N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 6, Number 426 (2017), 201 – 206

M. Zh. Zhurinov, A. B. Bayeshov, N. S. Ivanov, T. E. Gaipov,
U. A. Abduvaliyeva, A. E. Konurbaev, B. E. Myrzabekov, N. B. Sarsenbayev

D. V. Sokolsky Institute of Fuel Catalysis & Electrochemistry, Almaty, Kazakhstan.
E-mail: bayeshov@mail.ru, xumuk777@mail.ru, tulkinjon.gaipov@gmail.com, abdumida14@gmail.com,
abibulla.kon@mail.ru, myrzabekbegzat@mail.ru

ELECTROCHEMICAL OXIDATION OF PHENOL ON LUMPY ELECTRODES AT A SURGE CURRENT POLARIZATION

Abstract. Phenol which one of the most abundant pollutants in industrial wastewater was investigated for purification. The selected wastewater was provided from the rest of the solution after petroleum producing. This is the major problem for regaining the water without including poisonous contaminants and it should be solved throughly. For this purpose lumpy electrodes and a surge current polarization were employed. Phenol oxidation in a stationary mode was carried out by four-sectional electrolyzer which each has 75 mL volume capacity. Anode chambers of purification vessel were equally filled with lumpy electrodes obtained from graphite and they were separated from cathode chambers by porous divisions. Cathode chambers were also completely filled with graphite cores which were used as cathodes. Research of the phenol containing solutions for modeling was selected 10-50 mg/L and sodium sulfate as a background was adjusted with the ratio of 0,25-2,0 g/L. Phenol concentration was defined photometrically. The direct oxidation of phenol on lumpy electrodes at polarization with a surge current has significant advantages when compared to the previous electrochemical methods.

Key words: phenol, electrochemical oxidation, lumpy electrodes, stationary mode, anode, electrochemical method.

Introduction. Phenol which is also called oxybenzene, monohydroxybenzene or phenyl hydroxide has a weak acidity ($K_a=10^{-10}$) and specific fragrance. Phenolic compounds exist in some plants' structure such thyme, carnation and anise. It has been using in multipurpose fields like pesticides, making synthetic resins, perfumes, solvents, pharmaceuticals, dyes, lubricating oils and synthetic tanning agents. It had also used as drug for itching treatments in earlier ages. On the other hand its higher doses have found quite harmful and toxic for the human health in the last decades. Due to the facile solubility in water at room temperature (approximately 9g/100mL) and being miscible with any percentages at more than 65 °C are the main problems for the running water, lakes, seas etc. contaminated by petroleum or any reasons [1-3].

The production of phenol in each year is over 3 million tons so its pollution can't be ignored at all. The human central nervous system, lungs and kidneys are being damaged because of the long-term exposure. Thus, the phenol is classified as a water hazard substance in many countries. The allowed concentration of phenol is only 0.5 mg/L in drinking water. [4]

Purification of wastewater from phenol and its derivatives has carried out by a great number of techniques in particular with chemical oxidation with hydrogen peroxide, ozone [1, 2]. There is a great number of researches devoted to electrochemical oxidation of phenol which cause water contamination for the demand of human being [5-8].

The basic process of purification of water has applied not with direct oxidation of phenol, but also the usage of hydrogen peroxide reagent as it is described as a Fenton's reagent [2, 9-11]. Phenol oxidation has researched on with various modified electrodes by scientists [12-14]. It has been difficult to provide deep cleaning to electrodes in direct oxidation process due to the small contact area with solution that cause decreasing of final installation amount phenol. In the case of application of lumpy electrodes for the purification, it facilitates the handicaps with the aid of using a surge current which essentially reduces the voltage and allows achieving without a rectifier [15]. The lumpy electrodes lead us to remove phenol and