water

MDPI

Supplementary Materials

Adsorption of tannic acid and macromolecular humic/fulvic acid onto polystyrene microplastics: A comparison study

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1. Properties of DOMs

The selected physicochemical properties of HA, FA, and TA used in this study are presented in Table S1 [21].

Table S1. Selected physicochemical properties of model DOMs.

DOM	Elemental compositions (wt%)				Molecular weight (kDa)	Average molecular size (nm)
	C	H	N	O		
HA	54.8	4.8	0.9	39.5	22.8	185-280
FA	45.2	3.9	1.3	49.6	3.6	30-75
TA	53.6	3.1	-	43.3	1.701	~2.5

2. Adsorption kinetics

In order to study the adsorption mechanism of PS MPs on DOM, the pseudo-first-order model (1) [35], pseudo-second-order model (2) [36], and Elovich model (3) [37] were used to describe the kinetic adsorption model. The kinetic model is expressed as follows:

$$q_t = q_e(1 - \exp(-k_1 t)) \quad (1)$$

$$\mathrm{q}_t = \frac{{q_e}^2 k_2 t}{1 + q_e k_2 t} \quad (2)$$

$$q_t = \frac{1}{\beta}\ln(\alpha\beta) + \frac{1}{\beta}\ln t \quad (3)$$

where k_1 (1/min) and k_2 (g/(μg·min)) are the adsorption rate constants of the pseudo-first-order and pseudo-second-order models, respectively. q_t (μg/g) is the adsorption amount at time t, q_e (μg/g) is the adsorption amount per unit adsorbent at equilibrium; α (g/μg) is the initial adsorption rate constant, β (μg/(g·min)) is related to the surface coverage of the adsorbent and the activation energy of the chemical adsorption.

3. Adsorption isotherms

In this study, Langmuir model (5) [38], Freundlich model (6) [39], and Sips model (7) [40] were used to study the adsorption process of PS MPs on DOM. The isothermal adsorption model is as follows:

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \quad (4)$$

$$q_e = K_f C_e^{1/n} \quad (5)$$

$$q_e = q_m \frac{(K_s C_e)^{1/n}}{1 + (K_s C_e)^{1/n}} \quad (6)$$

where, q_e (μg/g) is the equilibrium adsorption amount; C_e (μg/L) is the equilibrium concentration of solution adsorbent; q_m (μg/g) is the maximum adsorption capacity; K_L (L/μg) is Langmuir adsorption constant; K_f (L/g) is the Freundlich distribution coefficient; K_s

(L/μg) is Sips equilibrium constant; and 1/n is the heterogeneous parameter of the material. The closer *n* value is to 1, the more homogeneous the material surface is.