Fe/SBA-15 MESOPOROUS MATERIALS AS PHOTO-FENTON CATALYST FOR AZO-DYES DEGRADATION

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ABSTRACT

The photo-Fenton processes are included in the Advanced Oxidation Processes (AOPs) which are efficient for the treatment of waste water affected by organic pollutants. This process involves the use of Fe ions as catalyst to activate hydrogen peroxide (H_2O_2) decomposition in order to generate hydroxyl radicals (OH*) which are able to degrade organic molecules in aquatic systems under ambient conditions [1]. The Fe salts often used as the metal source are soluble in water, and the Fenton process is usually in homogeneous phase. Nevertheless, this process has the inconvenient of the low operation pH (3) and the difficulty for the recovery of Fe from the generated sludge that need further treatments. Then, the immobilization of Fe species on solids supports result as an attractive option to developed Fenton catalysts in heterogeneous phase. In this sense, materials with porous structures as SBA-15 silicates have attracted increasing interests as supports due to their high specific surface and pore volume [2].

In this work the SBA-15 support was modified with Fe by a simple method (wet impregnation) using a solution of $Fe(NO_3)_3.9H_2O$ in ethanol. After eliminate the solvent in a rotary evaporator the solid was calcined a 350 ^oC for 3 h. The metal concentration for the impregnating solution was chose in order to reach an Fe load of 2.5 % wt. The solid was test as catalyst for the Acid Orange 7 (AO7) degradation under UV-vis radiation and using a stoichiometric concentration of H_2O_2. Under the pH of operation (3.5) it was not observed a considerable Fe lixiviation, confirming that the process is under heterogeneous phase. An almost total AO7 and H_2O_2 degradation was observed after 5 h of radiation. For its part, a high mineralization was also observed (81 %) which indicate the efficiency for the tested catalyst.

From the solid characterization by XRD, UV-Vis DR, N_2 physisorption and TPR, it was found that the high surface of the regular structured SBA-15 support was just slightly modified by the Fe presence, and a high dispersion of the metal was allowed. Thus, it could be concluded that the high dispersed Fe ions anchored in the SBA-15 surface are responsible for the activity and stability of the catalyst. Then, the catalyst was recovered from the aqueous medium an evaluated in a second catalytic cycle, reaching the same mineralization percentage. This result was other evidence of the high catalyst stability confirming that the process is in heterogeneous phase. Finally, this active catalytic reactivity for the synthetized solid, in addition with the observed stability, provide a great advantage for the proposed photo-Fenton process using a heterogeneous catalyst over the classic homogeneous Fenton process.

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References

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