Full Paper ____________ *Thematic Section:* Research into New Technologies.
Reference Object Identifier – ROI: jbc-02/18-56-12-102 *Subsection:* Technology of the Inorganic Substances.
Publication is available for discussion in the framework of the on-line Internet conference "*Butlerov readings*".
http://butlerov.com/readings/
Submitted on November 10, 2018.

The kinetics of the sulfonic acid cation exchanger KU-2×8 oxidative decomposition with an aqueous solution of H_2O_2

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Keywords: cation exchange resin KU-2×8, hydrogen peroxide, kinetic studies, chemical reaction constant, process activation energy.

Abstract

Ion exchange resins are used in various industries, including the purification of radioactive wastewater at nuclear power plants. Spent ion-exchange resins are heterogeneous radioactive low-level waste in the form of a cross-linked organic polymer beads. Such resins not always can be reused and regenerated. Therefore, there is a problem of their disposal in order to reduce the potential danger to the environment and human health. However, traditional technologies for the disposal of radioactive ion exchange resins are relatively expensive. In the present study, an attempt was made to solve the problem of spent ion-exchange resins utilization by the example of the sulfonic acid cation exchanger KU-2×8 oxidative destruction using the Fenton reaction. The decomposition of the cation exchanger was carried out with 5-25% hydrogen peroxide in the temperature range 348-368 K. The influence on the process of such factors as the process temperature and the concentration of hydrogen peroxide was estimated. When determining the speed of the decomposition process, the heterogeneous nature of the oxidation reaction for cation exchanger KU-2×8 and hydrogen peroxide was taken into account for the spherical shape of the sorbent granules. Within the studied temperature range with an increase in the process temperature, a systematic growth of the chemical reaction constant for the oxidative decomposition of the cation exchanger is observed by a factor of 12-18. It was established that the values of E_a for the resin decomposition reaction by H_2O_2 are in the range of 132.46-141.96 kJ/mol, which indicates the process is in the kinetic mode. Using electron-microscopic studies, it was established that changes on the cation exchanger's KU-2×8 surface upon its decomposition in H_2O_2 solution are local. At the same time, the granules change their shape and volume with an increase in the duration of the contact, and their surface becomes covered with cracks. The conducted studies have demonstrated an almost complete non-catalytic decomposition of the sulfonic acid cation exchanger KU-2×8 in hydrogen peroxide solution for 20-450 minutes at 348-368 K, which reduces the economic costs of sorbent disposal.

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