

ORIGINAL PAPER

Removal of selected chlorinated micropollutants by ozonation

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Feasibility of ozone oxidation for the elimination of selected dissolved organic micropollutants from water and wastewaters was studied. Five organochlorine pesticides, i.e. hexachlorobutadiene, pentachlorobenzene, hexachlorobenzene, lindane, and heptachlor, were used as organic contaminants of model water. The first four of them are classified as priority hazardous substances. The oxidation treatment process was performed in a jet loop reactor. Ozone was prepared from pure oxygen. Quantification of the organochlorine pesticides in water was achieved by the gas chromatographic method after liquid–liquid extraction. Significant contribution of stripping to the removal of the investigated compounds during the ozonation treatment was also proven by the results. Effective ozonation time with regard to treatment efficiencies was 30 min, which corresponds to the ozone input of 317 mg per liter of active volume of the ozonation reactor. Single power law kinetic models were used to describe experimental data and kinetic parameters were estimated. The best fit of the experimental degradation data of all studied pollutants was obtained by the second order kinetic model. It can be concluded, based on the results obtained, that the applied ozonation process is a promising procedure for the removal of the investigated pesticides from aquatic environment.

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Keywords: jet loop ozonation reactor, organochlorine pesticides, ozone oxidation, reaction kinetics, stripping, water and wastewater treatment

Introduction

The adoption of the Framework Directive on Water (European Commission, 2000) provides a policy tool enabling sustainable protection of water resources. Decision No 2455/2001/EC of the European Parliament and the Council (European Commission, 2001) constituted a list of 33 priority substances or groups of substances. The EC member countries have extended this list with pollutants relevant for individual countries. Thus, in the supplement of the Water Act (National Council of the Slovak Republic, 2004), 59 relevant substances for the Slovak Republic are identified. Many of the included pesticides belong to persistent organic pollutants. They are toxic,

slowly biologically degradable, and accumulative in organisms, and terrestrial and aquatic ecosystems. These compounds, in many cases enter the aquatic ecosystem due to agricultural use, after their discharge from industry or even after the discharge of municipal wastewater treatment plants effluents. Some of them are harmful to ecosystems and human health. Due to their bioaccumulation in animal tissues, they can concentrate at the top of the food chain. Environmental Quality Standards Directive, i.e. Directive 2008/105/EC (European Commission, 2001) defines the good chemical status to be achieved by all Member States in 2015 and provides, together with the Water Framework Directive 2000/60/EC (European Commission, 2000), legal basis for monitor-

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