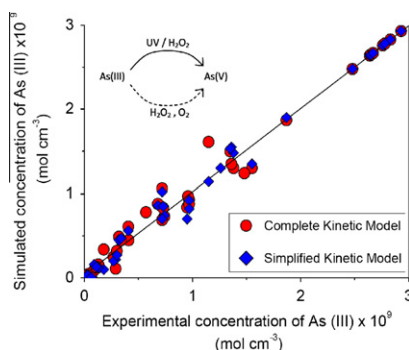


Kinetic modeling of arsenic (III) oxidation in water employing the UV/H₂O₂ processMaia Lescano^a, Cristina Zalazar^{a,b}, Alberto Cassano^{a,b}, Rodolfo Brandi^{a,b,*}^a INTEC (UNL-CONICET), Güemes 3450, 3000 Santa Fe, Argentina^b FICH (UNL), Ciudad Universitaria, Paraje El Pozo, 3000 Santa Fe, Argentina

HIGHLIGHTS

- ▶ A kinetic model for the oxidation of As (III) by the UV/H₂O₂ process is developed.
- ▶ The study includes dark and photoactivated reactions and estimates three parameters.
- ▶ A simplified model neglecting dark reactions is proposed.
- ▶ The kinetic models (complete and simplified) are in concordance with the experimental data.

GRAPHICAL ABSTRACT



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ABSTRACT

In a previous study it has been shown that the combination of hydrogen peroxide and UVC radiation is an effective and feasible process to oxidize arsenic in water. In this work, a kinetic model for the photo-oxidation of As (III) is presented. An initial concentration of 200 µg/L of As (III) was used. The model was based on mechanistic reaction steps and included the modeling of the local radiation absorption effects. The evaluation of the radiation field inside the reactor was achieved by solving the radiative transfer equation for the homogeneous system. Both dark and photochemical arsenic oxidation rates were incorporated in the complete kinetic expression. Three parameters were estimated and a simplified model that only considered photoactivated reactions was developed. The rates obtained from these simplifications were compared with the rates from the complete model and showed a satisfactory concordance. The study was carried out in a cylindrical reactor operated in batch recirculation mode and two germicidal lamps were used ($\lambda = 254$ nm) as the source of radiation. Experimental runs were performed varying the hydrogen peroxide concentration and incident radiation. Both models rendered a good representation of the experimental data.

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1. Introduction

The occurrence of dissolved arsenic in drinking water is a serious global problem. Groundwater contaminated by arsenic can have severe human health implications including various forms of cancer, cardiovascular and peripheral vascular disease and diabetes. Arsenic is released from soil into aquatic environment

through natural processes (weathering of arsenic containing minerals) and anthropogenic activities (release of uncontrolled effluents from mining and metallurgical industries and use of organoarsenical pesticides) [1].

The chemical species of arsenic, which can exist in the natural environment, heavily influence its mobility, adsorption properties and toxicity [2]. In natural waters, arsenic may occur in both inorganic (As (III) and As (V)) and organic forms (monomethyl arsenic acid (MMAA) and dimethyl arsenic acid (DMAA)). Arsenite (As (III)) is the most toxic water-soluble species and arsenate (As (V)) is also relatively toxic. The methylated forms are much less toxic [3].

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