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Abstract

Degradation of *Microcystis* sp. in Surface Water by Ozone †

Jesús J. Beltrán de Heredia Alonso [1,*,‡], José Martín Gallardo [2] and María del Mar Barrado Moreno [1]

[1] Department of Chemical Engineering and Physical Chemistry, Faculty of Sciences, University of Extremadura, 06071 Badajoz, Spain; mar88@unex.es
[2] Department of Plant Biology, Ecology and Earth Sciences, Faculty of Sciences, University of Extremadura, 06071 Badajoz, Spain; jomarga@unex.es
* Correspondence: jbelther@unex.es
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‡ Presenting author (poster).

Abstract: Due to the gradual increase in the concentration of algae, in general, in continental surface water reservoirs, it is necessary to incorporate advanced technologies in drinking water treatment plants with a view to reduce/eliminate the algae present. This degradation of the algal mass will additionally lead to the destruction of the toxins that could be released into the aqueous medium during the course of potabilisation. In this work, degradation assays of *Microcystis* sp. in surface water by oxidation processes with ozone have been studied. Ozonation experiments have been carried out in a homogeneous regime (mixture of an aqueous solution with dissolved ozone and surface water) and heterogeneous regime (continuous bubbling of a gaseous current with ozone in surface water). Different aqueous matrices were used for the assays (distilled water, Guadiana river as it passes through Badajoz (Spain), Villar del Rey reservoir (Spain) and a stream that circulates through the campus of the University of Extremadura in Badajoz (Spain)), which were doped with different amounts of a culture of *Microcystis* sp., provided by the University of Coimbra (Portugal), to achieve the desired initial load of algal mass. The original aqueous matrices were filtered through 0.45 micrometer filters (Millipore). An ozonizer (Sander, model 300.5) was used, capable of generating from pure oxygen a mass flow rate of 6 g/h with an ozone concentration in the gas phase of 1.6% by volume. In the case of the experiments in a heterogeneous regime, the reactor was a cylindrical column 20 cm high and 8 cm in diameter, fitted with a microporous diffuser. To determine the content of algal mass present in the initial sample and in those treated by ozonation, a portable fluorimeter (Aquafluor, Turner) was used, which allows to measure the content of chlorophyll in vivo between 0.3 and 300 µg/L. Ozone analysis in the aqueous phase was performed by the Karman Indigo method and in the gas phase by iodometry. Experiments carried out in homogeneous regime show that in only 5 minutes the chlorophyll content is reduced by 50% for all types of aqueous matrices and for different initial contents of algal mass between 15 and 50 µg/L. For a time of 30 minutes, the conversion is between 80 and 90%, except for the Guadiana river matrix, which is between 70 and 80%. In the case of the heterogeneous regime, ozonation experiments have been carried out by varying the ozone concentration between 4.5×10^{-5} and 5.4×10^{-4} mol/L. It is observed that this variable has a strong positive influence on the degradation of the algae. Thus, for a time of 30 minutes, the degradation is total with the four matrices for the ozone concentration of 5.4×10^{-4} mol/L, while for the concentration of 4.5×10^{-5} mol/L the degradation is between 80 and 90%. A kinetic study has been carried out in both types of ozonation regime. In the case of the homogeneous regime, the model includes both the self-decomposition of ozone in water and the direct reaction of ozone with the algae, and in the case of the heterogeneous regime, the mass transfer of ozone from the gas to the liquid phase is also incorporated. The resolution of the model with the MATLAB software leads to a value of the kinetic degradation constant of the alga between 9×10^{-4} (Villar del Rey reservoir) and 1.4×10^{-3} (distilled water) L/(µg chlorophyll min).

Keywords: surface water; potabilisation; ozonation; kinetic study; *Microcystis*

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