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Carbon materials with different properties for the removal of 2-nitrophenol by catalytic wet peroxide oxidation

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2-nitrophenol (2-NP), a light yellow compound often found in industrial wastewaters, is inhibitory, toxic and bio-recalcitrant and, therefore, can have a negative impact on conventional biological wastewater treatment processes. Thus, other technologies for 2-NP treatment should be considered. In the present work, carbon materials with distinct morphological and chemical properties, namely activated carbons (AC), multi-wall carbon nanotubes (MWCNT), glycerol-based carbon materials (GBCM) and carbon xerogels (CX), were tested for the removal of 2-NP in aqueous solutions, either by simple adsorption or by catalytic wet peroxide oxidation (CWPO), since it has been shown that carbon materials without any impregnated metal can act as catalysts for CWPO[1,2]. The experiments were performed in a glass reactor, loaded with a 2-NP solution (100 mg L^{-1}), considering T = 303 K, pH = 3, adsorbent/catalyst load = 0.1 g L^{-1} and, in CWPO runs, $[H_2O_2]$ = 34.6 mmol L^{-1}.

The results in Figure 1(a) show that AC has superior adsorption performance, exhibiting a 2-NP removal of 316 mg g^{-1} after 150 min of adsorption. On the other hand, MWCNT in CWPO increases the removal of 2-NP by 83%, in comparison with the removal obtained by adsorption, being reached a 2-NP removal of 929 mg g^{-1} after 150 min of reaction. Furthermore, the possible contribution of homogeneous catalysis promoted by leached Fe (which is present in the composition of the tested MWCNT) at the end of the CWPO experiment was assessed and considered negligible, Figure 1(b), suggesting that MWCNT are active and stable catalysts for CWPO. The opposite was observed for a classical iron supported activated carbon (AC/Fe), as observed in Figure 1(b), its activity resulting from the homogeneous contribution of Fe that is leached to the liquid phase.

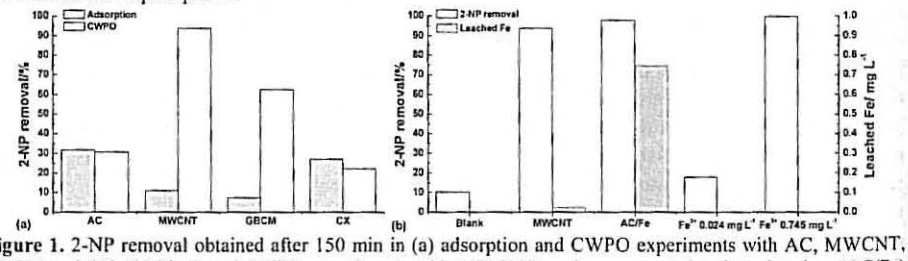

Figure 1. 2-NP removal obtained after 150 min in (a) adsorption and CWPO experiments with AC, MWCNT, GBCM and CX; (b) blank and CWPO experiments with MWCNT, an iron supported activated carbon (AC/Fe) and with homogeneous catalysts (Fe^{3+} with the same concentration as leached Fe during CWPO with the heterogeneous catalysts – whose values are also given).

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References
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