Supplementary information

Exploitation of expired cellulose biopolymers as hydrochars for capturing emerging contaminants from water

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Physico-chemical properties

$$\rho = m/V \quad [S1]$$

$$\eta_{sp} = \frac{t - t_o}{t_o} \quad [S2]$$

where ρ is the density of cellulose powder (g/cm^3), *m* is the mass of cellulose powder (g), and *V* is the volume occupied by the cellulose powder in the measuring cylinder (cm^3), while *t* and t_o are the flow times for cellulose dissolved in phosphoric acid solution and pure phosphoric acid solvent, respectively (min).

Plots for intrinsic viscosity

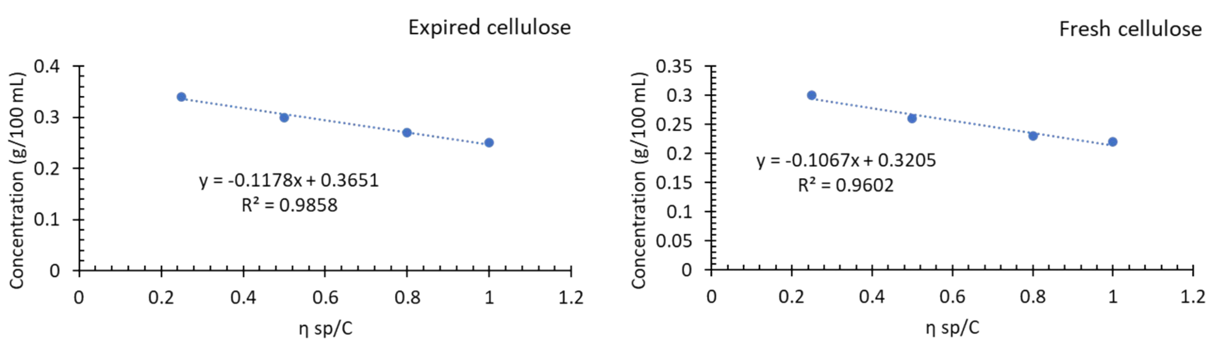

Fig. S1 Plots for intrinsic viscosity of expired and fresh cellulose.

Characterization
BET

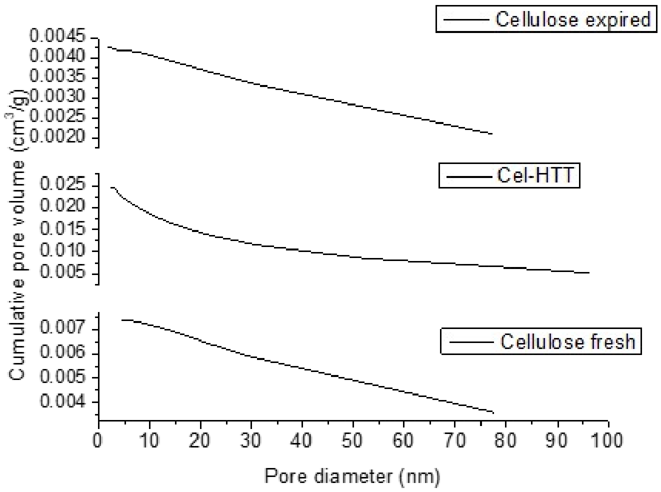

Fig. S2 Pore volume distribution of expired cellulose, Cel-HTT, and fresh cellulose.

Removal studies

$$\%Removal = \frac{C_o - C_e}{C_o} \times 100$$ [S3][1]

$$q_e = \frac{(C_o - C_e) \times V}{m}$$ [S4][2]

where C_o is the initial concentration (mg/L), V is the volume of the solution (L), m is the mass of the adsorbent (g), C_e is the equilibrium concentration (mg/L) and q_e is the equilibrium adsorption capacity (mg/g).

Kinetics

$$\log(q_e - q_t) = \log(q_e) - \frac{k_1}{2.303}t$$ [S5][2]

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e}t$$ [S6][3]

$$q = k_{id}t^{0.5} + c$$ [S7][4]

where k_1, k_2 and k_{id} are the rate constants for the pseudo-first-order, pseudo-second-order, and intra-particle diffusion models, respectively, q_t is the adsorption capacity at time t, and C is the boundary layer thickness coefficient.

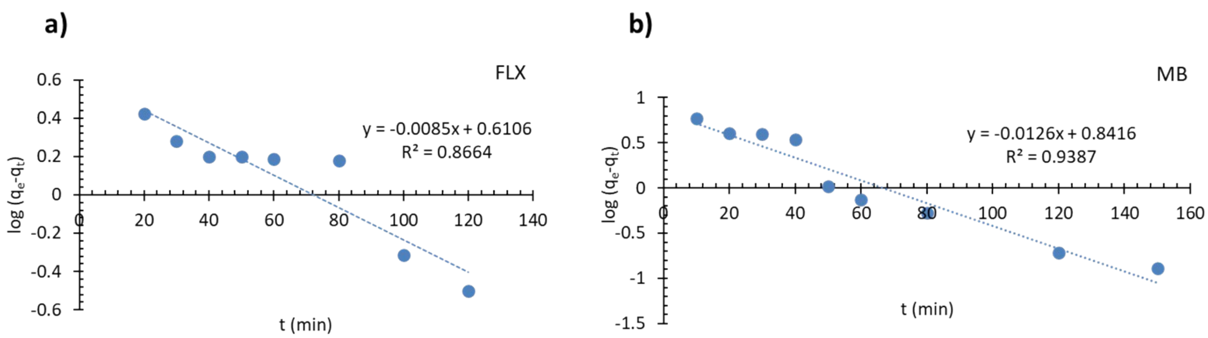

Fig. S3 Pseudo-first-order plots for FLX (a) and MB (b) at 50 ppm and adsorbent dose of 1.33 g/L at pH 7.5.

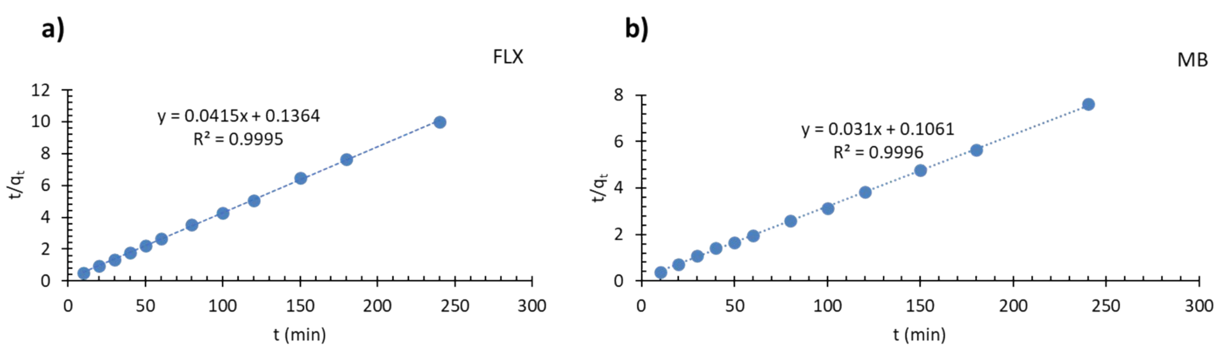

Fig. S4 Pseudo-second-order plots for FLX (a) and MB (b) at 50 ppm and adsorbent dose of 1.33 g/L at pH 7.5.

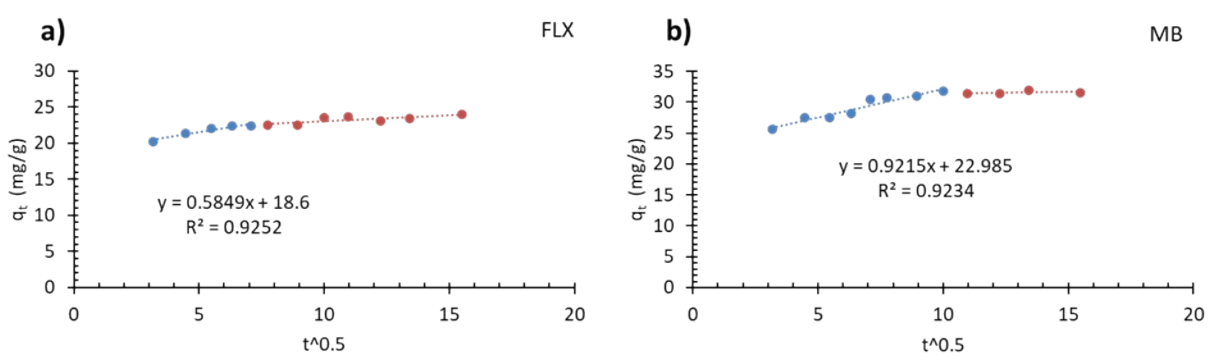

Fig. S5 Intra-particle diffusion plots for FLX (a) and MB (b) at 50 ppm and adsorbent dose of 1.33 g/L at pH 7.5.

Equilibrium isotherms

$$q_e = K_f C_e^{1/n}$$ [S8][5]

$$\frac{C_e}{q_e} = \frac{C_e}{q_m} + \frac{K_d}{q_m}$$ [S9][6]

where K_f and n are Freundlich constants, K_d is the Langmuir desorption constant (L/g) and q_m is the maximum adsorption capacity (mg/L).

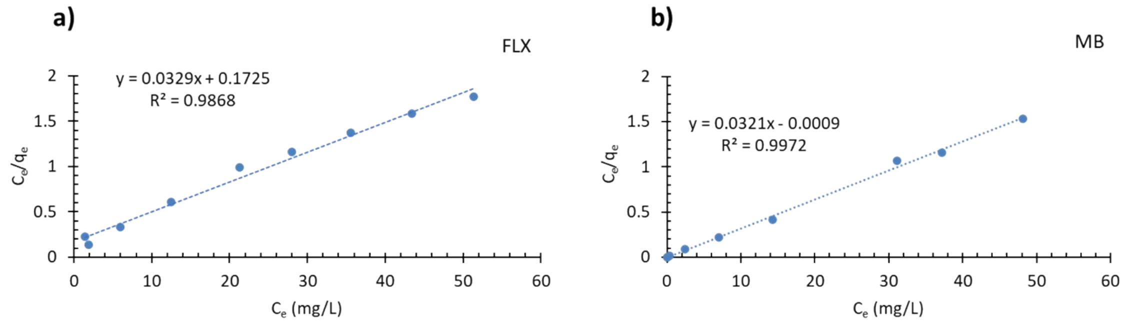

Fig. S6 Langmuir isotherm plots for FLX (a) and MB (b) at 10-90 ppm and adsorbent dose of 1.33 g/L at pH 7.5.

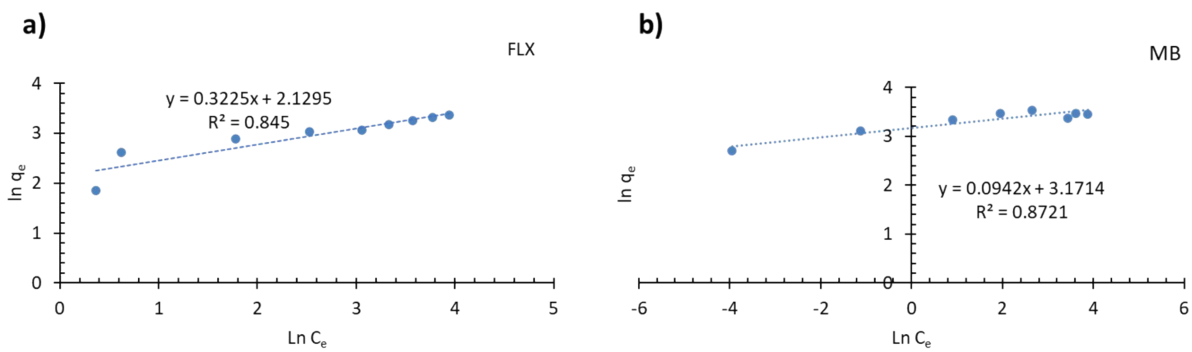

Fig. S7 Freundlich isotherm plots for FLX (a) and MB (b) at 10-90 ppm and adsorbent dose of 1.33 g/L at pH 7.5.

Adsorption mechanism

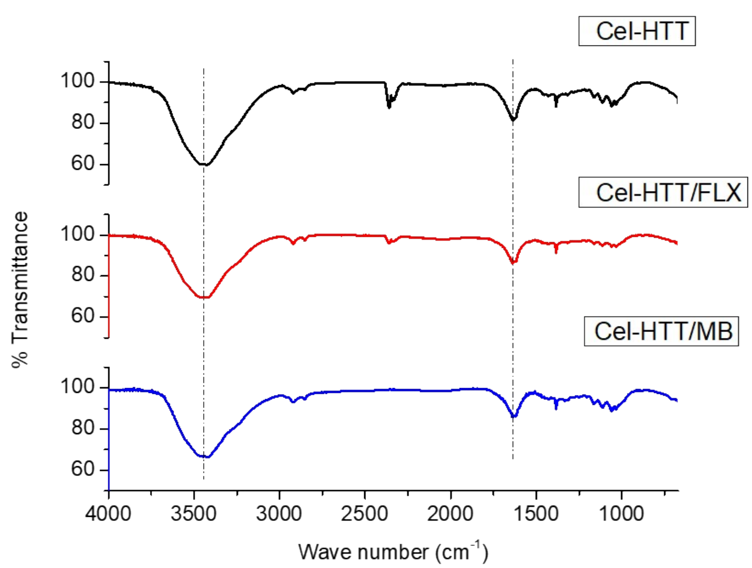

Fig. S8 FTIR measurements before and after adsorption of FLX and MB on Cel-HTT.

References

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