4TH National Conference of Iran Chmistry, Chemical Enginereeng And Nano

ELECTROPHOTOCATALYTIC PROCESS FOR REMOVING ACID HUMIC FROM AQUOUCE

G. Kashi[*,1], F. Khoushab[2]

[1,2]Department of Environmental Health, Islamic Azad University Tehran Medical Branch, Tehran, Iran (E-mail: g.kashi@yahoo.com)

Abstract: Humic substances, as precursor to disinfection by-products (DBPs), are produced by the microbial degradation of dead plant matter. The goal of this research is to investigate of humic acid (HA) from urban drinking water by batch electrophotocatalytic reactor (EPC) with using zinc oxide (ZnO) nanoparticles immobilized on zinc (Zn) sheet-copper electrode, and lamp emitting dynode (LED) ultraviolet-A (UV-A) lamp. Various operating variables are tested; these included current density, initial concentration of HA, lamp intensity, layering of ZnO nanoparticles, pH, and radiation time.To prepare the ZnO films on the Zn electrode, dry methods are used. The sample is prepared by adding 5-15 milligrams of HA per ml of deionized water. The studied variables are pH (4-10), the HA concentration (5-15 mg/L), the lamp intensity (360-600 mW/cm^2), radiation time (7.5-22.5 min), layering of zinc oxide nanoparticles (1-3), and current density (3-9 mA/cm^2). The HA concentration is measured by using spectrophotometer at a wavelength of 253.7 nm. The optimal removal (0) is obtained at pH 4, radiation time of 15 minutes, 2- layer of ZnO nanoparticles, lamp density 600 mw/cm^2, and current density of 9 mA/cm^2. The HA decay follows a first order reaction. The results of HA removal efficiency by Taguchi model indicates that the reaction time is the most important variable. The electrochemical (E) process is the least efficiency. The rate of decay decreases at higher concentrations. Thus, batch experiments show that the EPC reactor could be considered as a promising technology for treating HA-polluted water.

Keywords: Aqueous water, Electrophotocatalytic, Humic acid, Taguchi model, Zinc oxide.

1. INTRODUCTION

Chlorination process, the most common method of drinking water chemical disinfection, of natural water leads to formation of trihalomethanes (THMs) due to reaction of chlorine with natural organic matter (NOMs), predominantly humic (HA) and fulvic acid. The most harmful organic compounds in drinking water are considered as disinfection byproducts (DBPs). THMs as a main sub-group of DBPs are carcinogenic for persons [1]. The THMs consists of chloroform (TCM), dichlorobromomethane (DCBM), dibromochloromethane (DBCM), and bromoform (BCM). They are classified to be possible carcinogenic compounds (B2 class) [2]. Presence of THMs in drinking water perhaps leads to enhancing incidence of bladder, rectal (colorectal carcinoma), and colon cancer [3]. HA ($C_{187}H_{186}O_{89}N_9S_1$) is composed of aromatic molecules, linked with phenolic and carboxylic functional groups [4]. HA, an allochthonousact mater, as mixtures of dibasic acids, with a pK_1 value around 4 for protonation of carboxyl groups and around 8 for protonation of phenolate groups [5]. HA is insoluble in strong acid (pH equal to 1). A 1:1 hydrogen-to-carbon ratio characterizes aromatic character such as the presence of benzene rings in the structure, an inadequate low oxygen-to-carbon ratio characterizes fewer acidic functional groups than presence in fulvic acid, the other acidic organic polymer that can be extracted from humus. The guideline level for total THMs (TTHMs) and TCM in drinking water are $\leq$ 1 and 200 µg/L, according to the World Health Organization (WHO) [6]. The increase in natural organic matters (NOMS) such as HA levels in ground and surface water have been mainly attributed to anthropogenic (the food, leather, and wood manufacturing) and natural (the microbial degradation of dead plant matter) sources [7]. The concentration of NOMS of Karaj, Jajrood, and Lar rivers is 11.33, 12.9, and 8.53 mg/L,

[1]Water Purification Research Centre (WPRC), Tehran Medical Sciences Branch, Islamic Azad University, Tehran, Iran (E-mail: WPRC@iautmu.ac.ir)