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Supplementary data

Transformation of Glass Fiber Waste into Mesoporous Zeolite-Like Nanomaterials with Efficient Adsorption of Methylene Blue

Cheng-Kuo Tsai [1,2,*] and Jao-Jia Horng [1,2]

[1] Department of Safety Health and Environmental Engineering, National Yunlin University of Science and Technology, Yunlin 64002, Taiwan; horngjj@gmail.com
[2] Emergency Toxic Response Information Center, National Yunlin University of Science and Technology, Yunlin 64002, Taiwan
* Correspondence: yuntech.edu.tw; Tel.: +886-5-5342601 (ext. 4491)

Table S1. Experimental parameters and three levels.

Factor	Description	Unit	Level 1	Level 2	Level 3
A	GFW with activating agent ratio	(w/w)	1：2.5	1：5	1：10
B	Activating agent Conc.	M	1	2.5	5
C	Hydrothermal Temp.	K	393	423	453
D	Hydrothermal Time	Hour	8	16	24

Table S2. Fabrication of MZN material orthogonal L9 array for MB sorption.

Exp. no	Factors			
	A	B	C	D
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

Table S3. Ten-time validation experiments of the optimization procedure.

Number	Adsorption Capacity (mg/g)
1	123.0
2	122.8
3	121.9
4	119.5
5	118.2
6	120.8
7	119.6
8	116.9
9	118.0
10	121.5
Average	120.2

STDEV	2.1

Table S4. Compositions of dominant constituents in GFW and MZN.

Metal Oxide (wt.%)	GFW	MZN
SiO_2	69.8	58.4
Al_2O_3	13.1	15.3
CaO	15.7	17.0
MgO	0.64	1.14
Na_2O	<0.01	6.80
SiO_2/ Al_2O_3	5.37	3.81

Note. Compositions of dominant constituents followed by ASTM C169-16 method

Table S5. The surface area, pore volume and pore size of the glass fiber waste before (GFW) and after (MZN) the activation process.

	GFW	MZN
Surface area (m^2 g^{-1})		
BET surface area	11.2	166
t-Plot micropore area	0.20	43.4
Pore Volume (cm^3 g^{-1})		
Single point adsorption total pore volume of pores	0.046	0.234
BJH Desorption cumulative volume of pores	0.046	0.222
Pore size (nm)		
BJH adsorption average pore diameter	24.2	7.3
BJH aesorption average pore diameter	16.4	6.6

Table S6. Isotherm parameters of MB adsorption onto the MZN material.

Langmuir Isothermal Model			Freundlich Isothermal Model		
q_{max}mg g-1)	k_L (Lmg-1)	R^2	K_f	n	R^2
132.0	0.35	0.996	42.6	3.5	0.901

Table S7. Thermodynamic parameters for the adsorption of MB on MZN.

T(K)	Kc	ΔG (KJ·mol^{-1})	ΔH(KJ·mol^{-1})	ΔS (J·(mol K)$^{-1}$)
288	1982000	−34.7	-25.9	31.0
298	1506000	−35.2		
308	1056000	−35.5		
318	716000	−35.6		

K_C values calculated from $K_C = 10^6 \times K_L$, K_L *(L mg^{-1}) is the Langmuir constant related to the affinity between an adsorbent and adsorbate* [1]

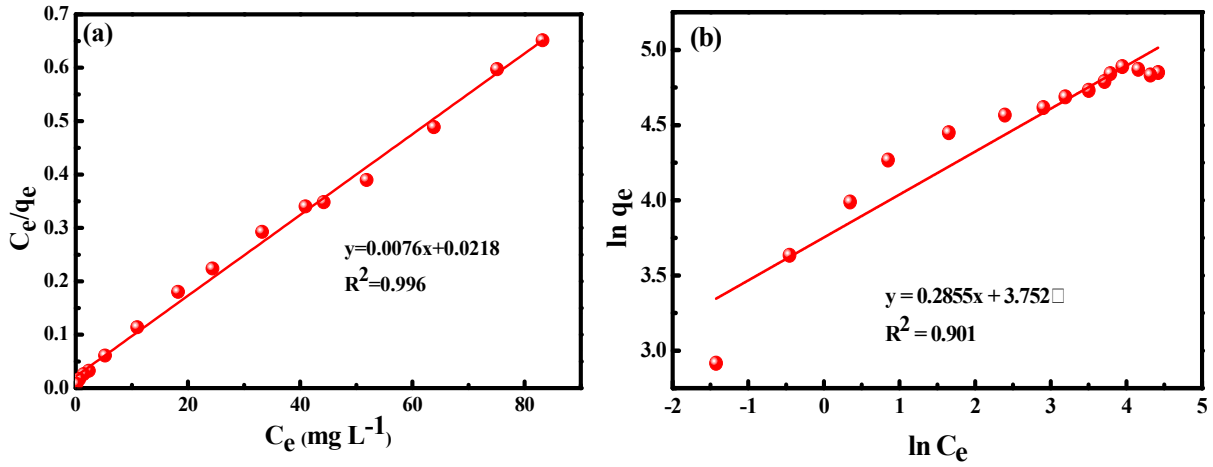

Figure S1. (a) Langmuir and (b)Freundlich adsorption isotherms of MB onto MZN.

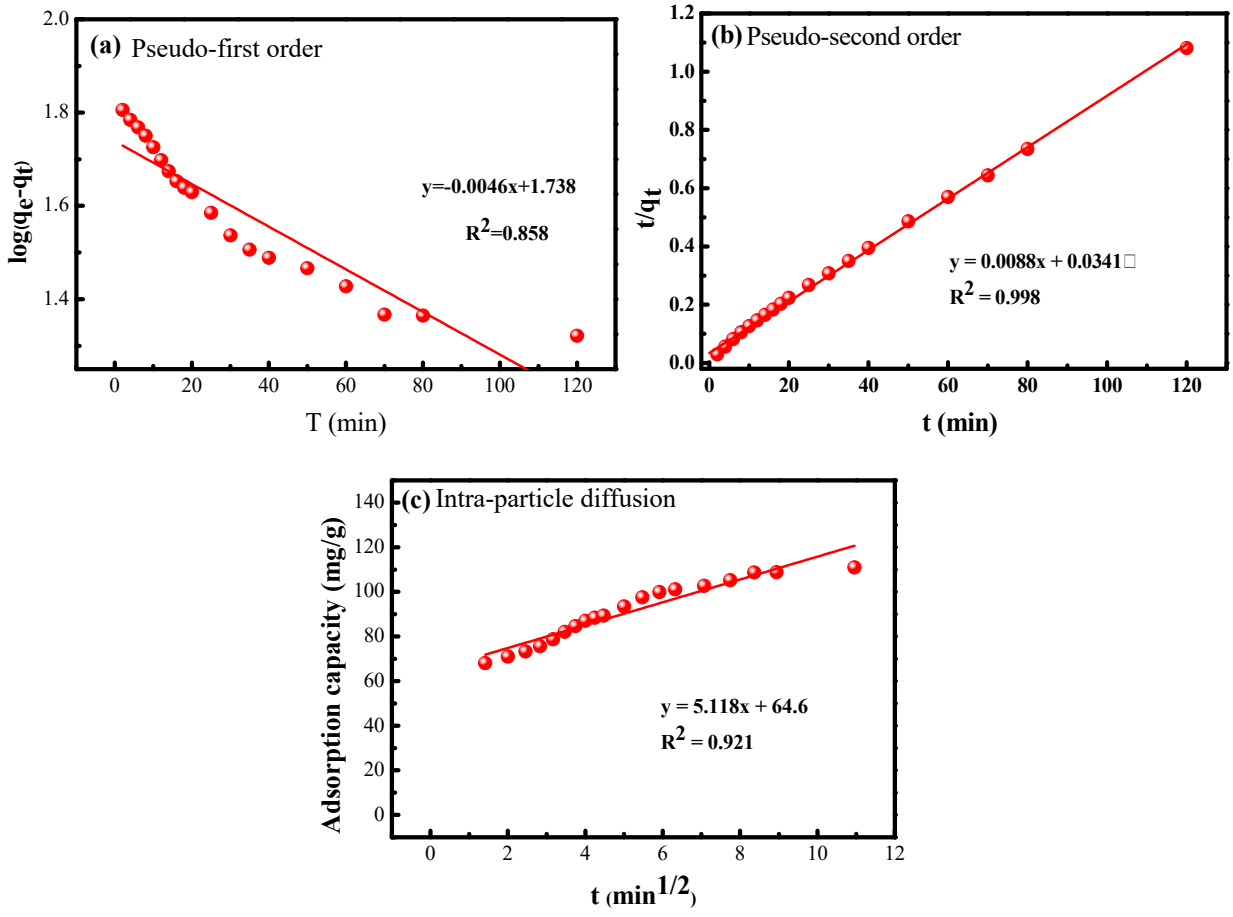

Figure S2. The (a) pseudo-first-order, (b) pseudo-second-order kinetics and (c) intra-particle diffusion model of adsorption of MB onto MZN nano-adsorbent.

Reference:

1. Tran, H.N.; You, S.-J.; Chao, H.-P. Thermodynamic parameters of cadmium adsorption onto orange peel calculated from various methods: A comparison study. *J. Env. Chem. Eng.* **2016**, *4*, 2671–2682.