TECHNOLOGY OF DEVELOPMENT OF WELLS USING COILED TUBING INSTALLATIONS

Ivano-Frankivsk National Technical University of Oil and Gas

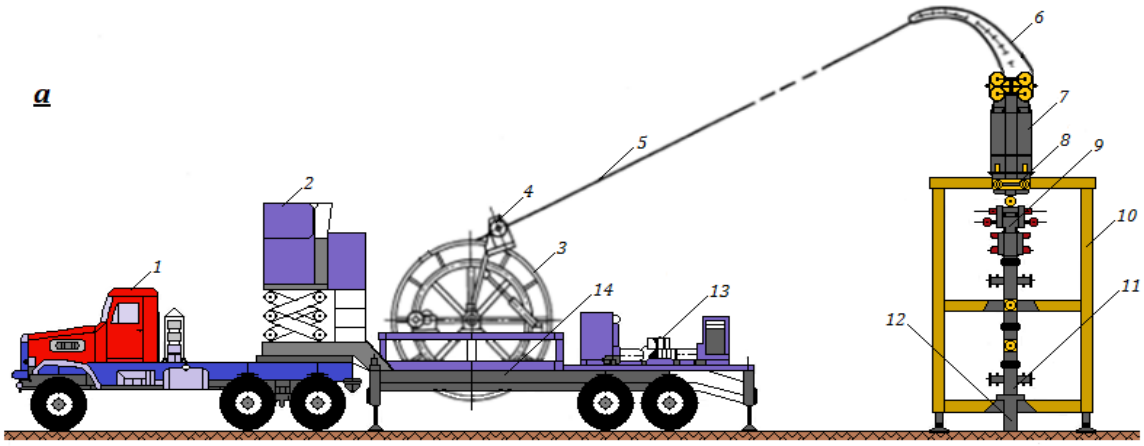
Femiak Ya. M., Doctor of Technical Sciences, Professor, Professor of the Department of Well Drilling
Vytyaz O. Y., Doctor of Technical Sciences, Professor, Director of the Institute of Petroleum Engineering
Femiak V. Ya., Graduate student of the Department of Well Drilling
Fedyk O. M., Assistant of the Well Drilling Department

The basis of coiled tubing technologies is the use of a flexible metal pipe, which is wound on a drum and lowered and raised from the well by a special unit (Fig. 1: *a*, *b*).

The mobility of coiled tubing installations makes it possible to effectively use them in remote deposits, especially marine ones, to develop an individual scheme of repair, development, and maintenance for each well.

Many companies in the world develop and manufacture coiled tubing equipment. The products of each of them have their advantages and disadvantages. Among the most famous companies are «Halliburton», «Schlumberger», «B. J. Services», and many others.

Mobile coiled tubing installations are intended for conducting technological operations with coiled tubing pipes with a diameter of 19.05 to 73 mm in oil and gas wells [1]. These installations are produced by the specific conditions of the customer, depending on the climatic and territorial conditions of operation, according to the technical parameters of the planned works. They are also equipped with additional equipment and adaptations.



1 – towing vehicle; 2 – operator's cabin; 3 – drum with a column of flexible pipes (CFT); 4 – compiler of the CFT; 5 – column of flexible pipes (CFT); 6 – guide; 7 – conveyor; 8 – wellhead sealer; 9 – preventer; 10 – conveyor support; 11 - wellhead equipment; 12 - well mouth; 13 - pumping unit; 14 – the frame of the winch

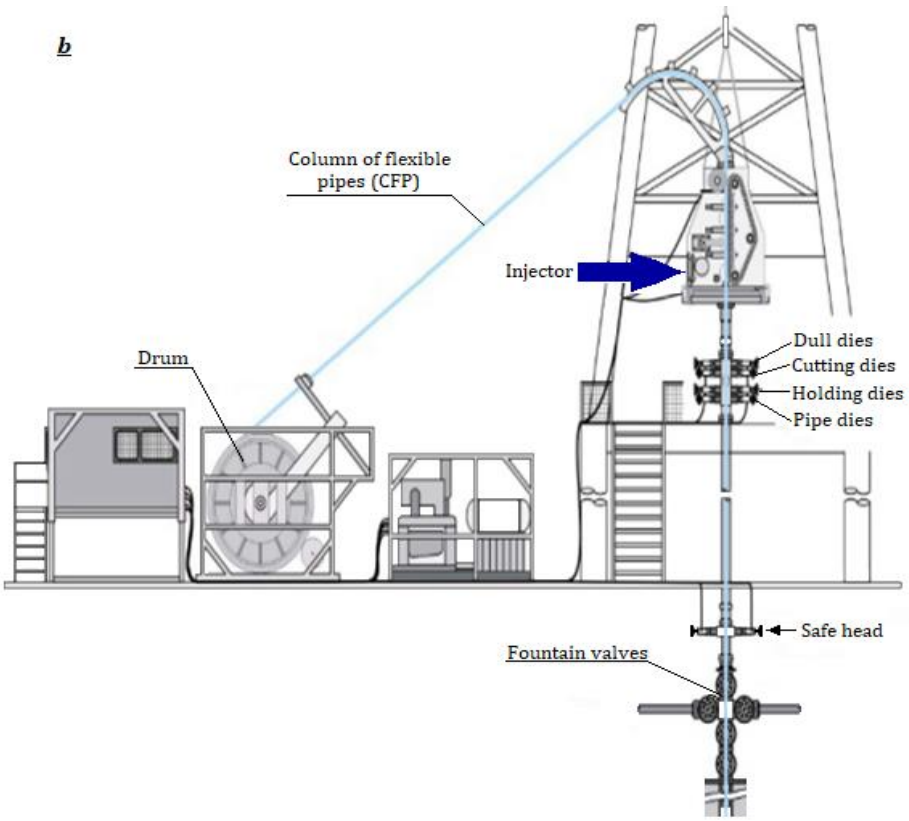


Figure 1 Mobile coiled tubing installations based on the chassis of a car (*a*) and a semi-trailer (*b*)

Coiled tubing technologies today meet world standards and their use facilitates the following technological operations, namely:

- the tightness of the wellhead is ensured at all stages of intra-well operations;
- all operations related to the inflow and development of the well are performed;
- it is possible to carry out work in oil and gas wells without their preliminary silencing;
- the time for preparatory and final operations during repair works in wells is reduced;
- reduction of time for lowering and raising internal well equipment is ensured;
- drilling, lowering of tools and devices, as well as the execution of underground repair operations in a horizontal or rather curved well are provided;
- the working conditions of employees improve;
- environmental safety is ensured because it prevents losses of formation and process fluids in a closed circulation system.

The technology gas-lift method of well development is used when there is a need to reduce the back pressure on the formation, caused by the presence of a quenching liquid or drilling fluid in the well, which remained after drilling operations or overhaul of the well. Works are performed when inflow is induced in oil and gas wells [1, 2].

Let's consider separately the layout of the gas lift equipment, which is shown in Fig. 2.

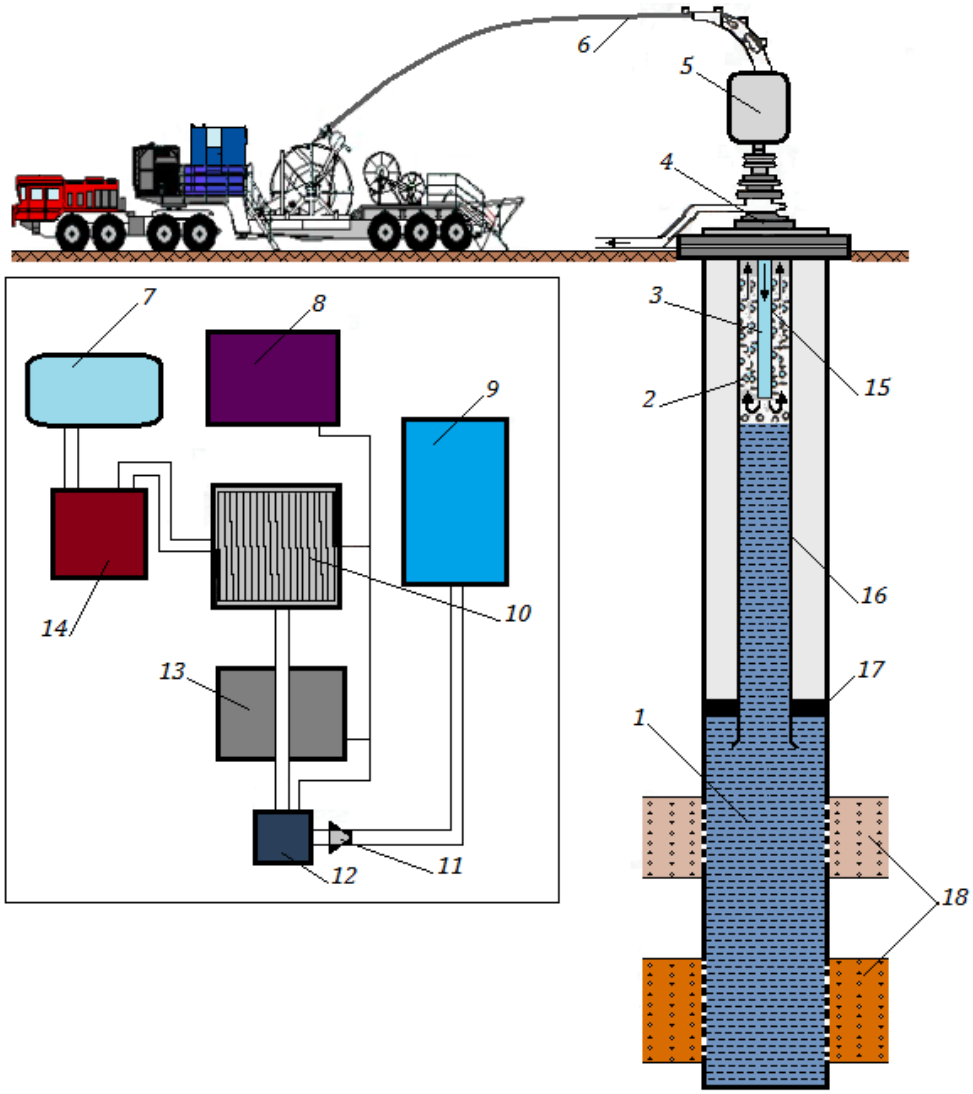


Figure 2 Layout of gas lift equipment

1 - technological liquid; 2 - a mixture of nitrogen and technological liquid; 3 – gaseous nitrogen; 4 - wellhead equipment; 5 - injector; 6 - coiled tubing wound on drum 10; 7 - nitrogen storage tank; 8 - the control system for the operation of coiled tubing installation (aggregate) units; 9 - container for collecting technological (reservoir) fluid extracted from the well; 10 - a drum with a coiled tubing pipe; 11 - throttle; 12 - injector drive; 13 - power plant (drive); 14 - compressor for injecting gaseous nitrogen; 15 - coiled tubing lowered into the middle of the tubing string 16; 16 – tubing column; 17 – packer; 18 – productive layer

At the same time, the following equipment and materials are used: coiled tubing installation; source of inert gas; nitrogen injection compressor; drainage capacity (if for some reason it is not possible to use the pipeline of the well production collection system); South Africa.

The diameter of the coiled tubing pipe is chosen based on the calculation that the hydraulic resistance of the pipe and the ring channel between it and the column of elevator pipes correspond to the required flow rate of the process fluid (or gas), which ensures the removal of the damping fluid.

At the same time, it is necessary to take into account the additional pressure caused by the hydraulic resistance of the ring channel, which affects the productive layer, because, during the process, the danger of absorption of the technological liquid or gas by the productive layer increases [3].

The technology for the process of causing formation fluid inflow is reduced to the following (Figure 2):

- the operation involves the descent into the cavity of the tubing string *16* of the coiled tubing pipe *6*, through which gas (nitrogen), aerating liquid is supplied to the well: Due to the decrease in the density of the liquid *1*, it is lifted and removed from the well (as a result of the decrease in hydrostatic pressure, gas (oil) from of productive layer *18* enters the well). Mixture *2* rises through the annular space between the coiled tubing pipe *15* and the tubing string 16;

- gas injection begins immediately or when the coiled tubing is submerged no more than 100 ÷ 200 m during its descent and does not stop during the entire inflow process: gas (nitrogen) is injected with a gradual increase in supply up to 14 ÷ 20 m^3/min, and the injection pressure gas (nitrogen) is constantly monitored and increased when the pipe is immersed in liquid 1;

- first, liquid *2*, which is in the column of lift pipes of tubing *16*, begins to aerate: if the described operation is carried out after carrying out work on the well, which was preceded by its silencing, then, as a rule, it is mineralized technical water or, in the worst case, clay drilling mud. Due to the reduction of hydrostatic pressure on the productive layer, the inflow of liquid (gas) begins, which, together with the gas that is pumped through the coiled tubing pipe, accelerates and in general improves the process of removing the liquid from the well, which was filled with it at the time of inflow.

To improve the foaming process of liquid 1 to be removed and increase the efficiency of the development process, it is recommended to add surfactant.

However, you should pay attention to the following:

- after the descent of the coiled tubing pipe to the level of the lower perforation holes, during the necessary period, ensure the operation of the gas lift;

- the gas lift process must continue until formation fluid begins to rise along the column of tubing lift pipes. Then, continuing the supply of gas (nitrogen), the coiled tubing pipe begins to rise gradually and smoothly;

- it is necessary to carefully control the composition of the liquid coming from the well and the flow rate of the latter;

- after lifting the coiled tubing pipe to a depth of 100 ÷ 200 m, if the gushing process continues, then the supply of gas (nitrogen) to the well is stopped.

References

1. Polinyk M.M., Yasyuk V.M., Yaremiychuk R.S. Koltubing in oil and gas production. - Lviv: Center of Europe, 2014. - 336 p.

2. R. S. Yaremiychuk, Ya. S. Yaremiychuk. Development of wells: Reference edition. - Lviv: Center of Europe, 2007. - 368 p.

3. Y. M. Femiak. Development of scientific foundations for effective construction of oil and gas wells in Ukraine / Materials of the report of the International Scientific and Technical Conference «Oil and Gas Energy - 2019», Ivano-Frankivsk, May 27-31, 2019, p. 48-53.