APPLICATION OF POTENTIAL DROP TECHNIQUE FOR INVESTIGATION OF LARGE STRUCTURE INTEGRITY

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ABSTRACT
The measurement system based on potential drop technique is described and its application is demonstrated on long-term monitoring of crack initiation on large generator structure for production of sulphuric acid.

Keywords: Potential drop technique, crack, monitoring system.

INTRODUCTION
Boilers, steam pipe lines and other structure parts are exposed in power and chemical plants to high temperature, pressure and stresses, which may in consequence lead to the development of creep and plastic deformation and formations of cracks, followed with possible damage of the whole structure. The monitoring of structure deformation is therefore very usefull method for detection of these effects in the early state of their development. In many cases the use of strain gauges is not suitable due to their local type of measurement and high cost for stable performance in higher temperature conditions.

The potential drop technique is promising method for monitoring the creep, plastic deformation, and crack development and corrosion loss at room and high temperatures over 600°C. The measurement method is based of different features of potential field, which is in the material formed with electrical current, introduced with the help of two feeding electrodes. The pattern of the potential field is dependent on the object under investigations and the distance of supplying and one or two measurement pairs of electrodes. The plastic deformation $\varepsilon_p$ can be easy determined from the ratio of measured $U(I)$ and initial $U(I_0)$ potentials. The crack length $a$ can be directly calculated from potential, measured between two parts of measuring electrodes with mutual distance $y_1$ and $y_2$, see (1).

$$\varepsilon_p = \frac{U(I)}{U(I_0)} - 1$$

$$a = \sqrt{\frac{A^2y_2^2 - y_1^2}{1 - A^2}}$$

$$A = \frac{U(a,y_1)}{U(a,y_2)}$$

The method was applied for long-term monitoring of large generator structure for production of sulphuric acid. The distance of the electrodes was larger in comparison with standard use.
RESULTS AND CONCLUSIONS

The outer wall of the tank was provided with three pairs of electrodes at twelve high stressed areas, at each area the “gage length” was approximately 150 mm (Fig. 1). The electrodes were led with cables of 30 m length to the central control case (Fig. 2). Each area was provided with thermocouple and welded high temperature strain gauges were used. The temperature of measured points was about 300°C. The 6-channel measuring apparatus Techlab SRT-6K was used, which enables potential drop measurement both in DCPD and ACPD modes. The measuring system Data Taker DT80 was used for controlling the test time schedule. The data were on-line pre-evaluated and sent to the server via GSM router. The main task for the software unit was to monitor the trend of the signal and watch the limit values.

![Fig. 1 - Example of installed electrodes](image1.png)

![Fig. 2 - Controlling case in front of the tank](image2.png)

![Fig. 3 - Measured short time potential drop $\Delta U$, strain $\varepsilon$ and temperature $t$ at one area on the tank surface](image3.png)

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