Removal of methylene blue and orange II from dye solutions by natural Portuguese clayey materials

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With the increment of dye use in different domains and in the aim to find solutions to their derived wastes, this study investigated the removal of Methylene Blue and Orange II dyes from synthetic wastewater by the adsorption and photocatalysis by Portuguese clay-based materials.

These clays were collected from two different geological domains. The representative clayey material (AV) is a product of quartz diorite rock recent alteration and it is located in Benavila region and the Hercynian Massif domain. The two other samples, OC (Torres Vedras region) and BA (Barracão), were collected from the Lusitanian basin and they are attributed to Cretaceous and Pliocene deposits, respectively.

By accessing the mineralogical content of Benavila benthonitic materials, 65 wt.% of smectite with palygorskite as secondary phase (20 wt.%) were depicted. Barracão clays are mainly kaolinitic (63 wt% kaolinite) which explains their low specific surface area (15.8 m^2/g). Torres Vedras ones are illitic-kaolinitic (28 wt.% kaolinite and 22 wt.% illite) and are richest in iron.

Dyes were first removed by single adsoprtion. The operation parameters investigated included temperature (25-55ºC), initial dye concentration in the solution (100-300 mg/L), and variations of sorbent content (0.05 to 0.2 g). Trials were conducted in a batch reactor. The experimental adsorption isotherms were analyzed by using the Langmuir and Freundlich models, being compared with activated carbon.

Another set of tests was conducted by photocatalysis. To do so, new titania pillared nanocomposites were firstly prepared, by solvothermal reaction between P25 TiO_2 and the mentioned clays. The tests were conducted in a liquid-solid regime, monitoring the degradation of an organic dye, under UV light irradiation. The AV clay, when combined with P25 TiO_2, showed the best photocatalytic results, within the tested samples.

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