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Abstract

Evaluation of Photocatalysis Effect of Stainless Steel Mesh Coated with Nitrides, Oxynitrides and Transition Metals Cr and Ti on the Degradation of Orange II Dye †

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† Presented at the 15th International Symposium "Priorities of Chemistry for a Sustainable Development" PRIOCHEM, Bucharest, Romania, 30 October–1 November 2019.

Published: 11 October 2019

Keywords: wastewater; drinking water; advanced oxidation processes (AOPs); photocatalysis; hydroxyl radical; corrosion; coatings; removal efficiency

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The increased detection of organic pollutants in drinking water and their resistance to degradation by wastewater treatment processes has motivated the development of more efficient, affordable and sustainable methods of purification of drinking water and wastewater. Advanced oxidation processes (AOPs), such as photocatalytic systems based on the production of powerful hydroxyl radicals, have been found to be efficient for water and wastewater remediation. Recently, semiconductor transition metals have been used as photocatalytic supports to minimise post-filtration of powder catalysts from the treated effluents and related costs. However, a few studies claim that exposure of metal supports such as stainless steel to an acidic environment for a prolonged time results in corrosion of the materials. Hence, coating of stainless steel photocatalytic supports with corrosion- resistant layers could be an alternative to overcome this limitation. In this study, the catalytic activity of Cr and Ti-based anticorrosion layers deposited on stainless steel meshes (coated by cathodic arc evaporation) was evaluated for the decolouration of 5 mg/L of orange II (O.II) dye solution that was exposed to UV light for 60 min. The absorbance of treated and untreated O.II samples was measured by UV-vis spectroscopy. The results showed that best dye decolouration was attained at pH 2.5 but all decolouration percentages were below 25%. On the other hand, slightly elevated decolouration of orange II dye was achieved with CrON, CrN/CrON, TiON and TiON/TiN coatings, respectively. The stability of anticorrosion coatings in an oxidative environment indicated that Cr and Ti nitride and oxynitride layers are effective and durable anticorrosion coatings. Nevertheless, their use as catalytic supports in photocatalytic systems, as well as their low removal of O.II dye, should be optimised to achieve high pollutant removal efficiencies.