



Prediction of advanced oxidation performance in various pilot UV/H₂O₂ reactor systems with MP- and LP- and DBD-UV lamps

Roberta C.H.M. Hofman-Caris^{a,*}, Danny J.H. Harmsen^a, Erwin F. Beerendonk^a, Ton H. Knol^b, Corine J. Houtman^c, Deborah H. Metz^d, Bas A. Wols^a

^a KWR Watercycle Research Institute, Department of Drinking Water Technology, P.O. Box 1072, 3430 BB Nieuwegein, The Netherlands

^b Dunea, P.O. Box 34, 2270 AA Voorburg, The Netherlands

^c Het Waterlaboratorium, P.O. Box 734, 2003 RS Haarlem, The Netherlands

^d Greater Cincinnati Waterworks (GCWW), 4747 Spring Grove Ave., Cincinnati, OH 45232, USA

H I G H L I G H T S

- Reaction kinetics and CFD-model to predict conversion in UV/H₂O₂ reactors.
- Tested for three different UV lamps.
- Tested for six different reactor geometries.
- Tested for various water matrices and qualities.
- Model gives good prediction of conversion for organic micropollutants.

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The UV/H₂O₂ advanced oxidation process is increasingly applied as a barrier against organic micro pollutants in drinking water treatment. Adequate modeling of the purification process, resulting in a reliable prediction of the reactor performance, would make it possible to optimize the operating parameters as a function of seasonal or diurnal fluctuations in the influent composition, and thus save energy while still guaranteeing safe drinking water. We recently developed two design tools to predict full scale performance of UV/H₂O₂ reactors: the UVPerox I and II models. UVPerox I is based on a kinetic model, describing both photolysis and oxidation. By means of Computational Fluid Dynamics (CFD) calculations of the reactor the UV dose distribution inside the reactor can be calculated, while the kinetic model gives the conversion as a function of the UV dose. UVPerox I is shown to be applicable to reactors equipped with Low Pressure (LP) or Dielectric Barrier Discharge (DBD) UV lamps, using a broad range of organic compounds, resulting in a <5–10% deviation from experimental data for different water matrix compositions. The conversion of micro pollutants as a function of the UV dose can also be experimentally determined, using a collimated beam (CB) set-up. The dose response curves thus obtained can also be directly implemented in the CFD-model of the reactor (UVPerox II). Using several model compounds UVPerox II is shown to be applicable to reactors equipped with three kinds of UV lamps (LP-, MP- UV and DBD lamps), each with its own emission spectrum. The deviation from experimental data was found to be <5–10%, independent of the composition of the water matrix. Both models were applied to several reactor geometries. Good agreement was obtained between both models and the actual conversion data for three types of UV lamps in various pilot reactors and water types.

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1. Introduction

The presence of new contaminants and increasing contaminant concentrations in water sources may form a serious threat to drinking water quality. In recent years it has been shown that ad-

vanced oxidation processes, like UV/H₂O₂ oxidation, have the potential to be important barriers against organic micro pollutants in drinking water treatment [1]. However, their performance strongly depends on the composition and properties of the water matrix (like e.g. UV-transmission), which is subject to seasonal and diurnal variations. In order to be on the safe side, in general a relatively high UV dose is applied. If it would be possible to adjust the operational settings to the actual influent composition, a

* Corresponding author. Tel.: +31 30 60 69 673; fax: +31 30 60 61 165.

E-mail address: roberta.hofman-caris@kwrwater.nl (R.C.H.M. Hofman-Caris).