Supporting Information

Green Preparation of Shell-Based Biochar and Its Adsorption of Multi-Component Chlorinated Volatile Organic Compounds

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1、Materials characterization

The specific surface area and pore size distribution of the samples were measured using the fully automated gas adsorption analyzer ASAP 2020 from Micromeritics Instrument Corporation (USA). The pore structure was characterized by N_2 adsorption-desorption isotherms, and the specific surface area was calculated using the BET method (Testing Parameters:Sample mass: 0.1 g, Analysis adsorptive : N_2, Analysis bath temp. : -195.640 °C, Equilibration interval: 10 to 15 s). The surface morphology of the materials was examined using a field emission scanning electron microscope (Regulus 8100) from Hitachi Ltd., Japan. The surface functional groups

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of the materials were determined using a Fourier transform infrared spectrometer (Nicolet iS50 FT-IR) from Thermo Fisher Scientific (USA). The Raman spectra of the materials were obtained using a laser Raman spectrometer (RM2000) from Renishaw plc (UK), with an excitation wavelength of 532 nm and a scanning range between 500–3500 cm^{-1}. X-ray photoelectron spectroscopy (XPS) was performed using an ESCALAB 250 system from Thermo Fisher Scientific (USA), with Al-Kα radiation at a power of 150 W. The elemental content of the materials was analyzed using an elemental analyzer (Vario EL cube) from Elementar Analysensysteme GmbH (Germany) via the combustion method. The thermal stability of the shell-derived biochar adsorbent was evaluated using a thermogravimetric analyzer (TGA/DSC 3+) from Mettler-Toledo Group (Switzerland).

2、Calculation of adsorption capacity

The adsorption capacities of VOCs were calculated by integrating the breakthrough curve using the following equation. The breakthrough time was defined as the time when the outlet concentration of VOCs was 5% of the inlet concentration, and the equilibrium adsorption time was the time required for an equal concentration of the VOC at the outlet and inlet.

$$q = \frac{FC_0 10^{-9}}{W}\left[t_s - \int_0^{t_s} \frac{C_i}{C_0} dt\right]$$

where q ($g \cdot g^{-1}$) is the estimated maximum adsorption capacity, F ($mL \cdot min^{-1}$) is the total gas flow, C_0 and C_i ($mg \cdot m^{-3}$) is the inlet and outlet gas concentration, respectively, W (g) is the mass of adsorbent, and t_s (min) is the adsorption time.