AJEMA GLOBAL RESEARCH NETWORK

AMERICAN Journal of Engineering, Mechanics and Architecture
Volume 2, Issue 12, 2024 ISSN (E): 2993-2637

Technological Features of Increasing Corrosion Resistance of the Logging Tip Part of the load-Bearing Geophysical Cable of Type Nkb

Guzashvili, K.V., Mirzarakhimova, Z.B.

Tashkent State technical university after name Islom Karimov

sabrinakamalitdinova@gmail.com

Abstract

In the oil and gas industry, precise measurements of well parameters are key, provided by modern equipment such as logging tips. These devices not only transmit important data on the geological structure and composition of wells, but are also subject to significant mechanical loads and aggressive environments, which increases the problem of corrosion. An effective solution to this problem requires not only the selection of the right materials and coatings, but also the use of specialized processing technologies.

Keywords: oil and gas industry, well parameters, logging tips, corrosion, materials and coatings, geological structure, mechanical loads, aggressive environments, electrochemical protection, thermal treatment, hydrogen sulfide (H_2S), carbon dioxide (CO_2), logging equipment, pipeline corrosion, economic impact.

Introduction

The durability of equipment and devices for measuring parameters in the oil and gas industry is determined by the quality of manufacturing of components and units, as well as the nature of environmental factors. However, one of the most significant problems faced by the oil and gas industry is corrosion. Since the main cause of corrosion in the soil of units or research equipment is the thermodynamic instability of the structural material in relation to the external environment. As a result, chemical-physical interaction leads to equipment degradation, increased maintenance and repair costs, as well as potential emergency situations. Therefore, development, including understanding the mechanisms of corrosion and the use of technology to increase the durability of metering and parameter control devices is of paramount importance for the successful conduct of research, ensuring the reliability and safety of oil and gas operations with minimization of equipment repair and replacement costs.

Main part. For the analysis of the geological structure of the subsoil and the identification of hydrocarbon raw materials during the development of oil and gas fields, modern physical methods of well research are based on the installation of logging cable tips of the NKB type (Fig. 1) [4], by lowering into the well on a load-bearing cable. As a result of immersion, wells are monitored, the NKB parts are subjected to mechanical loads and the effects of aggressive environments, which requires special measures to protect against corrosion.

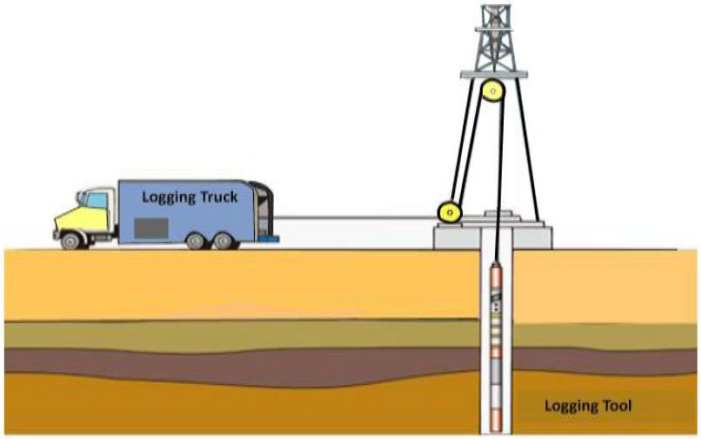

Fig. 1. Basic setup for wireline logging [5]

According to NACE According to the National Association of Corrosion Engineers (NACEE), direct costs of combating corrosion in the oil and gas industry amount to billions of dollars per year. In the United States, these costs are estimated at approximately $1.37 billion annually [1].

In developed countries, damage from corrosion today amounts to 2 to 4% of GDP, and losses from faulty products and equipment reach 10–20% of annual steel production. This emphasizes the need to develop measures to combat corrosion processes.

In 2006, corrosion caused an oil leak in the Trans-Alaska Pipeline, causing significant environmental and economic impacts. The cost of repairs and damages amounted to several hundred million dollars.[2]

Corrosion is also a major problem for offshore production platforms. For example, in 2012, corrosion caused a leak at the Elgin platform in the North Sea, causing losses of about $300 million.[3]

In 2018, a Middle East region experienced a communication failure during a logging tip lift due to a failure in the hoisting equipment, requiring a complex recovery operation and lost drilling time.

In 2020, a well anomaly in the US state of Texas caused a communications outage, making it difficult to obtain critical data on the geological structure.

In our country, there are no official statistics that would reflect the economic damage from corrosion, but, according to our estimates, it is at least 5% of GDP. For example, at the Kuyi-Surgil field in the Republic of Uzbekistan, during geophysical surveys of wells 11–15, a logging unit broke due to a collision with hydrogen sulfide at a depth of 3,000 meters. This led to the loss of geological data, claims the georesearch company IP OOO “ TNG LOGGING ASIA ”

In the context of the above, it is necessary to consider and study the causes of corrosion in this area, such as: electrochemical processes, including galvanic corrosion and microbiologically induced corrosion, since some microorganisms, such as sulfate-reducing bacteria, produce corrosive agents in the form of hydrogen sulfide, which promotes corrosion of metals and alloys; chemical influences occur due to the content of hydrogen sulfide (H_2S), carbon dioxide (CO_2) and other aggressive components in oil and gas, which, when dissolved in water, form acids that promote corrosion of equipment; physical influences, such as temperature fluctuations - high temperatures accelerate chemical reactions that cause corrosion and cause thermal fatigue of materials, leading to the formation of cracks and corrosion; environmental conditions, since corrosion of pipelines and equipment underground occurs due to soil moisture, the presence of salts and acids, as well as microorganisms; Mechanical stresses due to repeated cyclic loads cause

microcracks, which serve as foci of corrosion, especially in aggressive environments, causing intercrystalline corrosion of materials .

One of the main approaches to increasing the corrosion resistance of geosurvey equipment is the use of corrosion-resistant materials and protective coatings. The most common materials include stainless steel, nickel-based alloys and titanium alloys. These materials have high resistance to corrosion processes, which makes them ideal for use in aggressive environments. However, in some cases, the use of such materials may be economically impractical. In such situations, various types of protective coatings are used. For example, the application of anti-corrosion paints and varnishes, galvanic coating - includes the application of layers of zinc, nickel or chromium metals. As well as polymer-based coatings.

In addition to the choice of materials and coatings, technological processing methods have a significant impact on the corrosion resistance of the logging tip:

1. Electrochemical protection is a method of cathodic or anodic protection in which parts are connected to a DC source. The principles of electrochemical protection include the use of anodes and cathodes to control the potential of the tip material relative to the environment. Anodes made of materials with high electrochemical activity can be used to prevent corrosion by directing corrosion currents to themselves and thereby protecting the tip. This approach is widely used in the oil and gas industry for pipelines where corrosion and aggressive conditions can significantly reduce the service life of equipment. Electrochemical protection can significantly increase the resistance of logging tips to corrosion and mechanical damage, which is important for ensuring the safety and reliability of drilling and well operation.

2. Increasing the coating density of the logging tip is critical to improving its durability and corrosion protection in well operating conditions. The following methods can be used to achieve this goal: Electrolytic coating; Plasma spraying; Chemical vapor deposition (CVD).

3. Thermal treatment of a logging tool can be an effective way to improve its corrosion resistance. This process includes various technologies and methods aimed at optimizing the microstructure and mechanical properties of the surface layer of the material. Among them, the following are particularly important: annealing, carburizing, nitrocarburizing and tempering. Each of these stages plays a key role in strengthening the logging tools, reducing internal stresses, increasing surface hardness and improving the corrosion resistance of steel due to the formation of nitride phases. These processes also help to reduce the brittleness that can occur after hardening the material. Annealing: One of the most common heat treatment methods, in which the material is heated to a certain temperature and then cooled at a controlled rate. The purpose of annealing is to eliminate internal stresses, improve the crystalline structure and resistance to corrosion.

Conclusion. Ensuring corrosion resistance of logging tips plays a critical role in the long-term reliability and safety of oil and gas operations. The use of modern materials, protective coatings and heat treatment technologies significantly increases the service life of equipment and reduces its operating costs. However, as technologies and requirements continue to evolve, continuous improvement of corrosion protection methods remains an important task for the industry aimed at sustainable and safe energy production.

References

1. NACE International. (n.d.). “Economic Effects of Metallic Corrosion in the United States.”
2. Smith, C. (2006). “Alaska Pipeline Leak: Lessons Learned.” Oil & Gas Journal .
3. Green, M. (2012). “Elgin Platform Incident.” Energy Voice .

4. Arutyunov A.A. Equipment for oil production / A.A. Arutyunov et al. - Krasnodar: Publishing House - South, 2014. - 182 p.
5. Warren, J. 2018. Well (wireline) log interpretation of evaporites: An overview. Salty Matters, 31 March 2018, http://saltworkconsultants.businesscatalyst.com/blog/wireline-log interpretation-of-evaporites (accessed 7 April 2019).
6. Musaevich, S. S., Shukhratugli, B. B., Latipovna, A. Z., & Kh, T. T. (2020). Formation of Structure at Thermodiffusion Chroming of Porous Permeable Materials Based on Iron Powder.
7. Bektemirov, B. S. Advanced ceramic coating methods B. Sh. Bektemirov, R. Kh. Saydakhmedov, A. Kh. Alikulov Tashkent State Technical University named after Islam Karimov, Tashkent, Uzbekistan The article is dedicated to put together on data associated with researches.