IMPORTANCE OF CATHODIC PROTECTION SYSTEM FOR SAFETY OF THE PIPELINE OPERATION IN OIL&GAS INDUSTRY

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Pipelines in the oil and gas industry represent a very important part of the process in terms of the safety of people and the environment. This paper discusses and analyzes the importance of cathodic protection applied to the insulation joint of the pipeline. The pipeline is investigated by visual testing and ultrasonic measurement of thickness.

Keywords: corrosion, cathodic protection, piplines, insulation joint, oil and gas industry.

Pipelines in the oil and gas industry are exposed to aggressive environments, varying climate conditions, microorganisms, and stray currents. All of that can initiate corrosion which can cause the loss of the pipe wall thickness. Reduction of the structural reliability increases the risk of failure. Cathodic protection [1–5] is the most promising protection and is defined as reduction or elimination of corrosion by polarizing the metal as cathode by means of impressed current or sacrificial anodes. This paper analyzes the importance of the cathodic protection on the example of a pipeline corroded after cathodic protection was broken.

In this case, the impressed cathodic protection (CP) is chosen as it can efectively protect uncoated and poorely coated structures and a single inslulation can protect a larger metalic surface.

Successful application of CP depends on the selection, design, installation, and maintenance of the system. The nature and conditions of the soil are reflected by field measurements such as soil resistance, hydrogen ion activity (pH), and the redox potential.

Corrosion activity is always an inverse function of soil resistance. The current drastically increases in low resistive soils and the anode dissolution contribution increases.

The impressed current required to protect steel increases with a decrease in pH. With a decrease in pH, the equilibrium potential of the oxygen electrode becomes more positive; this increases the cathodic and anodic potential difference and shifts the corrosion potential to a more positive value. Therefore, the corrosion current increases with a decrease of pH. To counter this increased corrosion current, higher applied current is needed. At the moment the corrosion protection was broken, the pH value of the fluid was found to be normal.

Analyses confirmed that corrosion was caused by the microbiological activity. It increased the corrosion rate by depolarizing cathodes. Corrosion products decreased cathode effectiveness and caused damages to coating. The pipeline was investigated by nondestructive testing methods which included visual control and ultrasonic measurment of thickness. Corroson was found by visual inspection. Ultrasonic thickness measurment confirmed the thining of the pipeline wall. The minimum thickness was around the insulation joint and leaking occurred (Fig. 1). The pipeline was cut and the damaged part and the insulation joint were replaced. The anode was selected according to the dissipation rate of the anode. Due to its low dissipation rate, the high-silicon, chromium-bearing cast iron was selected. The visual inspection and the liquid penetrant testing are performed on the welded joint showing that the weld is in good condition. The measurement of electric parameters confirmed that the new cathodic protection is in good condition. Fig. 2, *a* shows the replaced part of the pipeline and the insulation joint. The damaged part of the pipeline was cut and

a new part was welded. The insulation joint is replaced with a regular one, as well as the cathodic protection. The electric cabinet (Fig. 2, *b*) measures electric parameters and shows that cathodic protection works again.

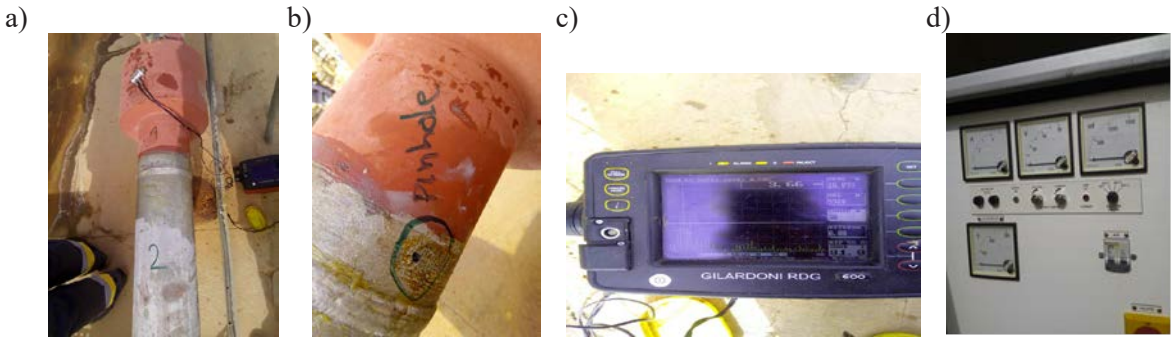

Fig. 1. Pipe – general view (*a*, areas *1* and *2*), pinhole found on the line (*b*, in area 1), ultrasonic thickness measuring near pinhole: minimum thickness 3.66 mm (*c*), main electric cabinet shows electric parameters at zero (*d*)

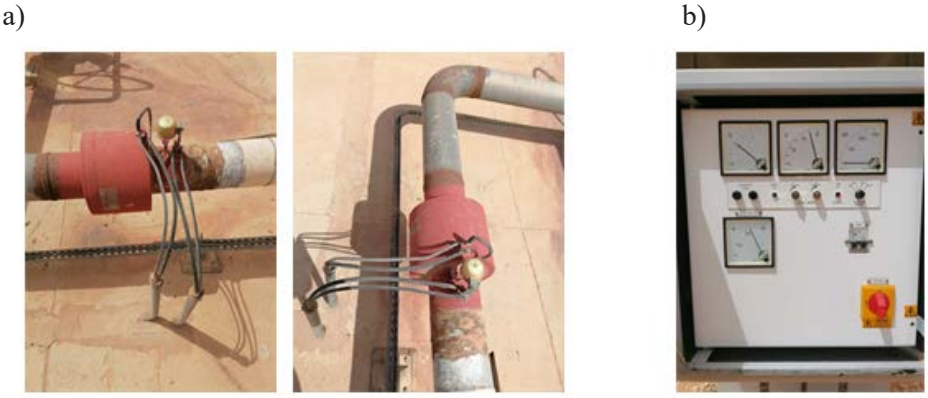

Fig. 2. Replaced part of pipeline with insulation joint and cathodic protection (*a*), main electric cabinet showing electric parameters (*b*)

The further investigation will include numerical methods for modeling cathodic protection systems, in first place finite element model.

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Значення системи катодного захисту для безпеки експлуатації трубопроводів нафтогазової промисловості

Трубопроводи в нафтогазовій промисловості є дуже важливими об'єктами з точки зору безпеки людей і навколишнього середовища. У цій роботі обговорюється важливість катодного захисту та його застосування на прикладі ізоляційного з'єднання трубопроводу. Трубопровід досліджується візуально та ультразвуковим вимірюванням товщини.

Ключові слова: корозія, катодний захист, трубопровід, ізоляційне з'єднання, нафтогазова промисловість.