PHOTOCATALYTIC DEGRADATION OF TNT FROM WATER IN UV-VIS/Fe-TiO_2 SYSTEM

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Abstract

2,4,6-Trinitrotoluene(TNT) is one of most common toxic pollutant identified in wastewater generated from ammunitions plants. Due to its potential carcinogenic characteristics, TNT presence in water bodies represents a risk for human health and aquatic life. Among modern treatment methods, TiO_2 photocatalysis was successfully applied in order to remove toxic pollutants. Fe-TiO_2 assisted photocatalytic degradation of TNT in aqueous media, under UV-VIS irradiation was studied. The effects of operating parameters on photocatalytic process performances, kinetic and mechanism of pollutant degradation were investigated. Solutions with (0.27-2.72) x 10^{-4} M TNT content were photo-oxidized using a medium pressure Hg lamp as UV-VIS light source (λ = 320 – 550 nm), in the following working conditions: pH = 7; photocatalyst dose = 50 – 500 mg/L; irradiation time = 30 - 240min. Prior to irradiation, the photocatalyst was added to samples, and resulted suspension was bubbled with air (50 L/h). In order to evaluate the effect of the main active species involved in Fe-TiO_2 assisted photocatalytic degradation of TNT we suppressed the free •·OH radicals mediated process by addition of 16 x 10^{-3}M iso-propanol (i-PrOH) scavenger. Lock of •·OH_{ads} radicals' production on the catalyst surface was assured by addition of 16 x 10^{-3}M sodium iodide (NaI). The initial and irradiated samples were analysed for TNT, NO_3^-, NO_2^- and NH_4^+ concentrations by Gas Chromatography (GC), and Ion Chromatography respectively. In the tested experimental conditions, at 2.72 x 10^{-4} M pollutant concentration, the increase of catalyst load up to 200 mg/L leads to the enhancement of initial TNT degradation rate up to 0.64 x 10^{-7} Ms^{-1}. Since, ten times increase of initial TNT content has a negative effect on pollutant degradation rate constant, in similar experimental condition, prolonged irradiation time from 60 to 240 min was needed in order to assure pollutant advanced degradation efficiencies (≥ 99.9%). The TNT degradation and its inorganic by-products formation obeyed a pseudo-first-order kinetics. The experimental results of the reactive species quenching showed that •·OH radicals was the predominant oxidant species participated in reaction, and the pollutant degradation occurred mainly on the surface of catalyst.

Keywords*: 2,4,6-Trinitrotoluene, Fe-TiO_2 photocatalyst, AOPs*