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**Kobeza V.S. student 185m-21z-1****Scientific supervisor: Khomenko V.L., Ph.D., Associate Professor of the Department of Oil and Gas Engineering and Drilling***(Dnipro University of Technology, Dnipro, Ukraine)***VIBRATIONS WHEN DRILLING WELLS FOR OIL AND GAS**

The article discusses the causes of drill string vibrations when drilling oil and gas wells. It was established that they can be divided into three large groups: geological, technical and technological. The harmful effect of vibrations on the technological process of drilling wells, the operation of drilling equipment and tools is considered.

The column of drill pipes operating in the well is an elastic system, in the lower part it is supported by a bit on the bottom of the well, and in the upper part it is fixed in the rotor. Under the influence of the torque and the load, this system resembles a spring with a large step between turns, the value of which depends on the forces acting on the column, as well as on the diameter of the well. While rotating, such an elastic loaded system experiences various forms and modes of oscillations, the deviation of its axis from the axis of the well, the angle of rotation and the range of oscillations change periodically. Oscillating processes of the drill string are called vibrations. The vibration mode is characterized by the number of oscillations per unit of time (frequency) and the largest deviation of the column from the axis of the well (amplitude), as well as the range of oscillations corresponding to the doubled amplitude; the inverse of the frequency is called the oscillation period (the time between two successive identical states of the system). When the frequency of forced disturbing forces coincides with the frequency of natural oscillations of the column, resonant phenomena occur, the amplitude and frequency of oscillations increase and vibration appears. The frequency of rotation of the column, which leads to resonance, is called critical.

According to research by National Oilwell Varco specialists, vibration is one of the main causes of drilling tool wear (Fig. 1.1).

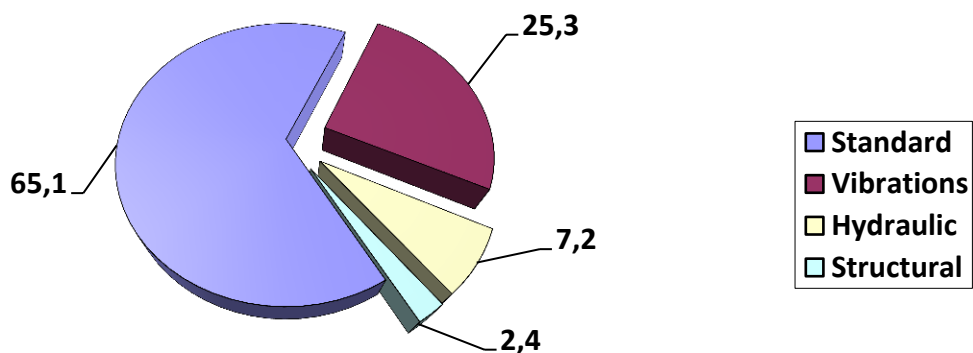


Figure 1.1 – Causes of drilling tool wear

To successfully deal with drill string vibrations in production conditions, it is necessary to know the causes of their occurrence; in other words, the best way to deal with vibrations is to eliminate the causes that cause them.

The causes of vibrations are divided into three groups: geological, technical and technological.

1. Geological reasons: interspersed hard and soft rocks, as well as rocks with uneven grain size and heterogeneous structure; destroyed and cracked rocks; sedimentary and layered,

banded and gneiss-like, the layering or shale formation of which forms an acute angle with the axis of the well; especially collapsing or cavernous rocks, and even rocks that form a "trough", in which the drill string can have a strong bend.

2. Technical reasons:

1) curved drill pipes; lack of alignment in the column due to incorrect manufacturing of threaded connections and housings of couplings and locks; uneven one-sided wear of pipes and joints;

2) large gaps between drill pipes and well walls; insufficient rigidity of the drill shaft; increased development of separate intervals of the shaft and deviation of the shape of the well cross-section from the annular one;

3) improper installation and unsatisfactory condition of the drilling equipment (insufficient rigidity of the foundation of the drilling rig, installation of the machine on a sloping site, loose fixing of the rotor); uneven operation of rotors with insufficient drive power; gear wear; eccentric fastening of the conducting drill pipe in the rotor; use of unbalanced drilling seals; backlash in gear engagements; elimination of the crown block in relation to the center of the well; displacement of the rope running on the roller of the crown block in relation to the axis of the well, etc.

3. Technological reasons:

1) the use of chisels that do not correspond to the type of physical and mechanical properties and roughness of rocks, as well as chisels with one-sided wear of the end, with worn arms;

2) deviation of the recommended values of the parameters of the drilling mode from the optimal or rational for the given drilling conditions: exceeding the axial load on the bit and the rotation frequency of the tool, supplying an excessively large amount of flushing fluid, drilling at high pressure and fluid pulsation in the drill pipes;

3) drilling with significant distortions of the wellbore, in the presence of pieces of metal or rock in the hole;

4) the use of faulty or low-quality keys, rod holders or cartridges with dies that distort drill and column pipes.

Vibrations have a multifactorial, very harmful effect on the technological process of drilling, the operation of equipment and tools. The power consumption of the rotation of the drilling projectile increases sharply (by 2-2.5 times), which limits the use of high rotation frequencies and reduces its productivity [1].

With an increased range of oscillations, frequent and strong shock loads are created on the bit, which increases its wear. Due to the frequent impacts of the drill string, the wear of the casing pipes increases, the annular cementation of the casing string is disturbed: potholes (grooves) are formed in the unsecured parts of the shaft, and pieces of rock fall out in the destroyed areas; which jam the projectile in the well. In the drill pipes and joints there is a great tension, fatigue wear increases; in collisions with the walls of the well, the abrasive wear of the tool and pipes increases; in this connection, the number of accidents due to projectile breaks and its grips is increasing. The fastenings of the units of the drilling unit loosen, their wear increases, and the equipment and devices installed on the unit fail prematurely.

### References

1. Ratov B.T., Fedorov B.V., Khomenko V.L., Baiboz A.R., Korgasbekov D.R. Some features of drilling technology with PDC bits // *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*. – 2020. – № 3. – P. 13-18. <https://doi.org/10.33271/nvngu/2020-3/013>.