Aqueous Acid Orange 7 dye removal by clay and red mud mixes

Walid Hajjaji[1], Robert C. Pullar[2], João A. Labrincha[2], Fernando Rocha[1]

1 —Department of Geosciences & Geobiotec, University of Aveiro
2 —Department of Materials and Ceramic Engineering & CICECO, University of Aveiro

Portuguese clay, Fe-impregnated clay, red mud and clay/red mud mixtures were used in the removal of Acid Orange 7 by Fenton and photo-Fenton (under UV light) oxidation processes. Used red mud was supplied by ALCOA San Ciprián (Lugo, Spain), being a mixture containing about 40% of solids, collected immediately after alumina recovery from the digestion process (Bayer process). In comparison with pure adsorption, the catalytic activity of Fe-loaded clay showed an optimum removal rate (98%). This photo-assisted Fenton degradation of Acid Orange 7 azo-dye molecules was exploiting HO center dot radicals from generated H2O2 and clay supported iron species, following the pseudo-first order kinetic mechanism. Using red mud pre-calcined at 4000 C, 10% improvement in overall discolouration was observed in comparison to the untreated clay. This improvement is attributed to the partial reduction of Fe3+ to Fe2+ species on the surface of the catalyst, and to the reaction with H2O2 to generate highly oxidative hydroxyl radicals. The synergistic effect of photocatalysis due to the presence of TiO2 in the red mud also contributed in this photo Fenton process. Furthermore, the use of red mud/clay catalyst mixes assured 38% dye discolouration at pH 7, but a lowering of solution pH to 3 resulted in a much higher discolouration rate (over 80% after 1 h). The good fitting with a pseudo-second-order kinetic model (R-2 equals to 0.99) shows that adsorption.

FIGURE 1
Catalytic Activity (RM - Red Mud; RM400- Calcined; RM400+H2O2 –with H_2O_2 Addition).

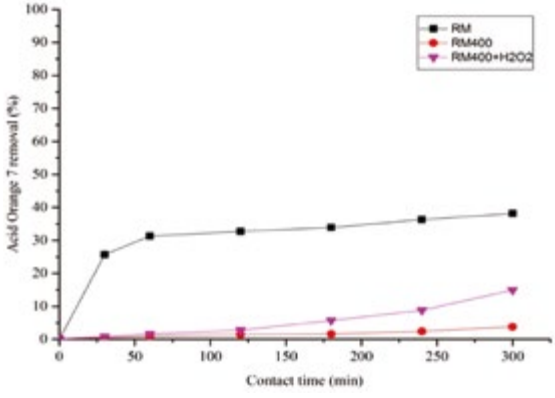

FIGURE 2
Catalytic Activity under UV, at different pH conditions