Grape Marc Activated carbon impregnation by Anatase-TiO_2 nano-particles: degradation of RB5 Azo dye with instantaneous regeneration of photocatalyst hybrid

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1. Introduction

Activated Carbon Powder (ACP) is a porous material exclusively used to treat wastewaters containing Persistent Organic Pollutants (POPs) refractory to other adsorbents [1-3]. The fact that these toxic substances are trapped in the pores, does not make this process clean, since it is an ordinary pollution transfer from a liquid to a solid phase.

The idea to degrade the molecules adsorbed in the pores of ACP, and consequently regenerating the ACP, is therefore attractive to remedy this problem. In this context, the modification of ACP by photo-catalysts nano-structured such as titanium oxide (TiO_2) has been performed by various authors [4-14]: **(i)** TiO_2 loading on the surface of ACP: Torimoto et al. [4] prepared photocatalysts by loading TiO_2 on ACP by using titanium tetraisopropoxide. Arana et al. [5] used a method where TiO_2 was loaded on the activated carbon surface by the hydrolytic precipitation of tetraisopropyl orthotitanate; **(ii)** carbon coating of TiO_2 particles surface : Li et al. [6] prepared TiO_2-coated ACP through hydrolytic precipitation of TiO_2 from tetrabutylorthotitanate and then used heat treatment; **(iii)** finally carbon doping in TiO_2 structure: Tryba et al. [7] prepared photocatalysts where TiO_2 particles were placed onto the surface of poly(vinyl butyral) through the hydrolysis of tetraisopropyl orthotitanate with carbon precursor and subsequent carbonization to different final temperatures between 700 and 900 °C. Tryba et al. [14] also prepared photocatalyst TiO_2-mounted ACP through hydrolytic precipitation of TiO_2 from tetraisopropyl orthotitanate, followed by heat treatment at 650–900 °C for 1 h under nitrogen flow.

These methods are able to degrade strongly organic pollutants in aqueous phase. However, they have two principal inconveniences: (i) the relative high cost of the process; (ii) and the complexity of the modification (synthesis).

In this work, we have chosen to impregnate natural ACP particles with an Anatase TiO_2 semi-conductor by a simple process and appropriate for application in industrial scale. In our humble knowledge, this impregnated hybrid (natural ACP + Anatase-TiO_2) has never been studied before. To illustrate its high photo-catalytic proprieties and demonstrate the synergistic effects between ACP and Anatase-TiO_2, some tests are realised on the Reactive Black 5 (RB5) dye in aqueous solution.