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IN-LINE ANALYZER FOR DETERMINING THE CONCENTRATION OF CORROSION INHIBITORS IN OIL

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Introduction. In the context of continuous extraction of oil and gas assets, there is a necessity to maintain metallic storage and transportation structures in a serviceable condition. For this purpose, various corrosion inhibitors are typically introduced into the system, and it is necessary to control their concentration in real time to avoid supplying extra dosage into fuel, as well as to prevent costly equipment from failing. This project aims to determine the optimal parameters used in electrochemical technology for determining the concentration of inhibitors in reservoir water and oil-water fluid through mathematical modeling and laboratory tests [1].

The initial step in preparing samples for determining the concentration of corrosion inhibitors in oil is the separation of the emulsion into oil and reservoir water. This is necessary to prevent electrode contamination during measurements, as well as to obtain high-quality voltammetric characteristics for subsequent processing using machine learning methods [2].

Main part. During laboratory experiments, a method for preparing stable oil-water emulsions with varying water/oil ratios was developed. It was found that for effective separation, it is most favorable to introduce the demulsifier "Denmaster 3030" at a concentration of no less than 30 g/t (grams per a tonne of emulsion), or the demulsifier "Iprodene P-2" at a concentration of no less than 17 g/t. The emulsion is heated to a temperature of 60 °C and maintained at this temperature for at least 8 hours. After 8 hours, the separated water phase is collected for electrochemical measurements.

The next stage in the development of the flow analyzer is related to the selection of materials for printed electrodes for the electrochemical cell, as well as the shape of the electrodes. Experimental studies have established that the current value depends on the electrical conductivity of the electrode material. As a result, copper is identified as the optimal material in terms of cost/quality ratio.

Designs for four types of printed electrodes: "sector," "target," "stripes," and "brush" were developed. The highest currents in reservoir water are observed for the "target" and "brush" electrodes, due to the larger total area of the two electrodes (working and auxiliary). However, the response to the addition of inhibitor for the "brush" electrode is significantly lower than for the "target" (5.75 mAs versus 1.99 mAs for the "brush"), making the "brushes" less sensitive to the inhibitor. Consequently, the range of electrodes was narrowed, and subsequently, the "target" was predominantly considered.

To determine the influence of oil not separated during the demulsification process on the electrochemical characteristics, experiments were conducted with "oil-contaminated reservoir water." When interacting with highly contaminated water and passing an electric current, oil deposition occurs on the surface of the electrodes. This leads to a significant deterioration of the electrodes resulting in electrode passivation and, consequently, a decrease in current values on the voltammogram.

Conclusions. The study shows that the current strength in the electrochemical cell increases with the increase in the electrode area. Copper as an electrode material maintains a balance between current strength and measurement stability. The comparison of four functional electrode geometries showed that two concentric circles representing a «target» electrode are the optimal one.

Oil settled on electrodes leads to their passivation. Voltammograms of the electrodes obtained in lightly and heavily contaminated water are characterized by a wide variation in shape and peak size, indicating the need to effectively separate the water and oil phases of the sample before measurement.

References.

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