of unstable rocks is prevented, quality of the well trunk (wall) also raises.
– terms of well development are reduced in 1.5 times in comparison with normative term,
– the most important is the debit of drilled wells with given technologies application in 1.5–2 times exceeds well debit, drilled on usual technology [4, 5].

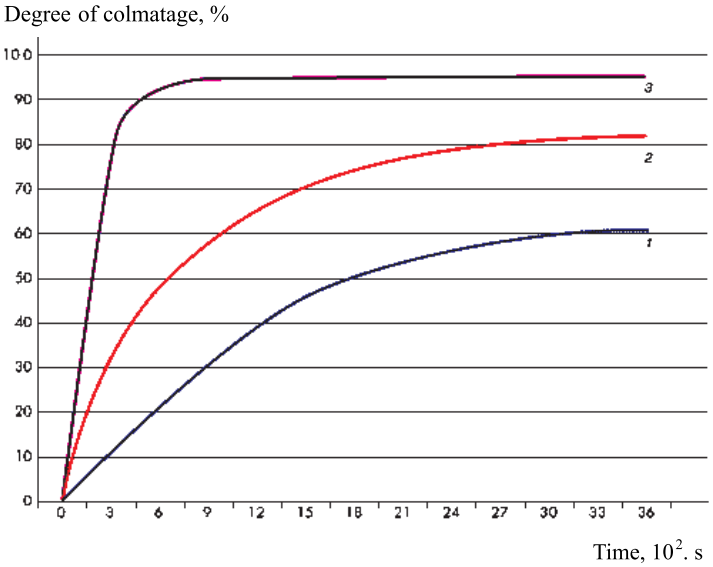

Fig. 2. Speed conversion of filtration (colmatage) with time by using static condition (1), dynamic condition (2) and hydro-acoustic action (3). Permeability of sandstone K_o = 0.13...0.2 square micrometres, P_{st} = 0.5 MPa [4]

Princip of work of the generator and of the hydro-acoustical device for well performance increasing and for exertion the depression of a formation and stimulation oil inflow is shown in Figures 3 and 4. Well drilling device using hydro-acoustical waves is shown in Figure 5.

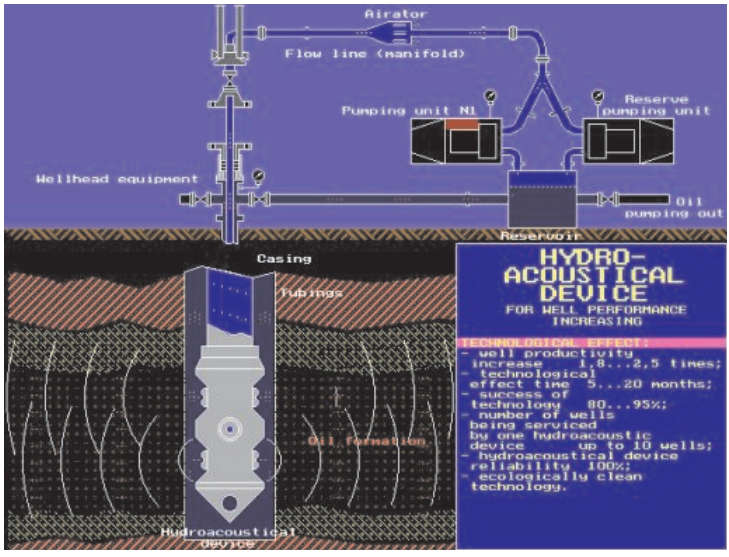

Fig. 3. Hydro-acoustical device for well performance increasing [5]

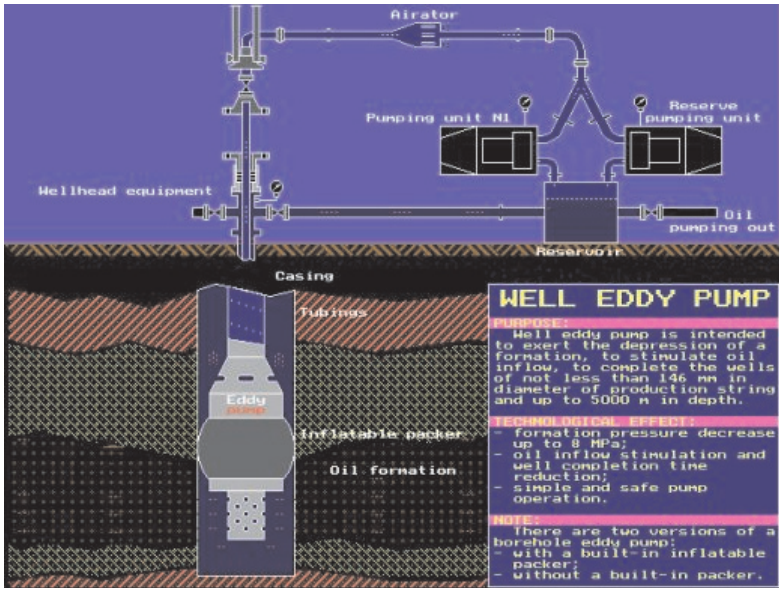

Fig. 4. Well eddy pump for exertion the depression of a formation and stimulation oil inflow. (There are two versions of a borehole eddy pump: with a built-in inflatable packer, without a built-in packer) [5]

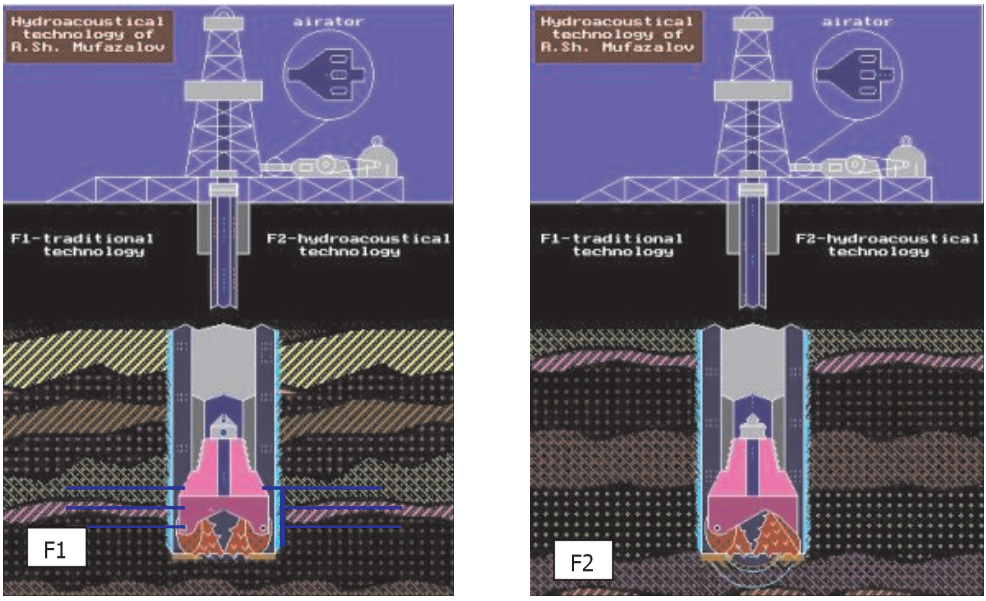

Fig. 5. Well drilling device using hydro-acoustical waves. F1 – traditional technology, F2 – hydroacoustical technology [5]

REFERENCES

[1] Bouyoucos J.V.: *Hydroacoustic Transduction.* The Journal of the Acoustical Society of America. July 1973, Vol. 54, Issue 1, 304–305 http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JASMAN000054000001000304000003&idtype=cvips&gifs=yes

[2] Khmelev V.N., Barsukov R.V., Tsyganok S.N., Khmelev S.S.: *Ultrasonic Hydroacoustic Complex for Increase Production Rate Oil Wells.* Electron Devices and Materials, 2007. EDM apos;07. 8th Siberian Russian Workshop and Tutorial on Volume, Issue , June 1 2007–July 5 2007, 327–329

[3] Mubarakshin G.K.: *New technology for well drilling and primary drill-in of the productive horizon.* 2006. http://www.tatnefteprom.ru/techen/

[4] Zaripov R., Mufazalov R., Klimova L.: *Gidroakusticheskaya texnologiya dlya bureniya skvazhiny i pervichnogo vskrytiya produktivnogo gorizonta.* Juny, 2006

[5] http://www.oilcapital.ru/technologies/2006/08/071152_95481.shtml

[6] http://www.tatnefteprom.ru/tech/princip/