Effects of ferrihydrite-impregnated powdered activated carbon on phosphate removal and biofouling of ultrafiltration membrane.

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Supplementary Data

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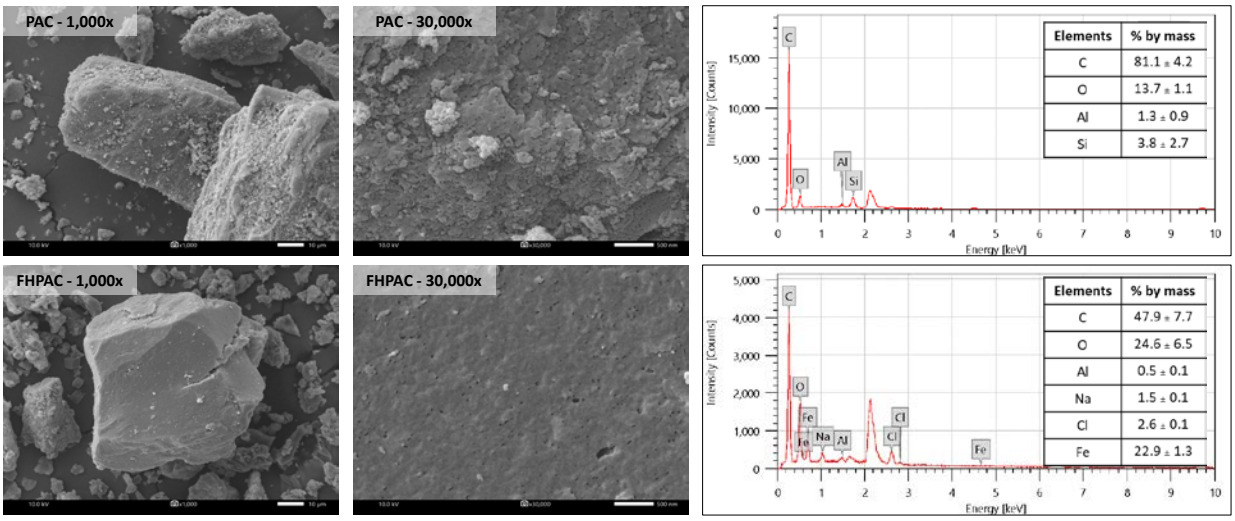

Figure S1 SEM images of PAC and FHPAC at different magnification levels (1,000x and 30,000x) and elemental compositions analysis by SEM-EDS.

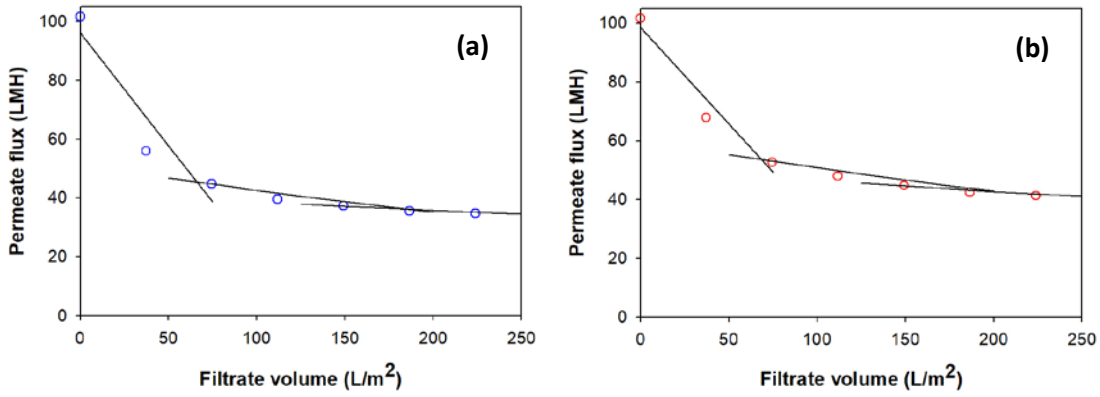

Figure S2 Mathematical models of fouling mechanism in biofouling test of (a) PAC+UF and (b) FHPAC+UF

Table S1 Tap water quality from the Metropolitan Waterworks Authority, Bangkok, Thailand (October 2020)

Parameters	Unit	Result
True color	TCU	1
Apparent color	Pt-Co	< 5
Turbidity	NTU	0.45
pH	-	6.88
Conductivity	µS/cm	299
Alkalinity	mg/L as $CaCO_3$	66
Total solids	mg/L	180
Total dissolved solids	mg/L	179
Chloride	mg/L	21
Sulfate	mg/L	44
Ammonia-nitrogen	mg/L	ND
Nitrate-nitrate	mg/L	2.82
Nitrite-nitrite	mg/L	ND
Calcium	mg/L	26.0
Iron	mg/L	< 0.05
Fluoride	mg/L	0.34
Manganese	mg/L	0.056
Magnesium	mg/L	6.00
Chlorine residual	mg/L	1.98
Total Bacteria	CFU/ml	0
E.Coli	Detectable/100 ml	non-detectable

Table S2 Kinetic parameters of phosphate onto PAC and FHPAC with an initial phosphate concentration of 1.0 mg PO_4^{3-}/L.

Adsorbents	$q_{e,exp}$ (mg/g)	Pseudo-first-order			Pseudo-second-order		
		k_1 (min^{-1})	$q_{e,cal}$ (mg/g)	R^2	k_2 (g mg^{-1} min^{-1})	$q_{e,cal}$ (mg/g)	R^2
PAC	0.80	3.34	0.71	0.298	2377.02	0.71	0.848
FHPAC	4.80	30.92	4.08	0.835	0.053	5.01	0.985

Table S3 Isotherm parameters of phosphate onto FHPAC with the variation of initial phosphate concentration from 0.1 – 13.7 mg PO_4^{3-}/L.

Adsorbents	Langmuir			Freundlich		
	q_m (mg/g)	K_L (L/mg)	R^2	K_F (L/mg)	n	R^2
FHPAC	22.32	0.97	0.921	7.66	1.81	0.924

Table S4 Mathematical models of fouling mechanism in biofouling test of PAC and FHPAC

Experiment	Complete blocking		Intermediate blocking		Cake filtration	
	K_b (h^{-1})	R^2	K_i (m^2 L^{-1})	R^2	K_c (h m^4 L^{-2})	R^2
PAC	0.762	0.891	0.0019	0.964	4×10^{-5}	0.985
FHPAC	0.656	0.954	0.0017	0.992	4×10^{-5}	0.987

Table S5 Fouling mechanism of PAC+UF and FHPAC+UF bench scale operation via mathematical models.

Cycle	Complete blocking		Standard blocking		Intermediate blocking		Cake filtration	
	K_b (h^{-1})	R^2	K_s (m^2 L^{-1})	R^2	K_i (m^2 L^{-1})	R^2	K_c (h m^4 L^{-2})	R^2
PAC								
1	-0.0764	0.804	-0.0024	0.887	0.004	0.998	-1.4×10^{-5}	0.837
2	-0.0273	0.988	0.0004	0.900	0.0045	0.937	4.0×10^{-6}	0.790
3	-0.0274	0.787	0.0004	0.954	0.0051	0.981	6.0×10^{-6}	0.886
FHPAC								
1	0.0690	0.830	-0.0024	0.894	0.0036	0.996	-1.4×10^{-5}	0.840
2	0.0502	0.979	0.0002	0.897	0.0044	0.936	2.0×10^{-6}	0.820
3	0.0374	0.897	0.00016	0.740	0.0053	0.925	1.8×10^{-6}	0.572