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Organic Chemistry: Current Research

Perspective

Decomposition of Ibuprofen in Aromatic Compounds and Mineralization of Organic Substrate

Larry Houdek*

Department of Bioorganic Compounds, University of the Andes, Carrera, Bogotá, Colombia

DESCRIPTION

Advanced Oxidation Processes (AOPs) like catalytic ozonation are important for treating water. In terms of the catalysts used and the optimization of operational parameters, catalytic ozonation has seen consistent improvement since its initial development. This study compares the catalytic activity of Polyaniline (PANI) and polyaniline that has undergone thermal treatment (PANI 900) in the catalytic ozonation of ibuprofen solutions at various pH levels. SEM, Raman spectroscopy, XPS, pHPZC, and other techniques were used to thoroughly characterise the catalysts, and various analytical techniques were used to determine how well the ibuprofen solutions (100 mgL^{1}) were being oxidised (HPLC, UV254, TOC, COD, and BOD5). Water contamination is a major problem in modern society. The existence of these developing pollutants in water, which inflict irreparable harm to human health and the ecological environment, has now become a significant environmental burden due to the rise in the consumption of Pharmaceuticals and Personal Care Products (PPCPs). PPCPs are found in surface waters, groundwater, sewage water treatment plants, and industrial wastewater at concentrations ranging from the gL^{1} to ngL^{1} and are thought to have a more detrimental effect on the environment and water quality than any other pollutants because of their bioactive activity and dangerous toxic metabolites.

Advanced Oxidation Processes (AOPs) are one of the most promising approaches for the removal of resistant developing organic pollutants from the environment. The O_3/H_2O_2 process was widely used in ozonation procedures like AOPs to degrade hazardous and refractory organic contaminants. Due to its relatively low solubility and stability in water and the selective oxidation between O_3 and pollutants, one of the drawbacks of the single ozonation method is slow oxidation or partial oxidation of some organic pollutants, which occasionally results in the generation of toxic intermediate products. In order to address these issues, the homogeneous or heterogeneous catalytic ozonation method that involves the addition of metal ions, metal oxidises, and carbon-based materials have gained interest recently. Despite the fact that the homogeneous catalytic ozonation process, which typically used metal ions as a catalyst, has good efficacy for the removal of organic pollutants, the presence of the metal ions may cause secondary pollution, which limited their application. Heterogeneous catalytic ozonation, which utilises metal oxides, metals or metal oxides on supports, activated carbon, and minerals as catalytic systems, enables the separation of the catalyst from the solution without causing secondary pollution with solid catalysts, as well as catalyst regeneration and further utilisation. The addition of heteroatoms to carbon frameworks, such as nitrogen, sulphur, phosphorus, and boron, is presently seen to be an excellent method for enhancing the catalytic abilities of carbon catalysts. The synthesis of heteroatom-doped carbon materials has been most thoroughly examined when Nitrogen (N) is introduced into carbon frameworks. The addition of N to carbon frameworks modifies the nearby carbon atoms' electronic structures to provide favourable electronic structures for a variety of catalytic activities and can enhance the surface's wetting and hydrophilic capabilities of the carbon material. However, due to its use in a variety of scientific processes, such as catalysis, energy conversion/storage, and water treatment procedures, nitrogen-containing carbon nanostructures have attracted a great deal of attention.

Catalytic ozonation is a significant option among advanced oxidation processes for water treatment due to its great effectiveness in removing a wide range of contaminants, including Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) like ibuprofen. In this study, ibuprofen was oxidatively destroyed utilising ozone as an oxidant agent, with thermal and non-thermal treated polyaniline (PANI 900 and PANI) used for the first time as catalysts. Regardless of the pH of the aqueous solution, the presence of catalysts enables the target pollutant to be removed twice as quickly compared to non-catalytic procedures. It was also noted that, in the presence of the prepared catalysts, the aqueous effluents comprising ibuprofen were thoroughly purified regardless of the pH value and the high initial concentration (100 mgL^{1}). The removal of the residual organic substrate was also assessed by various techniques (COD, TOC, BOD, UV 254, and HPLC). The findings demonstrate that when used in the oxidation processes, the two solids, PANI

Correspondence to: Larry Houdek, Department of Bioorganic Compounds, University of the Andes, Carrera, Bogotá, Colombia, E-mail: larry.houdek@vet.upen.edu

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and PANI 900, exhibit notable variations. For all pH levels, PANI 900 is a more effective catalyst for the breakdown of ibuprofen and exhibits a faster rate of ibuprofen degradation in aromatic compounds as well as more advanced mineralization of organic substrate.