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SELECTIVE WELL COMPLETION

Summary. Well completion is a significant and economically important stage preceding the handing over of a drill hole into the exploitation process which begins with opening of a productive horizon by means of drilling and finishes with pumping test. Drilling and logging practice proves that the quality of this stage influences the achievement by the probe of the potential oil, gas and gas condensate inlets and the functional safety and effective life thereof [1,2,3].

SELEKTYWNE WYPOSAŻANIE ODWIERTU

Streszczenie. Wyposażanie odwiertu jest istotnym ekonomicznie etapem poprzedzającym włączanie otworu do eksploatacji. Praktyka wierceń i karotażu dowodzi, iż jakość działań na tym właśnie etapie wpływa na wydajność, bezpieczeństwo i długotrwałość eksploatacji węglowodorów [1,2,3].

1. Introduction

Many technologies of selective well completion were developed worldwide to improve the quality of well completion in the reservoirs with more productive horizons.

The Russian oil company RITEK - «РИТЭК» elaborated and realized an innovative project focussed on the improvement of the quality of well completion in the deposits with more productive horizons [6, 7].

The shifter modules are being shouldered in the process of casing string cementing in the productive horizon zone, which are controlled by special equipment. Use of this equipment gives the technologist the possibility to open or close any of the modules in real time and to

secure this way the integration of both well and horizon into a unique mining system or separate them.

The sets of equipments of selective well completion, the number of which depends on the number of planned productive horizons to be added to the existing exploitation, are runned-in within the exploitation string set.

2. Possibilities of the equipments of selective well completion - ESWC

The main advantage of this equipment is the ability thereof to safely insulate:

- each porous layer from the contact with cementation paste during cementation,
- productive horizons from each other,
- productive horizons from water horizons.

The separation of productive horizons from water horizons is achieved by settling in upper and lower part of each productive horizon of filling packers, equipped with bypass junctions thanks to which the cementing paste from casing string cementation passes by the layer. In addition to insulation such solution eliminates the negative influence of pressure on the layer in cementing process.

ESWC is made up by shifter valves securing either integration or separation of exploitation string and the layer. The placing of shifter valves close to the upper and lower packer provides the possibility of washing of layer surface close to the probe wall from drilling fluid and the possibility of treatment by chemicals not only of the layer surface, but also of the layer as such.

The industrial tests have shown that in many cases it enables to provoke the inflow also from other objects that seemed not to function in the case of use of traditional technologies of well completion.

Equipment of each productive layer in the well by these equipments enables to carry out many important operations in the well without plugging, overrun, extension and perforation, such as: testing, treatment, exploitation, selective overlay, control of the individual stretches of a big height layer which are divided by filling packers. upper and lower filling packer, exploitation shifters, control and washing shifters, lining sections (spacer elements), control of shifter valves.

3. Composition and purpose of basic parts of ESWC

An ESWC set can consist of the following modules (Fig. 1):

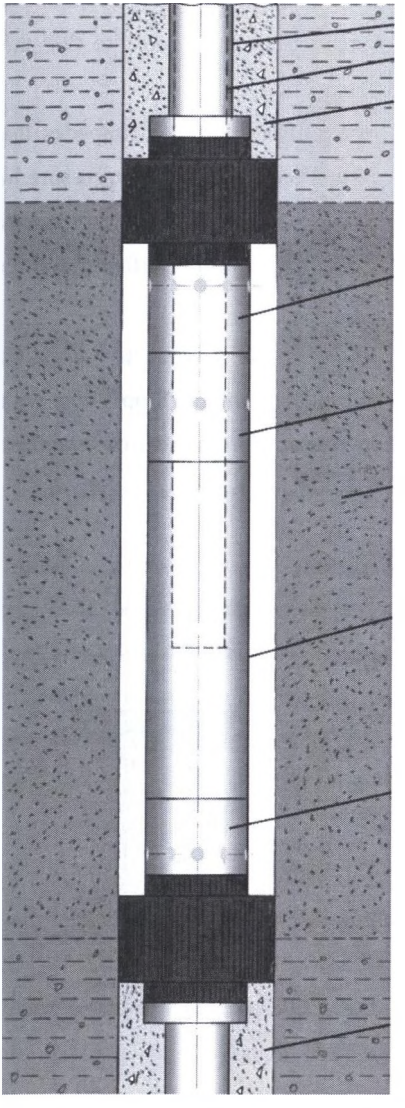

Fig. 1. Equipment of the selective well completion [8]
Rys. 1. Elementy selektywnego wyposażenia otworu [8]

Modules of upper and lower filling packers (Fig. 2) insulate the productive horizon from cementation paste in the process of casing string cementing.

The rubber jacket of the packer is filled with a liquid after the settlement of the whole ESWC complex in the well by means of cutting of compound plugs by a valve – plug (Fig. 3)

produced from drilling material. After having cut the plug, the stop valve is stopped on the ring – stop. The filling of rubber jacked of packer module with liquid takes place under the pressure in the range from 8,5 – 9,0 MPa during 15 – 20 minutes.

At the pressure of 12,0 MPa the plug is cut also in the annulus and the circulation is renewed through ESWC bypasses. The circulation and pressure increase indicate that the filling packers are in the working state and well is ready for cementing.

When the repletion pressure is reached of 8 MPa, the shifter equipment impedes the cementation paste penetration into the rubber jacked. Nevertheless, change of the pressure in the string does not change the pressure under rubber jacked. The cementing paste proceeds through bypass space form the well face to well mouth. Each module of shifter valves is located in a certain location.

Exploitation shifter module (Fig. 4) is located in the location of a productive horizon, recommended by the oil company geological service. The module contains 8 openings with the diameter of 18 mm and is equipped with the filtration element, produced from stainless steel wire with mesh size of 0,2 mm.

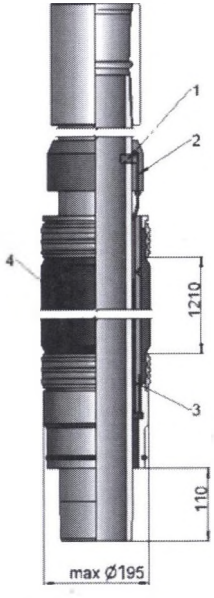

Fig. 2. Module of upper and lower filling packer [8]
Rys. 2. Moduł górnego i dolnego pakera [8]

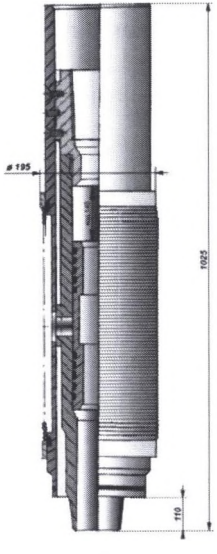

Fig. 3. Cutting element [8]
Rys. 3. Element tnący [8]

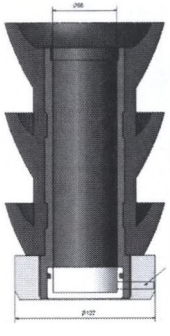

Fig. 4. Exploitation shifter module with filter [8]
Rys. 4. Moduł eksploatacyjny z filtrem [8]

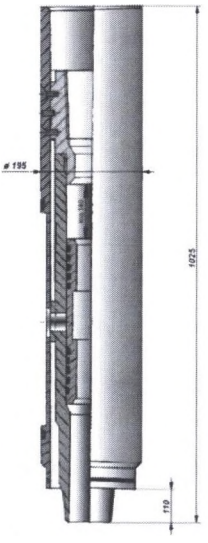

Fig. 5. Washing shifter module [8]
Rys. 5. Moduł płuczkowy [8]

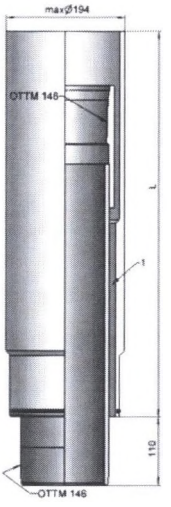

Fig. 6. Module of lining sections [8]
Rys. 6. Moduł uszczelniający [8]

Control and washing shifter modules (Fig. 5) are located in the lower and upper productive horizon periphery. Module has 8 openings with the diameter of 18 mm.

After the opening of washing module shifters and closing of exploitation module shifters and settlement of the packer it is possible to realize the whole range of technological operations to increase the layer efficiency (i.e. sand sluicing, acidizing, increase of exploitability, etc.).

Modules of lining sections (Fig.6) are designed for precise settlement of shifter modules in the well. The researches indicated that various lengths of modules enables precise to settle the packer, exploitation and washing modules in the productive horizon. Five dimensions of lining sections are used - 500 mm, 1000 mm, 1500 mm, 3000 mm and 6000 mm.

The Fig.7 shows 3 types **of control by shifter valves modules**.

In the module of shifter control of 1st type (Fig. 7a), its cams get into working state at the pressure of 2 MPa. When the shifter is either opened or closed and the pressure is increased up to 8 MPa, the cams are set into the transport position.

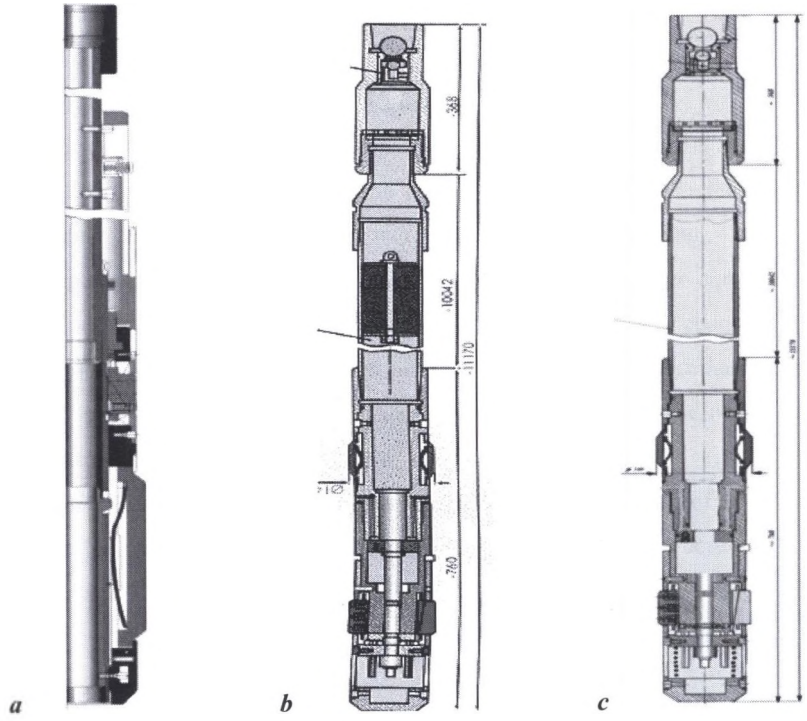

Fig. 7. Modules of control of shifter valves: a, b – dynamic, c – mechanical [8]
Rys. 7. Moduł napędowy: a, b – dynamiczny, c – mechaniczny [8]

Initiation of the cams into their working status in the module of control of direct actuation shifters (Fig. 7b) is realized, when a pressure of 4 MPa is introduced onto its piston. By pressure reduction, the spring node of the module returns the cams into the transport position.

Initiation of the cams into their working status in the mechanical module of shifter control (Fig. 7c) is realized by moving the string downwards and moving it round by 7 – 8 turns. After having finished the necessary works with the shifter, the module is returned into the transport position by pulling the string to 300 mm and turning it to the right to 7 – 8 turns.

4. Conclusion

At present, the equipments are produced in series for the selective well completion with both dynamic and mechanical principle of shifter control. The perfection continues of these equipments to increase the well completion quality in the reservoirs with more productive horizons and the development heads towards the automated systems of control of technological processes.

The control of shifter valves enables the alternate (progressive) introduction under pressure of various technological fluids (i.e. water to maintain the pressure in a deposit) into different layers without having to pull out the string. Use of this possibility enables to save the material resources, because in such case it is not necessary to use the additional impression well to maintain the reservoir pressure in each individual layer.

The ESWC producers considered also the alternative of equipping of shifter valves with sand filters for the cases of use in the sand releasing, non-casing layers [4, 5].

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