AZƏRBAYCAN RESPUBLİKASI ELM VƏ TƏHSİL NAZİRLİYİ
AZƏRBAYCAN DÖVLƏT NEFT VƏ SƏNAYE UNİVERSİTETİ

MINISTRY OF SCIENCE AND EDUCATION
REPUBLIC OF AZERBAIJAN
AZERBAIJAN STATE UNIVERSITY OF OIL AND INDUSTRY

“NEFTİN, QAZIN GEOTEXNOLOJİ PROBLEMLƏRİ VƏ KİMYA”
ELMİ-TƏDQİQAT İNSTİTUTUNUN

ELMİ ƏSƏRLƏRİ

SCIENTIFIC PROCEEDINGS

SCIENTIFIC RESEARCH INSTITUTE

“GEOTECHNOLOGICAL PROBLEMS OF OIL, GAS AND CHEMISTRY”

VOLUME 23 Number1

BAKU-2023

ISSN 2218-5054

Sci. Proc. SRI GPOGC. 2023. Volume 23, Number 1

Contents

The stated approaches to conceptual level of the engineering approaches to the solution are supported by examples from the practical work of Encotec LLC enabling successful project development and a significant tool to making right decision on all stages of the project.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research.

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Possibility to eliminate accidents in oil and gas wells occurring with glass fibre rods with the help of a rod head designed for them.

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Abstract

The operation of oil and gas wells with sucker rod deep well pumping units takes place in aggressive conditions of the oil and gas production field. This leads to accidents arising with deep well pump rods of these units. The report talks about the possibility of eliminating accidents arising with glass fibre rods, which differ from metal, steel rods by their physical and mechanical properties. These rods are the most important part of a deep-water pumping unit. It is noted that in order to eliminate accidents with deep-well pumping units it is necessary to develop a catching tool rod-header. The diameters of these rods used in production are specified. It is noted in the report that fibreglass rods are made in order to save metal, as well as these rods are anticorrosive in comparison with metal rods. The disadvantage of fibreglass rods is their relatively low strength (σ) compared to metal, steel rods and their smoother surface, which is less able to be effectively gripped by the rod head. The report explains the process of eliminating a fibreglass rod accident with this catching tool. Continuing the lowering of the rod-header there is a gripping inside the tool body by the surface of the coupling or body of the fibreglass rod by gripping elements, spiral parts and collet. The efficiency of the process of gripping of the glass fibre rod depends on what, as a

result of this, it is possible to eliminate the accident in a well with oil and gas producing deep well pumps with the help of the rod head developed for glass fibre rods.

Keywords: fibreglass rods, downhole rod pumping unit, accident elimination, rod header.
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1. Introduction

Downhole sucker rod pumping units are one of the main operating equipment for oil and gas production. The operation of these units takes place in aggressive conditions of producing oil and gas wells. The most responsible unit of the pumping unit is the pumping rod string. For oil and gas production, apart from metal steel rods, fibreglass rods are used. In terms of physical and mechanical properties glass fibre rods differ from metal rods. During operation of the wellbore, these rods are subjected to loads and stresses. A certain period of operation in downhole conditions leads to ageing and mechanical wear of glass fibre rods. As a consequence, the glass fibre rods are likely to break, resulting in a well pump abandonment accident. For this purpose it is necessary to eliminate the accident for further operation of oil and gas producing wells, i.e. to extract the remaining fibreglass rod from the wells. For this purpose a catching tool for fibreglass rods is developed. These rods are made of fibreglass material in order to save metal. The disadvantage of fibreglass rods is their relatively low strength (σ) compared to metal and steel rods and their smoother surface, which is less easy for the rod catcher to grip effectively. Consequently, there is a question of the possibility of accident elimination in oil and gas producing wells with fibreglass rods. That is, to solve this issue, it is necessary to consider and take into account the design features of the developed rod header, as well as its technical characteristics of the gripping unit and components.

2. Methodological part

The topic of the report is based on the method of critical analysis in oil and gas well remediation of accidents in oil and gas wells, arising with glass fibre rods with the help of the developed for them rod-header. Taking into account the disadvantage of glass fibre rods, i.e. their relative low strength (σ) in contrast to metal and steel rods and their smoother surface, which is less amenable to effective gripping by the rod head, as follows from this, the possibility of liquidation of accidents occurring with glass fibre rods is logically considered. The design of the developed catching tool of the rod header is given according to the outer diameters of glass fibre rods Ø16, Ø19, Ø22, Ø25 mm, i.e. its general view and the glass fibre rod itself. The process of effective gripping of the rod-header by its main working parts spiral and collet is described and analysed on this basis. According to the method of critical analysis, the possibility of elimination of accidents in oil and gas wells, arising with fibreglass rods, depends on the reliable process of engagement of the smooth surface of the body or coupling of the fibreglass rod with notches of the inner surface of the gripping elements of spiral and collet parts. The same reliability of the grip on the body of the glass fibre rod is possible at fixation and compressive forces (Fcj.), i.e. from large elastic properties of these gripping elements (parts). Having notches on the inner surface of the parts sproul and collet cover the whole diameter of the coupling end or the body of the fibreglass rod. It follows that in order to securely grip the emergency fibreglass rod, it is necessary to take into account, as a factor, the technological fit (e.g. H4; h4) between the smooth surface of the body or end of the coupling of the fibreglass rod (shaft system (e.g. h4)) and the inner surface with notches of the gripping elements, i.e. spiral and collet (bore system (e.g. H4)). And analyzing, it is possible to say that at gripping by the inner surface with notches of a spiral or a collet and a smooth cylindrical surface of a body or an end of a coupling of a fibreglass rod, a tight fit is formed, which promotes reliable gripping of an emergency object, i.e. this rod and makes possible liquidation of an accident occurring with these rods in a well with the help of a catching tool developed for them, i.e. a rod header.

3. Main part

Oil and gas production by downhole deep well sucker rod pumping units, i.e. their operation, takes place in unfavourable conditions of the oil and gas production field. Oil and gas fields at their operation by deep well rod pumps, in addition to the usual metal steel rods, glass fibre rods are used. The physical and mechanical properties of glass fibre rods differ sharply from metal rods. Deep well pumping rods are subjected to static and dynamic loads and stresses during operation in production wells. Being the most critical connection of this unit, the fibreglass rod string is also subjected to these loads and stresses. As a consequence, during a certain period of operation of the fibreglass rod string, its ageing and mechanical wear occurs. During this process there is a possibility of glass fibre rods breakage, resulting in an accident associated with the deep well pump remaining in the well. It is necessary to eliminate the accident for further operation of oil and gas producing wells. In this case we mean the elimination of the accident with fibreglass rods. For this purpose it is necessary to develop a catching tool, a rod header for glass fibre rods. It is known that metal rods with diameters Ø16, Ø19, Ø22, Ø25 mm are used in production. (Fig.1). These rods are made of fibreglass material in order to save metal and improve technical performance.

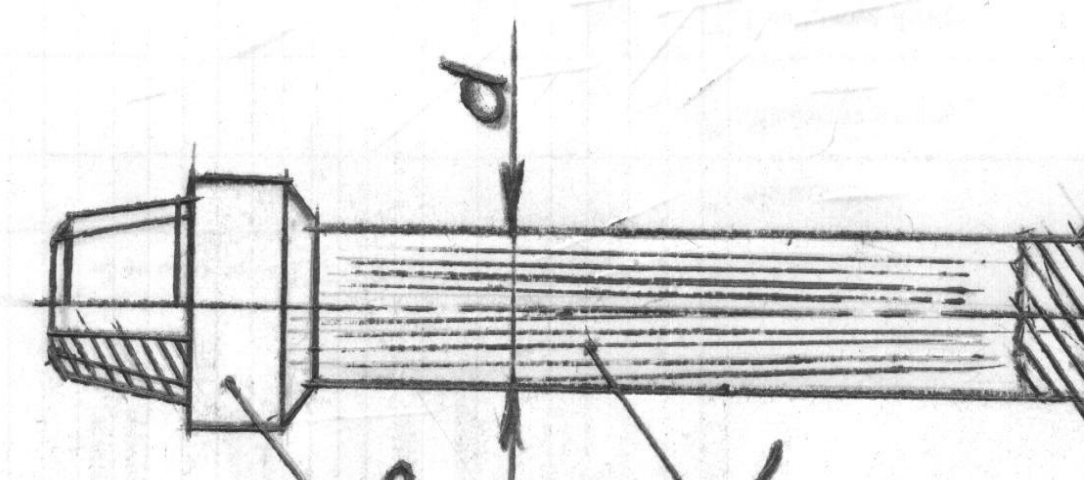

Fig.1 General construction of glass fibre rod: 1- glass fibre body (body) of the rod; 2- metal nipple end of the rod; 3- metal coupling end of the rod.

Compared to metal rods, fibreglass rods are economical to manufacture and anti-corrosive. The downside of fibreglass rods is their relatively low strength (σ) compared to metal steel rods and their smoother surface, which is less easy to grip effectively with a rod-header. The process of liquidation of an accident with fibreglass rods, consists of the operation of lowering the catching tool of the rod catcher on the string suspension of rods into the emergency well with the emergency object, fibreglass rod, its capture by the body of the rod catcher and extraction from the well. The construction of the rod head (Fig.2) consists of a cylindrical body.

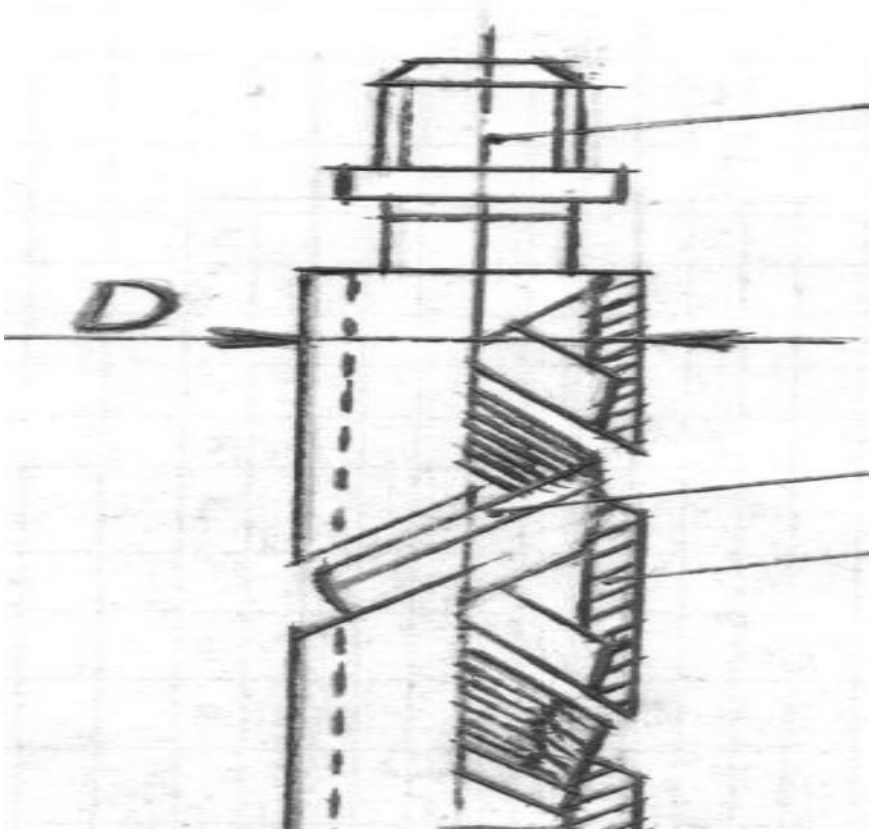

Fig.2 Assembly design of the rod-header for glass fibre rods: 1- body; 2- gripping element (detail)-spiral; 3- place of connection of the rod-header with the string of rods suspension for lowering into the emergency well.

In the upper part of the casing there is a place for connection to the rod string suspension for lowering the rod header into the well. The rod head body has a lateral spiral window with a spiral conical surface mating with it to hold the spiral and collet gripping elements (spiral and collet parts). The spiral gripping element with a spiral conical surface on the outside and notches on its inner surface is used for gripping both the body and the head of the boom. After lowering the rod-header into the well, its lower part of the body in the form of a funnel passes the end of the coupling or the head of the fibreglass rod inside the tool body. As the rod head continues to descend, the inner notched surface of the spiral or collet gripping element grips inside the tool body by the surface of the coupling or fibreglass rod body. In general, after the process of grasping the surface of the coupling or body of the glass fibre rod, the effectiveness of this grasping, as well as the possibility of eliminating the accident, that is, the extraction of the emergency object of the glass fibre rod depends on a reliable process of engagement of the smooth surface of the end of the coupling or body of the glass fibre rod with notches on the inner surface of the gripping elements, spiral and collet. Also fixation and compressive force (ability), i.e. from the large elastic properties of these gripping elements (parts), makes it possible to securely grip the body or end of the coupling of the glass fibre rod. The gripping elements of the boom catcher cover with their inner surface with notches over the entire diameter of the coupling end or body of the fibreglass rod. As follows, in order to securely grip the emergency rods, it is necessary to take into account, as a factor, an index of technological fit (e.g. H4; h4) between the smooth surface of the body or coupling end of the fibreglass rod (shaft system (e.g. h4)) and the notched inner surface of the gripping elements of the helix and collet (bore system (e.g. H4)). That is, the interference fit formed by the gripping surface

of the inner surface with notches of the helix or collet and the smooth cylindrical surface of the body of the coupling end of the fibreglass rod, contributes to the reliable gripping of the emergency object, i.e. the fibreglass rod, and makes it possible to eliminate accidents in a well with oil producing rod deep well pumps with the help of a catching tool, i.e. a rod head designed for fibreglass rods.

4. Results and discussion

The paper presents a schematic diagram of the fibreglass rod (Fig.1) and a schematic diagram of the rod catcher tool as an assembly drawing (Fig.2). The construction of the boom catcher and its parts is described. It clearly indicates the emergency object and the catching tool. The diameters of the metal (fibreglass) rods used in production are indicated accordingly. Operation of fibreglass rods takes place in unfavourable conditions of oil and gas production field and wells. Being the most critical connection of a downhole deep well pumping unit, the fibreglass rod string is subjected to static and dynamic loads and stresses. As a consequence, at a certain period of operation of the fibreglass rod string, the fibreglass rods age and wear out. This leads to the probability of glass fibre rods breakage, resulting in an accident associated with the abandonment of the deep well pump in the well. It is necessary to eliminate the accident, for further operation of oil and gas producing wells. With the help of the developed, for catching (capturing) the emergency object, remaining in the well fibreglass rod, rod-header (Fig.2), the liquidation of the accident is carried out. As a result, for reliable gripping of the smoother surface of the body or coupling of glass fibre rods in comparison with metal rods, it is necessary to have reliable meshing (high value of the coefficient of friction force at meshing) with notches of the inner surface of the gripping elements, i.e. parts of the spiral or collet rod-header. Also the possibility of reliable gripping of the body or coupling of the fibreglass rod, will be at fixation and compressive forces, i.e. from the large elastic properties of these gripping elements. When the notches on the inner surface of the spiral or collet parts are gripped, they cover the entire diameter of the end of the coupling or body of the fibreglass rod. The result of covering these parts indicates a process fit factor (e.g. H4;h4) between the smooth surface of the body or coupling end of the fibreglass rod (shaft system (e.g. h4)) and the notched inner surface of the gripping elements of the helix and collet (bore system (e.g. H4)). A tight fit is formed when the spiral or collet gripping elements are gripped by the notched inner surface of the smooth cylindrical surface of the body or end of the fibreglass rod coupling. This contributes to a reliable grip of the emergency object, i.e. fibreglass rods and as a result makes it possible to eliminate the accident with the help of the developed rod-header.

5. Conclusion

The operation of a downhole rod pumping unit takes place under unfavourable conditions in the oil and gas production field. The downhole pumping rod column is the most critical connection of this unit. Oil and gas producing wells during their operation by deep well pumps, in addition to the usual metal, steel rods, glass fibre rods are used. These rods differ sharply from metal rods by their physical and mechanical properties. In conditions of operation of glass fibre rods in oil and gas producing wells their ageing and mechanical wear occurs. This process contributes to probable breakage of glass fibre rods. This leads to an accident associated with leaving the deep well tubing pump in the well. It is necessary to eliminate the accident with fibreglass rods. For this purpose it is necessary to develop a catching tool, a rod head for fibreglass rods according to their outer diameter. At accident elimination the rod catcher is lowered on the string suspension of rods into

the emergency well with the emergency object, i.e. fibreglass rod. According to the specified design of the rod-header (Fig.2), its main gripping element is the spiral and collet parts located in the tool body. The end of the body or coupling of the fibreglass rod, when lowering the rod head, goes through the funnel inside the body of the rod head and the internal surface with notches of the gripping elements of the spiral and collet of this rod is captured. It is covered with its inner surface with notched gripping elements, over the entire diameter of the end of the body or coupling of the fibreglass rod. The body of the glass fibre rod has a smoother surface compared to metal, steel rods. Consequently, the possibility of accident elimination, i.e. extraction of the emergency object of the glass fibre rod from the well depends on the reliable process of engagement of the smooth surface of the end of the body or coupling of this rod with notches of the inner surface of the gripping elements, i.e. spiral and collet. That is to say, having a high coefficient of friction between these surfaces, the possibility of retrieving the fibreglass rod remaining in the borehole is more likely. Fixation and compressive force, i.e. from the large elastic properties of these gripping elements also makes it likely that the smooth surface of the body or end of the coupling of the fibreglass rod can be grasped and extracted from the well. Engagement of the gripping elements by their internal surface with notches along the entire diameter of the coupling end or body of the fibreglass rod indicates the factor of technological fit between these surfaces. The tight fit formed between these surfaces makes it possible to eliminate the accident with fibreglass rods with the help of a rod-header designed for them.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research

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Modeling and optimization of the process hydrotreating of diesel fuel

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Abstract

The main approaches to the development of a reactor unit for the hydro desulfurization of diesel fuels are considered, taking into account the reactivity of the organosulfur components that make up diesel fuel and the formation of pseudocomponents conditionally combining a group of organosulfur components. As the concentration of easily or difficult-to-hydrogenate sulfur-containing components in raw materials increases, the role of a substance limiting the quality of diesel fuel purification may shift from an easily hydrogenated to a difficult-to-hydrogenate