Electrochemical transformation study of antibiotic Sulfamethoxazole using $Ti/Ru_{0.3}Ti_{0.7}O_2$ anode: kinetics and energy cost evolution

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Abstract:

Pharmaceutical has recently been recognized an emerging environmental contaminants. Sulfamethoxazole (SMX) an important antibiotic has been identified in many wastewater treatment plants effluents. In the present study, an electrochemical experiments were conducted to degrade and mineralized antibiotic Sulfamethoxazole. A laboratory scale bench-top reactor was used to investigate the effect of various operating parameters such as applied current density and supporting electrolytes, using titanium based dimensionally stable anode (DSA). The degradation and mineralization of SMX was greatly enhanced by increasing the applied current density from (10 $mAcm^{-1}$ to 60 $mAcm^{-1}$). Maximum SMX degradation and TOC removal was achieved in 30 and 120 minutes using 60 mA cm^{-1}, respectively. The degradation of SMX was found to follow pseudo-first order reaction. The efficiencies of degradation and TOC removal are discussed in terms of the energy per order (EEO/$kWhm^{-3}$ $order^{-1}$) and energy consumption (EC/$kWhkg^{-1}$ TOC), respectively. These results indicated that SMX could be completely degraded and efficiently mineralized using DSA electrode.

Pharmaceuticals are developed and manufactured to serve human and animal health, and promote livestock farming. But after administration these compounds are not completely metabolized in the body and some of the traces are excreted with urine and feces in unmetabolized forms [1]. The excreted pharmaceuticals are ultimately discharged into conventional wastewater treatment plants (WWTPs). Where these compounds are often not eliminated and mostly they are not biodegraded in the environment [2]. Among these pharmaceuticals the antibiotic received extra ordinary attention because of their wide prescribed and unprescribed used. Sulfamethoxazole (SMX) is one of the frequently used antibiotics for treating various diseases in human and animals, and also used to promote growth in food producing animals. SMX is rigid to treatment employed at WWTPs. As result it has been found in effluents from WWTPs up to 1.9 μgL^{-1} and even in drinking water in the low ngL^{-1} [3]. The persistence of SMX in aquatic environment poses risk not only in the promotion

of resistance strains of bacteria, but also in other human, animal, and environmental impairments [4, 5]. Recently SMX has been detected in municipal wastewater and surface water bodies [6].

Advanced oxidation processes (AOP) is an effective method for the removal of various class of pollutants like dyes[7], pesticides[8], herbicides[9]and others organic compounds from wastewaters [10]. Fenton reaction is also well known in the literature. It is an efficient and cost effective method for wastewater and soil treatment [11]. Hydroxyl radicals are generated by the decomposition of hydrogen peroxide when reacting with ferrous ions. Some of the studies have been carried out for the treatment of wastewater containing sulfamethoxazole (SMX) but some of these methods need highly operational cost. However, no studies aiming its treatment using Fenton and coupled Fenton process have been found. The aim of the present study is to degrade and mineralized sulfamethoxazole (SMX) by an efficient and cost effective method.

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