

Supplementary Material

Two birds with one stone: high-quality utilization of COVID-19 waste masks into bio-oil, pyrolytic gas, and eco-friendly biochar with adsorption applications

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2.5. Adsorption models and Data analysis

Table S1 The list of kinetic and isotherm models.

Models	Expression	Parameters
Langmuir	$Q_e = \frac{aQ_m C_e}{1 + aC_e}, R_L = \frac{1}{1 + aC_0}$	Q_m, a
Freundlich	$Q_e = K_F C_e^{1/n}$	$K_F, 1/n$
Temkin	$Q_e = B \ln A + B \ln C_e$	A, B
Dubinin-Radushkevich (D-R) model	$\ln Q_e = \ln Q_0 - \beta \varepsilon^2, \varepsilon = RT \ln(1 + \frac{1}{C_e})$ $E = \frac{1}{(2\beta)^{0.5}}$	$Q_0, \beta, \varepsilon, E$
Pseudo-first-order	$Q_t = Q_e (1 - \exp(-\frac{k_1}{2.303} t))$	Q_e, k_1
Pseudo-second-order	$Q_t = \frac{k_2 Q_e^2 t}{1 + k_2 Q_e t}, h = k_2 Q_e^2$	Q_e, k_2, h
Elovich model	$Q_t = \frac{1}{b} \ln(a' b t + 1)$	a', b
Intraparticle diffusion	$Q_t = k_i t^{0.5} + C$	C, k_i

Where Q_e and Q_t are the adsorbed capacity ($\text{mg} \cdot \text{g}^{-1}$) at an equilibrium concentration ($C_e, \text{mg} \cdot \text{g}^{-1}$) and a given time of BPA in solution, respectively. Q_m ($\text{mg} \cdot \text{g}^{-1}$) denotes the maximum adsorption capacity. a and K_F are the Langmuir ($\text{mg} \cdot \text{L}^{-1}$) and Freundlich ($\text{mg} \cdot \text{g}^{-1}$) constants, respectively. $1/n$ is the heterogeneity factor. A is the equilibrium binding constant ($\text{mg} \cdot \text{L}^{-1}$), and B is the Temkin constant related to the adsorption heat. β is the D-R model coefficient ($\text{mol}^2 \cdot \text{J}^{-2}$), Q_0 is the maximum unit adsorption capacity ($\text{mmol} \cdot \text{g}^{-1}$), ε is the Polanyi adsorption potential, R is the ideal gas constant $8.314 \text{ J} \cdot (\text{mol} \cdot \text{K})^{-1}$, T is the absolute temperature, and E is the adsorption free energy ($\text{J} \cdot \text{mol}^{-1}$). k_1 , k_2 , and k_i are the rate constants for the pseudo-first-order (min^{-1}), pseudo-second-order ($\text{g} \cdot \text{mg}^{-1} \cdot \text{min}^{-1}$), and the intraparticle diffusion ($\text{mg} \cdot \text{g}^{-1} \cdot \text{h}^{-1/2}$) rate constant, respectively. h is the initial adsorption rate ($\text{mg} \cdot \text{g}^{-1} \cdot \text{min}^{-1}$). a' is the initial sorption ratio ($\text{g} \cdot \text{mg}^{-1} \cdot \text{min}^{-1}$), b is the desorption constant ($\text{g} \cdot \text{mg}^{-1}$), and C is a constant indicating the number of boundary layers of the adsorbent.

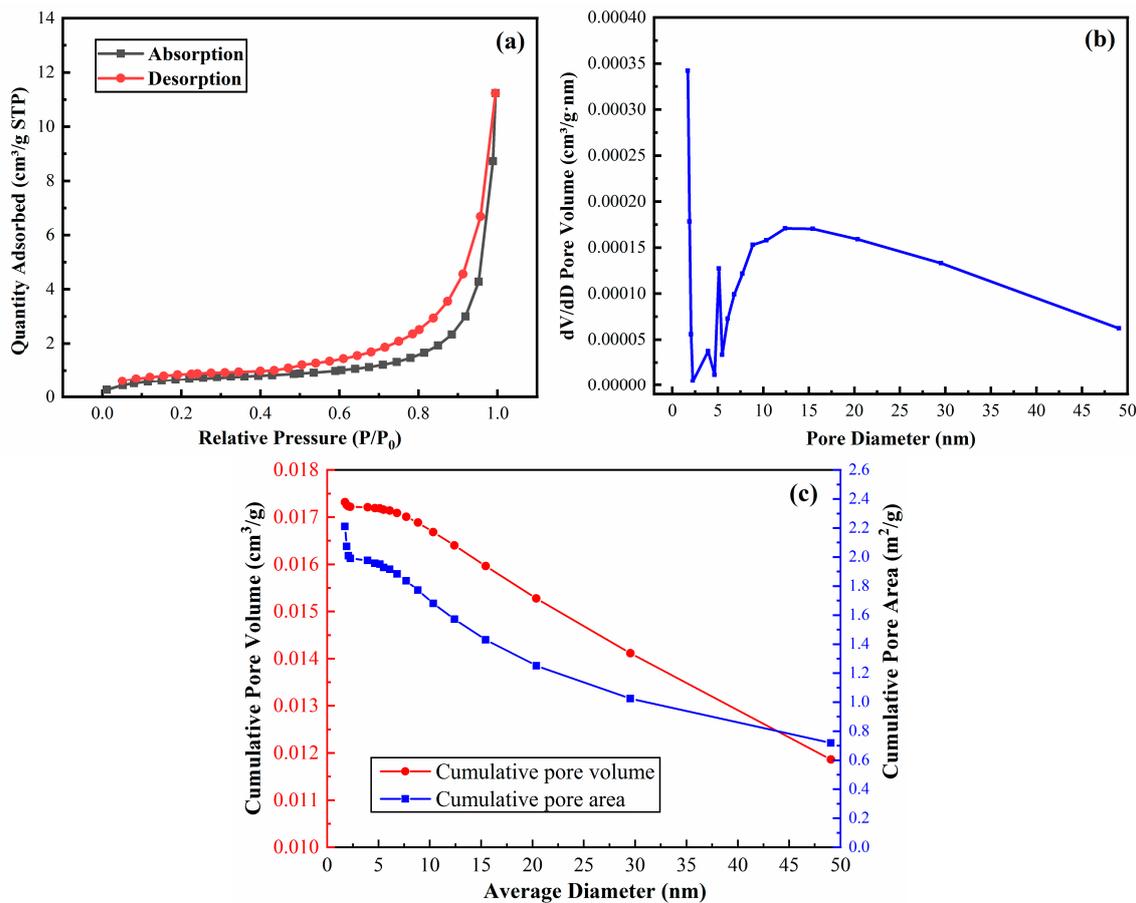


Figure S1 (a) Adsorption-desorption isotherm, (b) BJH-adsorption differential pore volume, and (c) cumulative pore volume/area-pore size distribution of WMB.

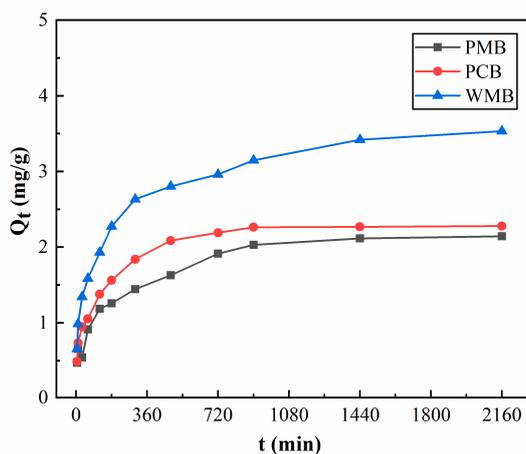


Figure S2 Comparison of BPA adsorption by the prepared materials.

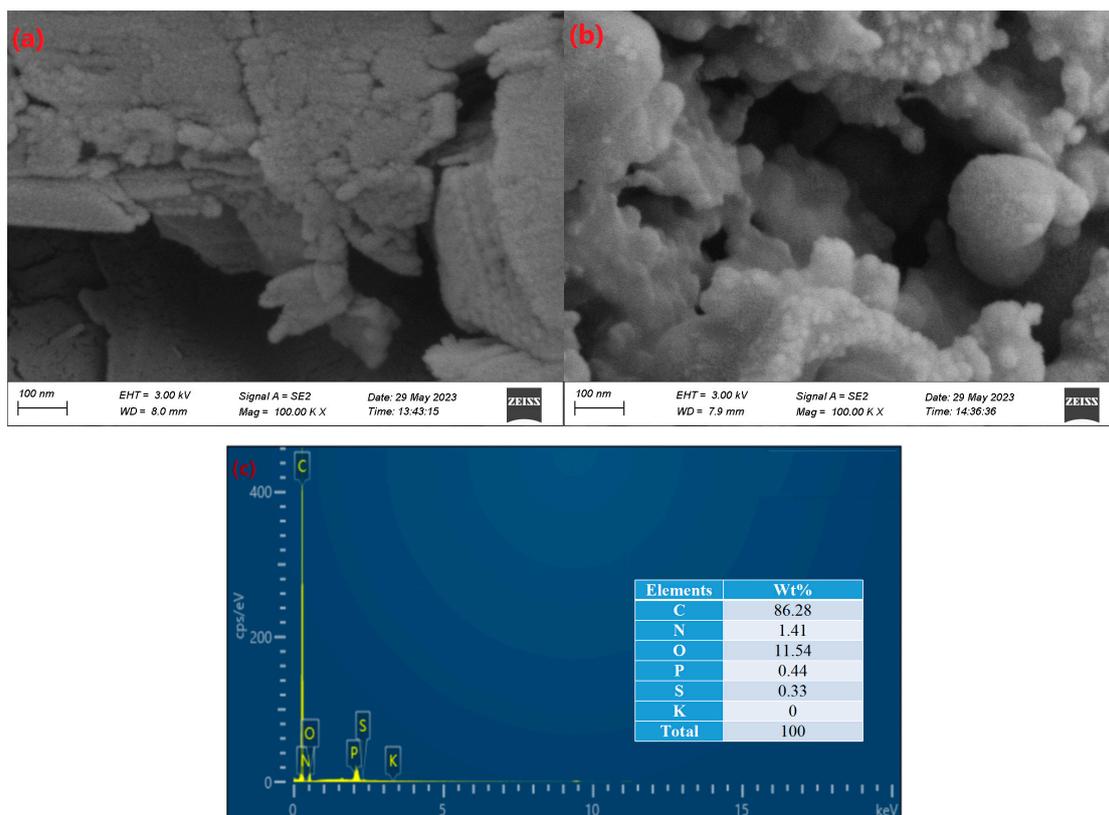


Figure S3 SEM and EDS images. (a) SEM for HMB (magnified 10,000 times), (b) SEM for HWMB (magnified 10,000 times), and (c) EDS for HMB.

Table S2 Specific surface area, pore volume, and pore size characteristics of HWMB.

Surface feature	Test item	Unit	HWMB	Remarks
Surface Area	Single point surface area		0.7173	Relative pressure (P/P_0)=0.1503 Where P is the adsorption pressure and P_0 is the saturated vapor pressure of the adsorbate
	BET Surface Area		0.8501	BET adsorption model
	Langmuir Surface Area		2.7459	Monolayer adsorption model
Pore Volume	t-Plot Micropore Area	$m^2 \cdot g^{-1}$	0.2049	/
	t-Plot external surface area		0.6452	/
	BJH Adsorption cumulative surface area of pores		0.5569	Pore size range from 1.7000 nm to 300.0000 nm
	BJH Desorption cumulative surface area of pores		0.6148	Pore size range from 1.7000nm to 300.0000nm
	Single point adsorption total pore volume of pores		0.0131	less than 40.3122nm diameter at $P/P_0=0.9500$
	t-Plot micropore volume		0.000026	/
Pore Size	BJH Adsorption cumulative volume of pores	$cm^3 \cdot g^{-1}$	0.0046	Pore size range from 1.7000 nm to 300.0000nm
	BJH Desorption cumulative volume of pores		0.0046	Pore size range from 1.7000 nm to 300.0000 nm
	Adsorption average pore diameter		6.1611	Calculated from $4V/A$, where the A corresponds to the adsorption BET specific surface area, adsorption cumulative pore internal surface area, desorption cumulative pore internal surface area, respectively; V is the gas adsorption volume
Surface Area	BJH Adsorption average pore diameter	nm	32.2499	
	BJH Desorption average pore diameter		30.1896	