Supporting Information for

Alginate Based Hydrogel Beads as Biocompatible and Efficient Adsorbent for Dye Removal from Aqueous Solution

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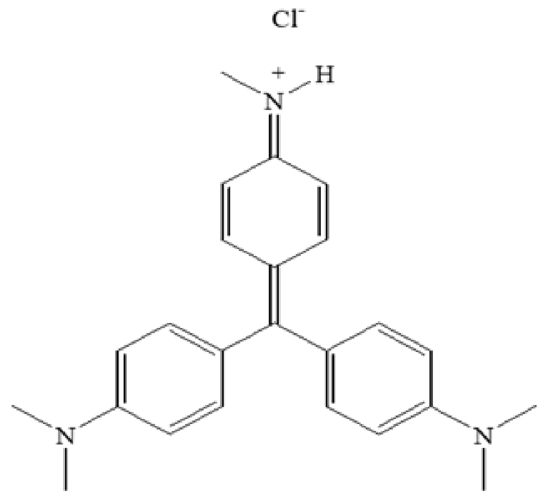


Figure S1. The chemical structure of methyl violet (MV).

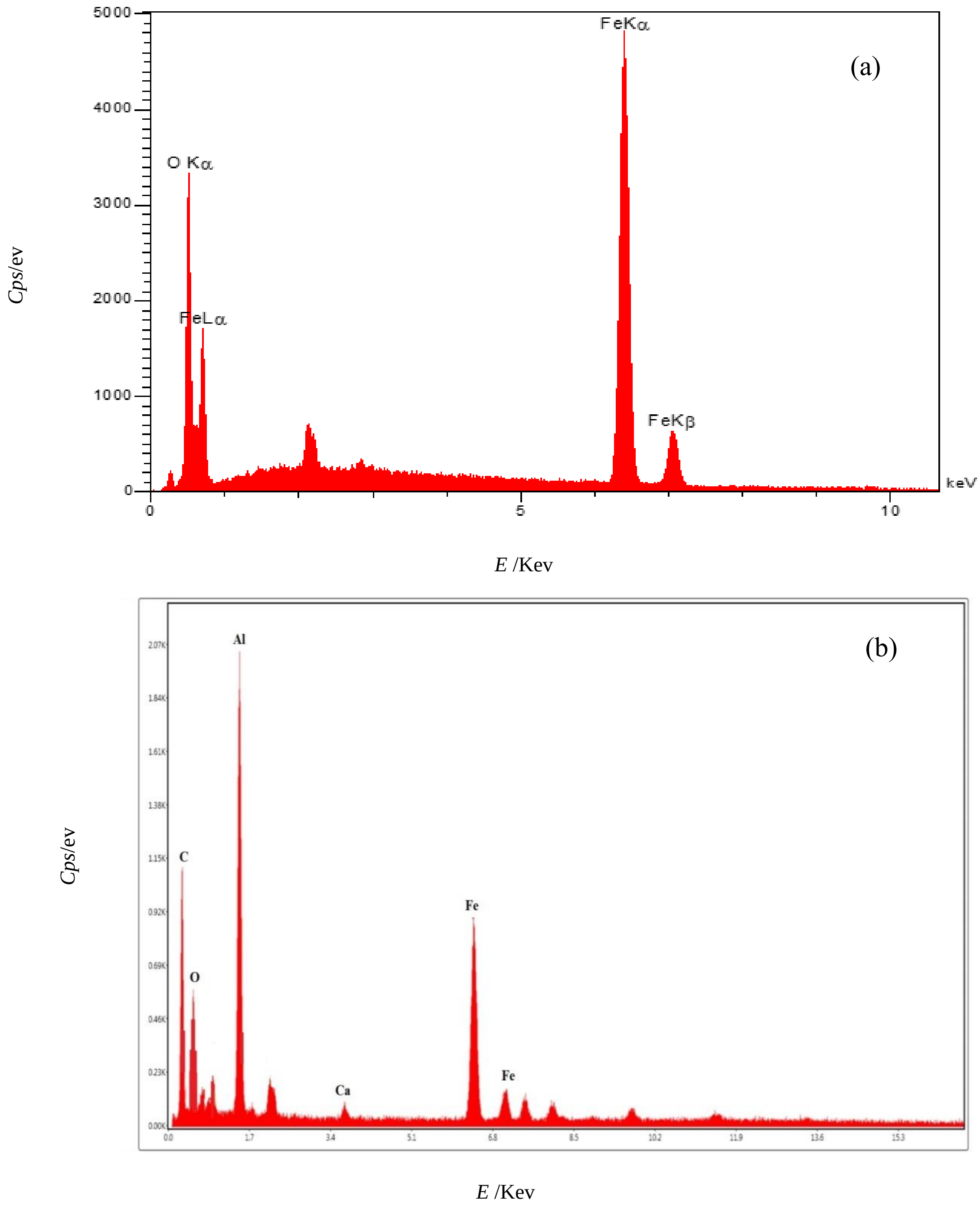
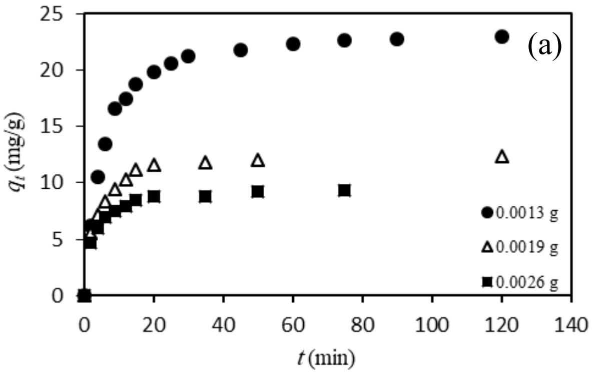


Figure S2. EDX spectrum of (a) synthesized iron oxide and (b) dried magnetic beads.



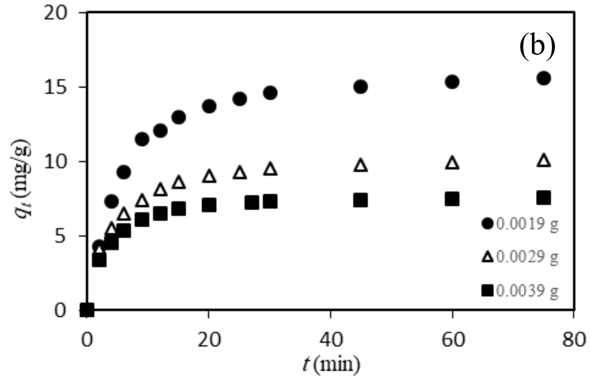


Figure S3. Variation of q with time for adsorption of MV onto different dosage of (a) calcium alginate hydrogel beads (b) magnetic hydrogel beads.

Table S1. Obtained kinetic model parameters for the adsorption of MV on to magnetic hydrogel beads.

Kinetic model	Equation	q_e (mg/g)	k	k_1 (1/min)	k_2 (g/(mg.min))	f_2	a	b	α	r^2
C_0= 2 (mg/L)										
PFO	$q_t = q_e(1 - exp(-k_1 t))$	4.38	-	0.255	-	-	-	-	-	0.9621
PSO	$q_t = k_2 q_e^2 t/(1 + k_2 q_e t)$	4.85	-	-	0.076	-	-	-	-	0.9945
MOE	$q_t = q_e((1 - exp(-k_1 t))/(1 - f_2\ exp(-k_1 t)))$	4.49	-	0.130	-	0.6	-	-	-	0.9839
Elovich	$q_t = \left(\frac{1}{b}\right) ln(1 + abt)$	-	-	-	-	-	1.342	9.670	-	0.9877
FL-PSO	$q_t = k q_e^2 t^\alpha/(1 + k q_e t^\alpha)$	5.20	0.083	-	-	-	-	-	0.550	0.9974
FL-PFO	$q_t = q_e(1 - e^{-kt^\alpha})$	4.79	0.433	-	-	-	-	-	0.544	0.9981
FL-MOE	$q_t = q_e(1 - \frac{exp(-k_1' t^\alpha)}{1 - f_2\ exp(-k_1' t^\alpha)})$	4.81	0.230	-	-	0.5	-	-	0.773	0.9980
C_0= 4 (mg/L)										
PFO	$q_t = q_e(1 - exp(-k_1 t))$	9.84	-	0.154	-	-	-	-	-	0.9902
PSO	$q_t = k_2 q_e^2 t/(1 + k_2 q_e t)$	11.11	-	-	0.0185	-	-	-	-	0.9958
MOE	$q_t = q_e((1 - exp(-k_1 t))/(1 - f_2\ exp(-k_1 t)))$	10.18	-	0.068	-	0.66	-	-	-	0.9982
Elovich	$q_t = \left(\frac{1}{b}\right) ln(1 + abt)$	-	-	-	-	-	0..492	6.514	-	0.9619
FL-PSO	$q_t = k q_e^2 t^\alpha/(1 + k q_e t^\alpha)$	10.69	0.016	-	-	-	-	-	1	0.9958
FL-PFO	$q_t = q_e(1 - e^{-kt^\alpha})$	10.13	0.793	-	-	-	-	-	0.216	0.9979
FL-MOE	$q_t = q_e(1 - \frac{exp(-k_1' t^\alpha)}{1 - f_2\ exp(-k_1' t^\alpha)})$	10.17	0.076	-	-	0.62	-	-	0.980	0.9982
C_0= 6 (mg/L)										
PFO	$q_t = q_e(1 - exp(-k_1 t))$	15.15	-	0.148	-	-	-	-	-	0.9898
PSO	$q_t = k_2 q_e^2 t/(1 + k_2 q_e t)$	16.73	-	-	0.0124	-	-	-	-	0.9961
MOE	$q_t = q_e((1 - exp(-k_1 t))/(1 - f_2\ exp(-k_1 t)))$	15.61	-	0.059	-	0.9	-	-	-	0.9980
Elovich	$q_t = \left(\frac{1}{b}\right) ln(1 + abt)$	-	-	-	-	-	0.367	13.67	-	0.9470
FL-PSO	$q_t = k q_e^2 t^\alpha/(1 + k q_e t^\alpha)$	16.08	0.01	-	-	-	-	-	1	0.9961
FL-PFO	$q_t = q_e(1 - e^{-kt^\alpha})$	15.50	0.211	-	-	-	-	-	0.794	0.9965
FL-MOE	$q_t = q_e(1 - \frac{exp(-k_1' t^\alpha)}{1 - f_2\ exp(-k_1' t^\alpha)})$	16.09	0.000015	-	-	-	0.9999	-	1	0.9994

Table S2. Adsorption kinetic parameters derived from pseudo second order (PSO) and extended pseudo second order (EPSO) models for MV adsorption on calcium hydrogel beads (and magnetic hydrogel beads).

MV/Hydrogel beads				
	PSO		EPSO	
Adsorbent dosage (g)	q_e (mg/g)	k_2 (g/(mg.min))	q_e (mg/g)	k_2 $(g^{0.8}.min)^{-1}$
0.0013	24.28	0.008	22.10	48
0.0019	12.86	0.026	12.37	58
0.0026	9.57	0.046	9.34	51
MV/Magnetic hydrogel beads				
	PSO		EPSO	
Adsorbent dosage (g)	q_e (mg/g)	k_2 (g/(mg.min))	q_e (mg/g)	k_2 $(g^{0.5}.min)^{-1}$
0.0019	16.73	0.0124	15.84	5.4
0.0029	10.54	0.0268	10.26	5.4
0.0039	7.94	0.0446	7.57	6.5

Table S3. Obtained constacts of different isotherms for adsorption of MV on to magnetic hydrogel beads.

Isotherm model	Equation	q_m (mg/g)	K_{ML} (dimensionless)	K_F (L.mg$^{(1-(1/n))}$/g)	K_R (L/g)	K_{MLF} (dimensionless)	*1/n*	α_R (L/mg)$^{\beta}$	b_T	β	r^2
ML	$q_e = \frac{q_m K_{ML} C_e}{(C_s - C_e) + K_{ML} C_e}$	831	535	-	-	-	-	-	-	-	0.9764
F	$q_e = K_F C_e^{1/n}$	-	-	93	-	-	0.39	-	-	-	0.9046
R-P	$q_e = \frac{K_R C_e}{1 + \alpha_R C_e^{\beta}}$	-	-	-	17	-	-	0.005	-	1.24	0.9846
ML-F	$q_e = \frac{(K_{MLF} C_e)^S}{(C_s - C_e)^S + (K_{MLF} C_e)^S}$	713	-	-	-	733	-	-	-	-	0.9887
Toth	$q_e = \frac{q_m b_T C_e}{(1 + (b_T C_e)^{1/n_T})^{1/n_T}}$	706	-	-	-	-	1.83	-	0.0215	-	0.9857

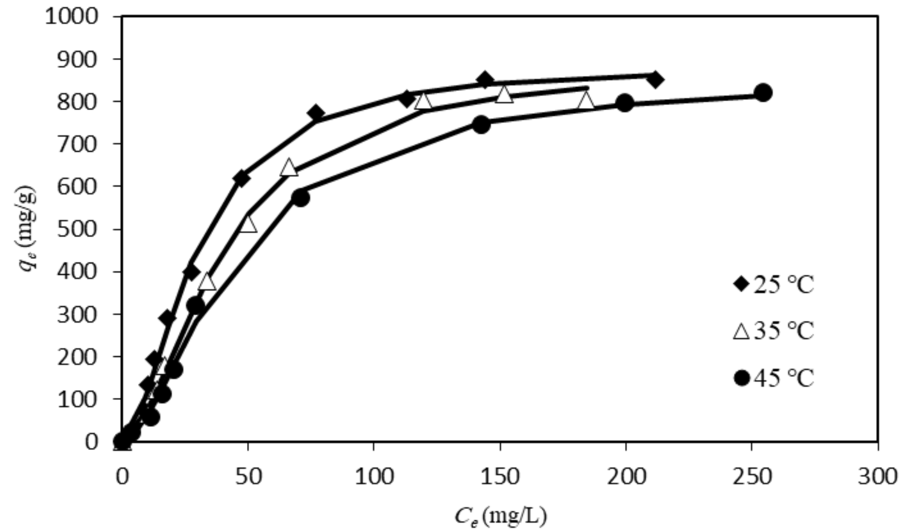


Figure S4. Effect of temperature on MV adsorption by calcium alginate hydrogel beads.

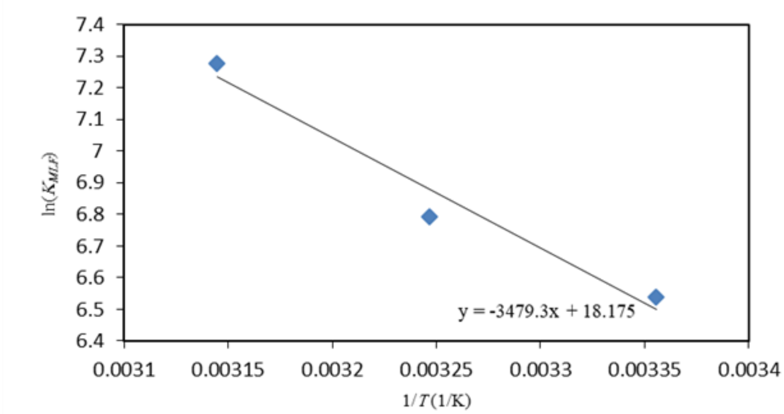


Figure S5. The plot of lnK_{MLF} against reciprocal temperature for adsorption of MV by calcium alginate hydrogel beads.

Table S4. Thermodynamic parameters for MV adsorption by calcium alginate hydrogel beads

Temperature (K)	$\Delta G_{ad}°$ (kJmol^{-1})	$\Delta H_{ad}°$ (kJmol^{-1})	$\Delta S_{ad}°$ (kJmol^{-1}K^{-1})
298	-16.20	28.93	0.15
313	-17.40		
328	-19.23		