Text S1 The analysis of adsorption kinetic and isotherm of Pb(II) on biochar

Pseudo-first order (Eq.1), pseudo-second order (Eq.2), and Elovich (Eq.3) models were used to fit the data of adsorption kinetic, which are expressed as followed:

$$Q_t = Q_e(1-e^{-k_1 t}) \quad (1)$$

$$Qt = (Q_e^2 k_2 t)/(1+Q_e k_2 t) \quad (2)$$

where Q_t (mg g^{-1}) and Q_e (mg g^{-1}) are the amounts of Pb(II) adsorbed at time t and at equilibrium, respectively, k_1 (h^{-1}) represents the rate constant of pseudo-first-order model, and k_2 is the rate constant of the pseudo second-order model (g mg^{-1} h^{-1}).

$$Qt = a+b\ln(t) \quad (3)$$

where Q_t (mg g^{-1}) is the amounts of Pb(II) adsorbed at time t, a, and b are constants.

The Langmuir (Eq. 4) and Freundlich (Eq. 5) model were appled to simulate the adsorption isotherm data.

$$Q_e = K_L q_{max} C_e/(1+ K_L C_e) \quad (4)$$

where Q_e (mg g^{-1}) and C_e (mg L^{-1}) are the adsorbed amount of Pb(II) by biochar and Pb(II) concentration at equilibrium solution, K_L (L mg^{-1}) is the Langmuir affinity constant, and q_{max} (mg g^{-1}) is the theoretical maximum adsorption capacity as the monolayer surface is completely covered.

$$Q_e = K_F C_e^n \quad (5)$$

where K_F [(mg g^{-1}) (L $mg^{-1})^{1/n}$] and n are the constants related to adsorption capacity and intensity, respectively.

Table S1. The TG-DTG characteristic parameters of cotton stalk, LDPE and their mixture.

	First Stage				Second Stage			
	T_i	T_f	T_{max}	Residue at T_{max} (%)	T_i	T_f	T_{max}	Residue at T_{max} (%)
CS	190.2	382.6	348.8	50.19	-	-	-	-
LDPE	-	-	-	-	390.5	503.9	474.6	35.06
C3P1	189.9	382.1	347.2	64.06	433.7	505.3	476.8	34.60
C2P1	189.5	382.4	345.7	67.97	431.5	505.0	479.8	34.35
C1P1	189.3	381.8	344.3	76.27	425.9	504.5	480.5	34.59

Table S2. The maximum Pb((II) adsorption capacities of biochar co-pyrolyzed by cotton stalk and LDPE, other biomass.

	Adsorption Conditions	Q_{max} (mg/g)	Ref.
Cotton stalk+LDPE	pH = 5.0, t = 24 h, 303K	199.82	in this study
Rice husk	pH = 5.0, t = 24 h, 298K	2.40	[1]
Pinewood	pH = 5.0, t = 24 h, 298K	4.25	
British broadleaf hardwood	pH = 5.0, t = 24 h, 293K	47.66	[2]
Corn stalk	pH = 5.5, t = 12h, 298K	49.70	[3]
Rice husk	-	26.70	[4]
Pine needle	pH = 5.0, t = 48 h , 308K	40.43	[5]
Saw dust	pH = 5.0, t = 24 h, 298K	62.68	[6]

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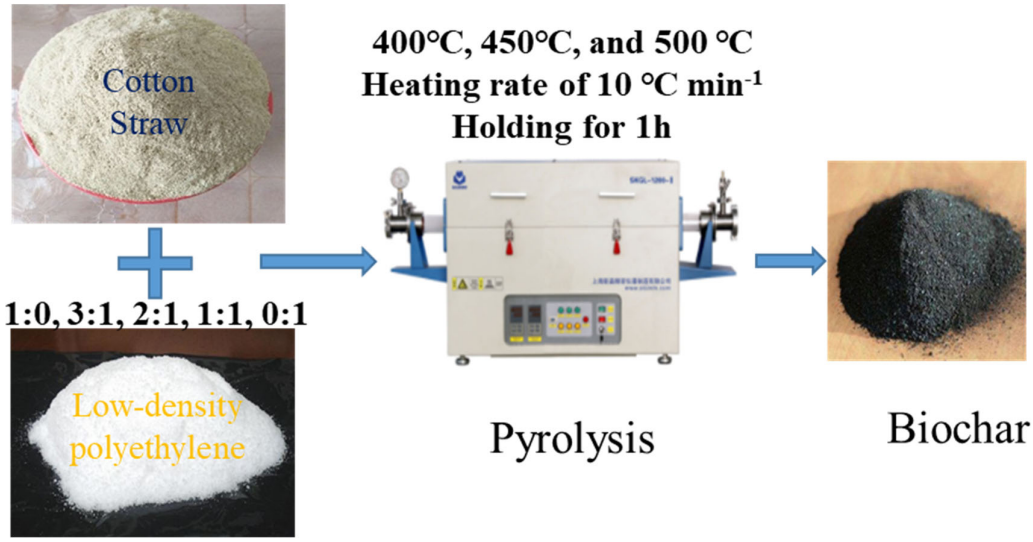

Figure S1. The experimental setup of vertical pyrolysis furnace.