Kaolin - based Filter Material to Remove Textile Dyes in Water

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In this research, the adsorption capabilities of four kaolin - based filter materials for dye removal was tested and locally available kaolin (collected from Meetiyagoda, Sri Lanka) is the main component of these four materials. First filter material (M1) is based only on kaolin. Second filter material (M2) is based on kaolin and activated carbon (5% w/w). Third filter material (M3) is based on kaolin and calcium hydroxide (5% w/w). Fourth filter material (M4) is based on kaolin and calcined eggshells (5% w/w). Pellets of each material had average diameter (2 mm) and average length (4 mm). Methylene blue (MB) was used as a model dye to understand properties of filter materials and also the adsorption capabilities of materials were tested with an industrial dye. The effect of dark (Reagent bottles were covered by aluminum foils) and light conditions (light box consisting of 20W, CFL bulb was used due to potential photocatalytic pathways possible), effect of initial concentration, effect of contact time for adsorption of MB and industrial dye was tested in this study. M3 has the highest MB removal efficiency (37.29%) and M1 has the highest industrial removal efficiency (13.69%) in light conditions. The removal efficiencies under dark conditions are considerably lower for all four filter materials. Next, adsorption of MB onto M3 was found to follow Freundlich isotherm (r^2 = 0.96, n = 1.96, K_F = 0.06 Lg^{-1}) than Langmuir isotherm (r^2_L = 0.95, q_{max}= 0.20 mg g^{-1}). Furthermore, MB adsorption was found to follow pseudo-second order kinetics (R^2 = 0.99, k_2 = 1.11 x 10^{-2} g mg^{-1} min^{-1}). Adsorption of industrial dye onto M1 was found to follow Langmuir isotherm (r^2L=0.89, qmax = 0.34).In conclusion, the study reveals M3 can be used to remove MB and M1 can be used to remove industrial dye in water more efficiently. Unlike activated carbon, kaolin based materials can be reused several times and can prevent the secondary pollution due to adsorbents.

Keywords: Kaolin, Fitter media, Textile dyes, Water purification, Photo catalysts