ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDY IN-SITU STATE OF HEALTH OF THE ALKALINE Zn-MnO2 BATTERIES UNDER CHANGING OF THERMAL MODES

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Alkaline Zn-MnO_2 elements are extensively used type of batteries today. Studies of the zinc oxidation mechanisms, the mechanisms of MnO_2 reduction and influence of various chemical additives in the electrolytes have been used for significantly increasing of the lifetime of such systems in conditions of power loads. However, the available data does not allow to evaluate the degree of the changes in the composition and structure of the electrodes and electrolyte in the electrochemical current source as they are derived from compromising the integrity of the working element. Electrochemical impedance spectroscopy (EIS) is a powerful technique for electrode kinetic analysis. This is because it can give the individual impedance for each reaction process, including that of the electrolyte, the passivation layer, charge-transfer, and metal diffusion, provided that the individual time constants are separable. In current study was investigated the effect of temperature factor on the electrochemical characteristics of the charged commercial alkaline zinc-manganese batteries (Duracell AAA) in size (MN 2400). The EIS data were recorded in a two-electrode system using electrochemical module Autolab-30 (PGSTAT302N Metrohm Autolab) that was equipped with an FRA (Frequency Response Analyzer) analyzer. In order to ensure the temperature measurement mode, was used an electromechanical medium temperature thermostat with the precision of temperature measurement ± 1 °C.

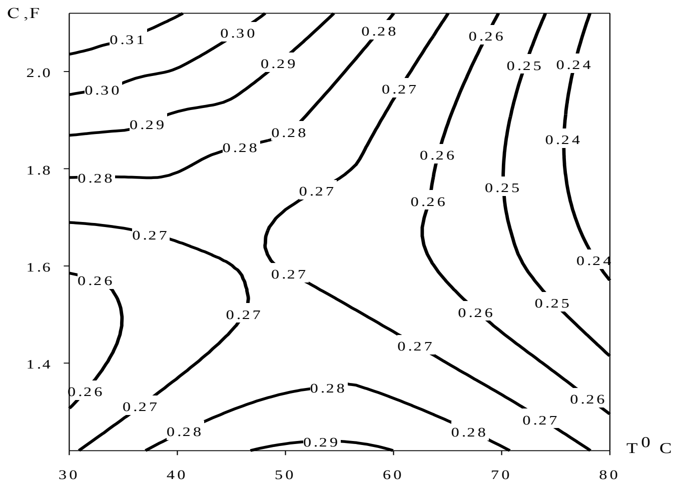

Fig. 1. The energy contour map of the surface capacitances and voltage variations of alkaline zinc-manganese batteries

The EIS data in Bode coordinates were used for determination of the values of the surface capacitances and voltage variations in an element for construction of the energy contours map (Figure 1) The temperature range (48–54 °C) corresponding to Zn and MnO_2 irreversible hydrolysis reactions was fixed experimentally. It was determined the optimal range of frequencies (102–105 Hz) for definition of the state of health of the studied elements.