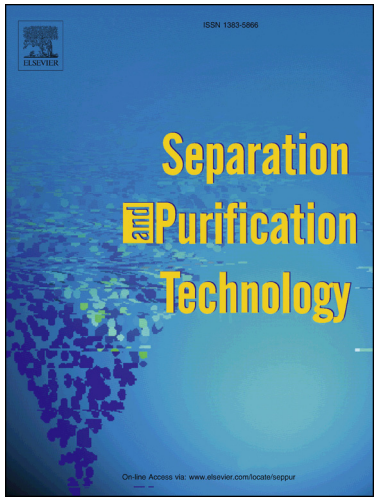

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Nitrobenzene degradation in aqueous solution using ozone/ cobalt supported activated carbon coupling process: a kinetic approach

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Abstract

In this study, a new supported catalyst (Co/OSAC) based on olive stones activated carbon (OSAC) was developed using the wetness impregnation method. A kinetic study was performedto investigate the effect of ozone/supported catalyst coupling process on nitrobenzene degradation in aqueous solution. Several analytical techniques, such asNitrogen adsorption-desorption at 77K, XRD, XPS and SEM-EDX analyses were used to characterize the new catalyst. The effect of adding t-BuOH as radical scavengers was also investigated. Characterization results showed that a highly distribution of cobalt nanoparticles on the surface of OSCA was obtained by using impregnation method. Results were modelled by a global first-order model (R^2> 0.99).Co/OSAC exhibited a high activity in oxidation of NB compared to ozone alone and OSAC. The total organic carbon (TOC) removal proved that Co/AC/O_3combined process increases significantly the mineralization of NB with about 65% in 20 min compared to 45% and 24% using O_3/OSAC and ozonation alone respectively.The kinetic contribution of radical mechanisms was estimated by using tertbutanol as radical scavenger. It was demonstrated that NB degradation is mainly due to radical generation promoted on the surface of the catalyst.

Keywords: ozonation, cobalt supported catalayts, activated carbon, couplingprocess, nitrobenzene.

1. Introduction

Recently, with the increasing varietyof manufactured products, the water pollution has become a global issue ofconcerns [1, 2]. The use of biological process for water treatment involves several problems [3]. Furthermore, the presence of toxic refractory molecules with low biodegradability characters prevents the use of such treatments [3, 4]. It is, therefore, urgent to achieve new effective treatment processes to resolve these problems. Advances in wastewater treatment have led to the development of new methods known by advanced oxidation processes (AOPs) [5]. AOPs can be generally defined as aqueous phase oxidation methods based on the generation of highly reactive species such as hydroxyl radicals (OH°) [6]. These radicals react rapidly with molecules present in water in an unselective way [7]. The application of AOPs such as ultrasonic, photo-oxidation, photocatalytic oxidation plasma, Fenton, photo-Fenton, wet oxidation, and ozone/ultraviolet (UV) has concerned many investigations for the degradation and mineralization of a wide rangeof organic compounds [8]. Due to their complexity and high costs, these processes are rarely used as a possible solution for water treatment [8]. Ozonation process appears as an appropriate AOP for water treatment [9]. Ozone is well-known as a powerful oxidant; however it reacts slowly with some organic compounds such as inactivated aromatic compounds [10] and rarely leads to total mineralisation [1]. Many researches are focused on developing catalysts in order to provide fast degradation and high mineralization level by ozone decomposition on high active species [11]. The combination of ozonation process with other agents such as UV, H_2O_2, or homogeneous catalyst (Mn^{+2}, Fe^{+3}, Fe^{+2}, Ag^{+}, Zn^{+2}, and Co^{+2}) can lead to an important degradation efficiency [11, 12, 13]. However, in this case, when dissolved metal salts in aqueous solutions or metal oxides were used as catalysts a secondary polluting problem can be exist [10]. Since, these catalysts have to be removed after the oxidation reaction of the organic compounds [10]. Therefore, these technologies are rarely selected as promising methods [8].