Editorial

Advanced Oxidation Processes for Wastewater Treatment

Meenakshisundaram Swaminathan,¹ Manickavachagam Muruganandham,² and Mika Sillanpää³

¹ Department of Chemistry, Annamalai University, Annamalai Nagar 608002, India

² Water and Environmental Technology (WET) Center, College of Engineering, Temple University, Philadelphia, PA 19122, USA

³ Laboratory of Green Chemistry, Faculty of Technology, Lappeenranta University of Technology, 50130 Mikkeli, Finland

Correspondence should be addressed to Meenakshisundaram Swaminathan; chemres50@gmail.com

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Clean and nonpolluted water is one of the basic requirements for all living organisms including human beings. But its availability is a major problem nowadays. In the future, this problem will further increase due to global industrialization and population growth. Natural waters are being contaminated by the discharge of industrial, domestic, and agricultural wastes. Hence, at present it is very important to remove the pollutants and pathogens from wastewater to fulfill the needs for irrigation and industrial and domestic use. In the past years, conventional biological and physical treatment methods (adsorption, ultrafiltration, coagulation, etc.) have been used to remove the organic pollutants. These methods are not efficient and cost effective for wastewaters containing high concentration of more toxic pollutants. This requires some novel techniques to transfer the highly toxic pollutants chemically into benign species. Advanced oxidation processes (AOPs) are more efficient, cheap, and ecofriendly in the degradation of any kind of toxic pollutants. AOPs generate hydroxyl radical, a strong oxidant, which can completely degrade or mineralize the pollutants nonselectively into harmless products.

This special issue covered various AOPs used for the treatment of industrial wastewater, sewage, and landfill leachates. In 25 papers, authors have submitted original research articles in the following topics: (i) Fenton/photo-Fenton processes, (ii) UV/H₂O₂/ozone and sonolysis processes, (iii) Heterogeneous photocatalysis using TiO₂/ZnO and their modified forms, and (iv) Use of different photoreactors for treatment.

A review on recent development in AOPs for water and wastewater treatment provides the latest developments

on heterogeneous photocatalysis, Fenton/photo-Fenton processes, and UV/H₂O₂/ozonation processes.

A brief outline of all the accepted papers is provided as the following. D. H. Tseng et al. studied the influences of oxygen and hydrogen peroxide (H₂O₂) on the degradation and mineralization of monochlorobenzene (MCB) in the UV/TiO₂ process. Their studies provided very useful information that the oxygen was a determining parameter for promoting the photocatalytic degradation.

N. R. Sanabria et al. reported development of pillared clays for wet hydrogen peroxide oxidation of phenol and its application in the posttreatment of coffee wastewater. From this study, they were able to conclude that catalytic wet hydrogen peroxide oxidation emerges as a viable alternative for posttreatment of coffee wastewater effluent.

Photo-Fenton and Fenton oxidation of recalcitrant industrial wastewater using nanoscale zero-valent iron was reported by H. Hansson et al., The highest removal of COD and TOC (80% and 60%, resp.) were achieved using photo-Fenton process.

W. S. Kuo and W. Y. Chen investigated Fresnel lens assisted by solar photocatalytic degradation of azo dye in aqueous TiO₂ suspension.

Tertiary wastewater treatment by using combined process of UV photolysis and ozonation with biological aerating filter was studied by Z. Jing and S. Cao. They concluded that the combination of UV/O₃ oxidation with biological aeration filter was quite efficient in the organic pollutants removal for tertiary wastewater treatment.

In “*Microbiological evaluation of the effectiveness of sewage sludge sanitization with solar drying technology*,” authors estimated the sanitization effectiveness of the process of solar drying of sludge on technical scale in Poland, based on the inactivation kinetics of some test bacteria and parasite eggs.

C. D. Stan et al., investigated degradation of mepiquat chloride pesticide wastewaters by heterogeneous and homogeneous photocatalysis.

The oxidation degradation of Rhodamine B by using UV/S₂O₈²⁻ treatment system was studied by X. Chen et al.

J. Naumczyk et al., studied the landfill leachates treatment by using the advanced oxidation processes (AOPs) such as H₂O₂/UV, O₃/H₂O₂, modified Fenton, and modified photo-Fenton methods. They concluded that modified photo-Fenton process was the most effective among the all AOPs investigated.

N. Kishimoto, E. Nakamura reported bromate formation from potassium bromide solution with or without 6.4 μM of 4-chlorobenzoic acid by using six physicochemical oxidation processes, such as UV irradiation, single addition of hydrogen peroxide, ozonation, UV irradiation with hydrogen peroxide addition (UV/H₂O₂), ozonation with hydrogen peroxide addition (O₃/H₂O₂), and ozonation with UV irradiation (O₃/UV).

M. Antonopoulou et al. studied the simultaneous photocatalytic reduction of Cr(VI) and oxidation of benzoic acid in aqueous suspensions using N-F-codoped TiO₂, and simulated solar irradiation in the present study. Chemometric optimization tools such as response surface methodology (RSM) and experimental design were used to model and optimize selected operational parameters of this simultaneous redox process.

In “*Energy effectiveness of direct UV and UV/H₂O₂ treatment of estrogenic chemicals in biologically treated sewage*,” the removal efficiency by direct UV and the UV/H₂O₂ treatment was investigated in biologically treated sewage for the parabens, industrial phenols, sunscreen chemicals, and steroid estrogens in wastewater in a thorough setup. Removal effectiveness was found to increase with H₂O₂ concentration up to 60 mg/L.

The electrochemical incineration of phenolic compounds using boron-doped diamond electrodes was studied by A. Medel et al. The results were compared to the photo-electro-Fenton process.

Z. Ding et al. have reported the preparation of a modified PTFE fibrous photo-Fenton catalyst and its optimization towards the degradation of organic dye. They found that increasing the Fe content or incorporation of Cu(II) ions could significantly improve the catalytic activity of the complexes.

The oxidation of landfill leachate by heterogeneous Fenton process using ceria-based catalysts was reported by E. Aneggi et al., They concluded from their studies that the heterogeneous Fenton technique could be effectively used for the treatment of landfill leachate.

S. Palmas et al. investigated the adsorption of glycerol at TiO₂, as well as its oxidative process during the contemporary water photo-electro-splitting for hydrogen production.

In “*Photocatalytic degradation of aniline using TiO₂ nanoparticles in a vertical circulating photocatalytic reactor*,” photocatalytic degradation of aniline in the presence of titanium dioxide and ultraviolet illumination was performed in a vertical circulating photocatalytic reactor. The Langmuir-Hinshelwood kinetic model was successfully applied. The reactor was used successfully in the treatment of a real petroleum refinery wastewater.

The photocatalytic reduction of Cr(VI) ions in aqueous solutions by using UV/TiO₂ process was investigated by C. M. Ma et al. The influence of various experimental parameters on the photocatalytic reduction was studied.

In “*Photocatalytic treatment of shower water using a pilot scale reactor*,” a pilot scale study of photocatalytic degradation of impurities in real shower water was performed using titanium dioxide as the photocatalyst in a continuous slurry recirculation mode. More than half of the total organic carbon (TOC) elimination was obtained after 6 hours of treatment. Importantly, photocatalysis was successfully transposed from bench scale to pilot scale.

In “*A new photocatalytic system using steel mesh and cold cathode fluorescent light for the decolorization of azo dye Orange G*,” a new photocatalytic system was prepared by coating nanosized TiO₂ particles on steel mesh support and using cold cathode fluorescent light irradiation in a closed reactor for the oxidation of azo dye C.I. Orange G (OG). Efficient color removal of the OG azo dye by the photocatalytic system with TiO₂-coated temperature at 150°C was achieved at the optimal TiO₂ dosage 60 g m⁻². The TiO₂-coated steel mesh could be used repeatedly over 10 times without losing the photocatalytic efficiency.

R. Liu et al. reported the preparation of TiO₂ and Ag-TiO₂ by coprecipitation method. The synthesized photocatalysts were characterized by using suitable analytical techniques. The *E. coli* inactivation by using the synthesized photocatalyst was investigated.

R. M. Mohamed and M. A. Barakat synthesized the Pt-doped ZnO/SiO₂ photocatalysts and their photocatalytic activity was tested by using phenol as a model pollutant. The synthesized photocatalysts were characterized by using advanced analytical techniques.

V. Naddeo et al. studied the degradation of diclofenac by using various advanced oxidation processes such as ozonation (O₃) and sonolysis (US) and their combined application (US+O₃).

C. Y. Lee et al. studied methylene blue decomposition by using novel microwave/UV/DO/TiO₂ photocatalyst hybrid system. Authors discussed the effect of TiO₂ dosage, the influence of dissolved oxygen level, and the effect of microwave irradiation on the removal of methylene blue.

Q. Zhang et al. studied how the methylene blue dye degradation was affected by the high photon flux UV irradiation and results were compared with routine low photon flux photocatalytic process. Under the optimized conditions, the UV photocatalytic reaction 99% decolorization and 95% TOC removal of 20 mg L⁻¹ methylene blue could be achieved in 30 s and 120 s of UV irradiation time, respectively.

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*Meenakshisundaram Swaminathan
Manickavachagam Muruganandham
Mika Sillanpaa*