BOOK OF ABSTRACT

7th SETAC Africa Conference and Horizon Scanning Project Workshop held at Anthene Conference Centre, Langerbaan, South Africa, 5-8 October 2015

Theme: Identifying Knowledge Gaps and Research Priorities in Africa: A pivot for Sustainable Environmental Development

Degradation of 2-nitrophenol in aqueous solution by combination of dielectric barrier discharge and TiO_2 photocatalyst supported on stainless steel mesh

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Abstract: The growing numbers of priority organic pollutants such as 2-nitrophenol and their metabolites in different water sources due to industrial activities, climate change, population growth and individual consumption habits have attracted public concern. Their removal from water especially drinking water has become necessary considering their associated perceived acute toxicity on human and aquatic ecosystem. Thus, development of cost effective and sustainable combined advanced treatment technologies is considered to be an attractive option. In the present study, a novel combined dielectric barrier discharge (DBD) and TiO_2 nanocrystals supported on stainless steel mesh was explored to effectively decompose 2-nitrophenol (2-NP) in aqueous solution. The synthesised supported TiO2 nanocrystals via sol-gel method was characterised using different analytical techniques such as HRSEM, HRTEM, XPS, and XRD. The XRD patterns and HRTEM micrographs confirmed the formation of a highly crystalline pure anatase TiO_2 phase. The influence of operating parameters such as solution pH (3-12), and initial concentration of the model pollutant (10-30 ppm) on the extent of degradation was investigated. The residual concentration of 2-NP and the intermediates compounds were quantified and identified using High-Performance Liquid Chromatography coupled with Mass Spectrometry (HPLC-MS). The obtained results showed that degradation rate constants (k) decreased with the increase in solution pH and initial pollutant concentration. The DBD system alone without catalysts successfully removed 58.6 % of 2-NP within 60

minutes while combined DBD/supported TiO_2 nanocrystals achieved 77.5% within the same treatment time. The increase in removal rate was attributed to the existence of a synergistic effect between the DBD system and the supported catalysts. The degradation experimental data fitted well to pseudo-first order kinetics model. The supported TiO_2 catalyst demonstrated exceptionally high stability and retained catalytic properties after four repeated applications. Catechol, hydroquinone, hydroxyl-1,4-benzoquinone, 2-nitrohydroquinone, and 2,4-dinitrophenol were identified as major intermediate products. This study has demonstrated that combined DBD/supported photocatalysts can be effectively applied to remove 2-NP in water. Keywords: 2-nitrophenol, dielectric barrier discharge, supported TiO_2 photocatalysts, degradation pathways, kinetics,

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