ASSESSING BISPHENOL A DEGRADATION VIA ELECTRO-FENTON PROCESS: THE ROLE OF LACTIC ACID AS AN INDICATOR

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Abstract

Bisphenol A (BPA) is a commonly used industrial chemical in the manufacturing of plastics and resins; however, its endocrine-disrupting properties pose serious health risks to living organisms. By interfering with hormonal balance, BPA can contribute to reproductive and developmental problems. Due to its extensive use, BPA remains prevalent in the environment, highlighting the importance of developing efficient methods for its degradation and monitoring. The electro-Fenton process, utilizing a SnO_2-MWCNT (multi-walled carbon nanotube) anode and a stainless-steel cathode, operated at a current density of 15 mA cm^{-2} in 0.1 M Na_2SO_4 at pH 4 with externally added H_2O_2 (30 mM) and Fe^{2+} (3.66 mM), demonstrated high efficiency in removing BPA from water, achieving complete mineralization into carbon dioxide and water through OH radicals. During the oxidation of BPA via the electro-Fenton process, various intermediates are formed, including hydroxylated BPA derivatives (catechol, dicatechol, quinones) and smaller single-ring molecules such as 4-isopropenylphenol, benzoic acid, 4-hydroxybenzoic acid, 4-hydroxyacetophenone, and hydroxyquinone. These intermediates slowly convert into carboxylic acids, such as lactic acid, and eventually break down into carbon dioxide and water. Based on the obtained results, it can be observed that the concentration of lactic acid steadily increases up to the fourth hour of the electro-Fenton process, at which point it reaches its maximum level. After this peak, the concentration of lactic acid suddenly decreases, suggesting that the degradation process is progressing towards the complete mineralization of BPA. This decline in lactic acid concentration indicates the successful breakdown of intermediate products and the further transformation of these compounds into simpler molecules, ultimately resulting in the complete mineralization of BPA into carbon dioxide and water.

This study highlighted the potential of utilizing lactic acid as an effective indicator of BPA degradation within the electro-Fenton process. The findings suggest that lactic acid can serve as a reliable marker for tracking the progress of the degradation process and provide valuable insights into its overall effectiveness. By monitoring the concentration of lactic acid, it is possible to predict the efficiency of the electro-Fenton process, offering a practical tool for assessing the extent of BPA removal and the success of the mineralization process over time.

Keywords: *bisphenol A, electro-Fenton, OH radicals, wastewater treatment*