INVESTIGATION OF UV/CHLORINE PROCESSES FOR TRIMETHOPRIM TRANSFORMATION USING LPM (254 nm) AND LED (275 nm) LIGHT SOURCES

Luca Farkas, Teodóra Dragić, Tímea Molnár, Tünde Alapi

Department of Inorganic and Analytical Chemistry, University of Szeged, H-6720 Szeged, Dóm tér 7, Hungary
e-mail: fluca@chem.u-szeged.hu, alapi@chem.u-szeged.hu

Pharmaceuticals are essential in the treatment of many human and animal diseases. Recently, due to their growing consumption and hard biodegradability, the elimination of pharmaceuticals is one of the challenging tasks of water treatment today. Special attention must be paid to removing antibiotics due to the severe ecological and public health consequences of their release into the environment. Nowadays, more than 700,000 deaths happen globally due to infections caused by antibiotic-resistant bacteria strains. Application of advanced oxidation processes as post-treatment is one of the possibilities to remove biologically active trace organic pollutants from treated water.

The low-pressure mercury vapor (LPM) lamp is a widely used light source in water treatment because of the germicidal effect of emitted 254 nm UV light. However, organic pollutants can also be effectively disposed of by adding the appropriate oxidizing agents (O_3, H_2O_2, HOCl, ClO_2, etc.). In recent years interest turned to the application of LED light sources in water treatment due to their several favorable features [1]. In the case of the UV/chlorine process [4], HOCl, a widely used disinfectant, can be an oxidizing agent. HOCl can react directly with organic substances, besides its UV photolysis leads to many different reactive species, including hydroxyl radical, chlorine radical, and others [4]. The formation of reactive species highly depends on the pH as well as the wavelength of the UV radiation.

In this study, the efficacy of the LPM lamp (254 nm) and UV LED (275 nm) were studied and compared for trimethoprim, a widely used antibiotic transformation, using the UV/HOCl process. At 254 nm (LPM lamp), the molar absorbance of the HOCl and OCl^- are the same, while at 275 nm (the wavelength of the maximum of the LED emission spectra), the molar absorptivity of OCl^- is two times higher than that of HOCl. Consequently, pH has a crucial role. Trimethoprim reacts fast with HOCl, while the reactivity towards OCl^- is negligible. At pH 5, the transformation occurs within two minutes without UV irradiation, while at pH 9, there is practically no change. Without the pH setting of the solution, both 254 and 275 nm radiation highly enhanced the transformation rate. One of the drawbacks of the chlorine-based advanced oxidation process is the formation of chlorinated products. The AOX measurements proved that UV/chlorine process generates less chlorinated organic products than the direct reaction of trimethoprim with HOCl.

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