Supporting Information for

Cyanobacterial biochar modified ceramic membrane for in-situ filtration and peroxymonosulfate activation: Focusing on interface adjustment and enhanced anti-fouling

Kunlun Yang [a, b, c,*], Dengyang Wang [a], Yuxuan Yang [d], Youxiang Pan [a], Mengsi Wu [a], Hengfeng Miao [a, b, c,**].

[a] School of Environment and Ecology, Jiangnan University, Wuxi 214122, PR China

[b] Jiangsu Key Laboratory of Anaerobic Biotechnology, Jiangnan University, Wuxi 214122, PR China

[c] Jiangsu Engineering Laboratory of Biomass Energy and Carbon Reduction Technology, Jiangnan University, Wuxi 214122, PR China

[d] JCET Group Co., Ltd., Wuxi 214437, PR China

*Corresponding author: Kunlun Yang, Jiangnan University, Wuxi 214122, China.

E-mail: yangkunlun@jiangnan.edu.cn

**Corresponding author: Hengfeng Miao, Jiangnan University, Wuxi 214122, China.

E-mail address: hfmiao@jiangnan.edu.cn

Supplemental data caption

Text S1 Cleaning method of membrane

Text S2 Characterization of anti-fouling performance of ceramic membrane

Text S3 Extraction method of membrane surface pollutants

Text S4 Toxicity experiment of Chlorella

Text S5 Membrane flux determination method (J, L/(m^2·h))

Text S6 Calculation method of membrane fouling resistance

Text S7 Conventional index detection methods

Table S1 Summary of water quality indexes

Table S2 Comparison of the target contaminant removal performance in this proposed system with the similar reported catalytic filtration systems

Fig. S1 Comparison of TOC removal rates across different systems

Text S1 Cleaning method of membrane [1]

(1) Backwashing: The effluent from membrane filtration was utilized for backwashing in the reverse direction, lasting for 5 min, with a flow rate of 48.0 ± 2.0 L/($m^2 \cdot h$).

(2) Chemical cleaning: At the conclusion of operation, the membrane was removed and immersed in a NaOH solution with a pH of 11 for 2 h. Following this, it underwent several backwashing cycles with ultrapure water for an additional 2 h. The washing flow rate during this process was 6 L/($m^2 \cdot h$). Ultimately, the transmembrane pressure difference of the ceramic membrane, under a flux of 20.0 L/($m^2 \cdot h$), ranged from 2.5 to 3.5 kPa.

Text S2 Characterization of anti-fouling performance of ceramic membrane

A sodium alginate (SA) solution with a concentration of 50 mg/L, designed to replicate the polysaccharide conditions found in natural water, served as a medium for evaluating the antifouling properties of catalytic ceramic membranes infused with biochar materials. A specific concentration of PMS solution was introduced to initiate the filtration process [2]. The DOC concentration matched that of SA, acting as an indicator of changes in SA levels throughout membrane filtration. A vacuum pressure gauge was used to monitor the variations in the transmembrane pressure differential.

Text S3 Extraction method of membrane surface pollutants [3]

The pollutants trapped on the membrane surface were first extracted by 0.01 mol/L NaOH soaking, then the pH of the extract was adjusted, and finally the extract was determined by fluorescence spectrometer (F-7000 FL, Hitachi).

Text S4 Toxicity experiment of Chlorella

BG-11 medium served as the culture environment for Chlorella. The glassware was sterilized at 121 °C for 30 min. Chlorella species were inoculated into the prepared medium under the following conditions: 12-h light/dark cycle, light intensity of 4500 Lux, temperature of 30 ± 1 °C, and pH of 7.1. The initial algal density was assessed using a hemocytometer and optical microscope (BM1000, Nanjing Jiangnan Yongxin Optical Co., Ltd., China). Subsequently, this culture was introduced into water samples from various treatment groups: A. Lake water containing HCQ; B. Effluent from the CM treatment system; C. Effluent from the CM-PMS treatment system; D. Effluent from the ITC-2-800@CM-PMS treatment system. Each treatment group consisted of four replicates, with a liquid volume of 20 mL per sample. After a 7-day exposure to light, the algal density was re-evaluated.

Text S5 Membrane flux determination method (J, L/($m^2 \cdot h$))

The filtrate volume (V) of a certain size of membrane area (S, the application area of the flat ceramic membrane used in this experiment is 0.075 m^2) was measured by an electronic stopwatch at 5 min (t) using a measuring cylinder, and the membrane flux

(J) was calculated using Formulas 1-1 [4].

$$J = \frac{V}{S \times t} \tag{1-1}$$

Text S6 Calculation method of membrane fouling resistance

The resistance distribution of membrane fouling was calculated by using the resistance series model, as shown in the formula 1-2 ~ 1-5.

$$R_t = \frac{\Delta P}{\mu J_1} = R_m + R_r + R_{ir} \tag{1-2}$$

$$R_m = \frac{\Delta P}{\mu J_0} \tag{1-3}$$

$$R_r = \frac{\Delta P}{\mu J_1} - \frac{\Delta P}{\mu J_2} \tag{1-4}$$

$$R_{ir} = R_t - R_m - R_r = \frac{\Delta P}{\mu J_2} - \frac{\Delta P}{\mu J_0} \tag{1-5}$$

where R_t (m^{-1}) is the total hydraulic resistance; ΔP (Pa) is TMP; μ is dynamic viscosity (Pa s); R_m is the inherent membrane resistance; R_r is reversible fouling resistance; R_{ir} is hydraulic irreversible fouling resistance. Among them, J_0 L/(m^2·h), J_1 L/(m^2·h) and J_2 L/(m^2·h) represent the permeation flux of ultrapure water, the final permeation flux and the pure water flux after hydraulic backwashing, respectively.

Text S7 Conventional index detection methods

Potassium persulfate ultraviolet spectrophotometry was used to measure and analyze TN. Nessler 's reagent spectrophotometry was used to measure and analyze NH_4^+-N; UV_{254} was measured and analyzed by ultraviolet spectrophotometer (TU1810, Purkinje, Beijing, China).

Table S1 Summary of water quality indexes [5]

	TN (mg/L)	**NH_4^+-N (mg/L)**	**NO_3^--N (mg/L)**	**DOC (mg/L)**	**TP (mg/L)**	**Turbidity (NTU)**	**SUVA [L/(mg·m)]**
Raw Water	0.97	0.28	0.34	3.44	0.14	17.24	3.62
CM	0.89	0.11	0.29	2.92	0.12	3.28	3.76
CM-PMS	0.73	0.09	0.24	3.32	0.09	3.19	3.46
ITC-2-800@CM-PMS	0.52	0.10	0.19	1.11	0.10	3.12	2.97
Drinking water standard	≤ 1.0	≤ 0.5	≤ 10.0	＜ 2.0	≤ 0.2	≤ 1.0	/

Table S2 Comparison of the target contaminant removal performance in this proposed system with the similar reported catalytic filtration systems

Materials	**Pollutants**	**Operating parameters**		**Removal efficiency**	**References**
		PMS	**Residence time**		
Mn-1/Al catalyst membrane	4-hydroxylbenzoic (80 ppm)	2 g/L	120 min	100%	[6]
M_{Co}-GAC	Bisphenol A (10 mg/L)	0.1 mM	60 min	89.3%	[7]
CuO@CHFMs	Bisphenol A (10 mg/L)	0.5 mM	30 min	91.4%	[8]
CFCM	Ofloxacin (40 μM)	2 mM	30 min	100%	[9]
CM@NC	Phenol (0.1 mM)	0.65 mM	60 min	100%	[10]
PPy/CCM-800	Bisphenol A (20 mg/L)	0.1 g/L	180 min	97.89%	[11]
Fe/N/BC membrane	Sulfamethoxazole (10 mg/L)	0.5 mM	30 min	78.0%	[12]
ITC-2-800@CM	Hydroxychloroquine (1 mg/L)	0.2 mM	180 min	90.0%	This work

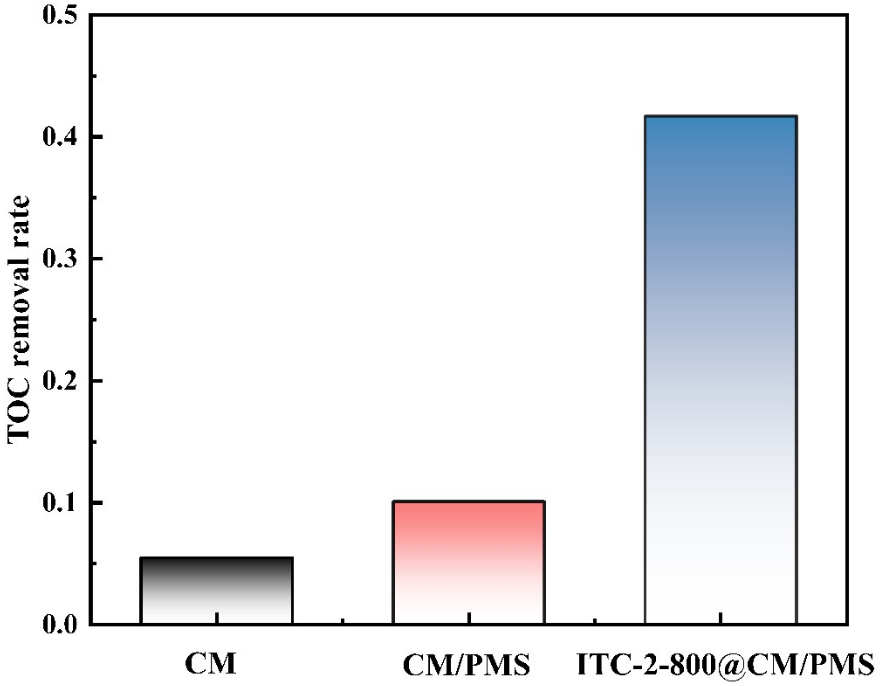

Fig. S1 Comparison of TOC removal rates across different systems

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