ADSORPTION OF REACTIVE BLUE 19 DYE ON MAGNETIC CHITOSAN MICROPARTICLES

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Objectives: Magnetite/chitosan composite (MCC) microparticles produced by a previously developed procedure [1] were evaluated as non-expensive, environmentally friendly adsorbents for removal of synthetic textile dye Reactive Blue 19 (RB 19) from simulated waste water.

Materials and methods:

• Magnetite/chitosan composite (MCC) microparticles with an average size of 169 μm (Dv)/73 μm (Dn) and saturation magnetization of 17.6 emu/g were prepared by an in-situ procedure

• Batch adsorption tests showed that the extent of RB 19 adsorption was dependent on dye concentration, adsorbent concentration, contact time, pH and temperature.

• The adsorption isotherms were analyzed using the Langmuir and Freundlich models.

• The adsorption kinetics was tested for the pseudo-first order and pseudo-second order kinetic models.
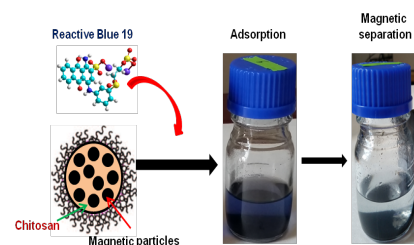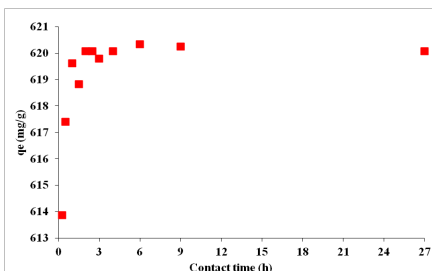

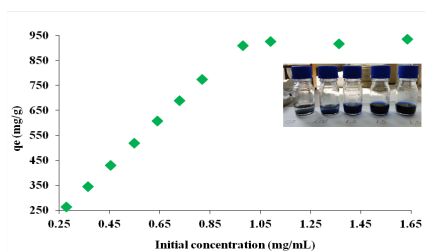**Figure 1. Schematic representation of adsorption process**

Results
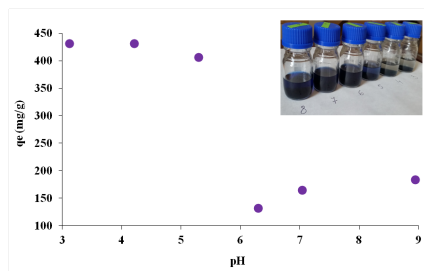
Figure 2. Effect of pH

Figure 4. Effect of contact time (C_i=0.8 mg/mL)

Figure 3. Effect of initial dye concentration

Table 1. Desorption and re-use

Eluent	% Desorption
Aq.NaOH (pH=13)	8-15
Aq.NaOH+surfactant (pH=11)	55-62

Re-use (c_i=0.79mg/g)

MCC	q_e, mg/g
Initial (calculated)	745
Re-used (measured)	550

Table 2. Constants obtained from the Langmuir and Freundlich sorption isotherms

Langmuir constants			Freundlich constants		
R^2	q_m (mg/g)	K_L (L/mg)	R^2	K_F	n
0.9999	909.09	1100	0.9109	288	18.21

Table 3. Kinetic data for the adsorption of dye RB 19 on magnetite/chitosan composite (C_i=0.8 mg/mL)

$q_{e,exp}$ (mg/g)	Pseudo-first-order model			Pseudo-second-order model			Intra-particle diffusion model constants	
	$q_{e,calc}$ (mg/g)	k_1 (h^{-1})	R^2	$q_{e,calc}$ (mg/g)	k_2 (g/mg/h)	R^2	k_{id} (mg/g/h$^{0.5}$)	R^2
620.06	609.58	1.055	0.968	625	2.56	1	0.769	0.2734

Conclusion

The procedure for removing RB 19 from simulated waste water using MCC as an adsorbent has been optimized with respect to the following parameters: sorbent mass (50 mg), solution pH (range 3-4), initial dye concentration (1 mg/mL) and contact time (2h). The maximum adsorption capacity is 909 mg/g. About 60% of the dye can be desorbed using aqueous NaOH solution with the addition of a non-ionic surfactant. The material may be re-used, but the capacity is about 26% lower.

REFERENCE:

[1] Polymer Bulletin, 67(1), 177-186 (2011)