Supplementary Data for the article

Preparation of Porous Carbon Materials as Adsorbent Materials from Phosphorus-Doped Watermelon Rind

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1. Adsorption of dyes

1.1 Determination of standards

Determination of the maximum absorption wavelength of the dye: the two organic pollutants malachite green and reactive black were accurately weighed and configured with a volumetric flask as a dye solution of 10 mg/L, and they were prepared into the required solution with different concentration gradients. Since the perceived color of chemicals such as dyes will be directly affected by the reflection or absorption rate in the visible light range, in order to obtain the maximum absorption wavelength of the dye, the full spectrum scanning can be determined by using an ultraviolet spectrophotometer from Shanghai Sunny Hengping Scientific Instrument Co., Ltd. model UV2200.

Determination of the standard curve of the dye: malachite green (5mg/L, 7.5mg/L, 10mg/L, 12.5mg/L, 15mg/L, 17.5mg/L, 20mg/L, 22.5mg/L) and active black solution (5mg/L, 10mg/L, 15mg/L, 20mg/L, 25mg/L, 30mg/L, 35mg/L, 40mg/L) were prepared with concentration gradients, respectively. The absorbance of the same solution at the maximum absorption wavelength (the measurement wavelength of MG is 664 nm, and the measurement wavelength of AB is 596 nm) at different concentrations was determined by violet spectrophotometer, and the linear relationship between the absorbance of the dye and the corresponding concentration was fitted, the correlation coefficient R^2 was calculated, and the advantages and disadvantages of the fitting relationship were judged according to the calculated value.

1.2. Efect ofadsorption conditions on adsorption performance

In order to explore the adsorption performance of WC-M materials, the single variable method was used to explore the influence of different experimental conditions on their adsorption performance.

Effect of pH on adsorption performance: The concentrations of 0.1mol/L HCl and 0.1mol/L NaOH were prepared as acid-base adjustment solutions to adjust the pH of the experimental sample solution. Malachite green and active black solutions with dye solution concentrations of 12.5mg/L and 40mg/L were configured, and the pH of the solution was adjusted to 3, 4, 5, 6,7 and 8, respectively, and the absorbance of each solution at the optimal absorption wavelength was measured by violet spectrophotometer. Take 100mL of the dye solution (a total of ten samples), put 20mg of WC-M material into each sample, and adsorb the dye solution. The experimental temperature was kept at 25°C and the experimental duration was 2h. After 2h, the dye solution was filtered using a 0.22 μm filter membrane to remove the WC-M sample precipitate contained in the solution, and its absorbance was tested again by ultraviolet

spectrophotometer at its optimal absorption wavelength, and its adsorption capacity was calculated according to the standard curve.

Effect of temperature on adsorption performance: malachite green and active black solutions with solution concentrations of 12.5mg/L and 40mg/L were respectively, and the absorbance of the two solutions at the optimal absorption wavelength was measured by violet spectrophotometer. Take 100mL of dye solution (two dyes, take three 100mL solutions each) at 30 °C, 45 °C, 60 °C three ambient temperatures, add 20mg WC-M sample to each dye solution, and conduct an adsorption experiment with an experimental duration of 2h. After the experiment, the dye solution was filtered using a 0.22μm filter membrane to remove the WC-M sample precipitation contained in the solution, and its absorbance was tested again by ultraviolet spectrophotometer at its optimal absorption wavelength, and its adsorption capacity was calculated according to the standard curve.

Effect of time on adsorption performance: Malachite green and active black solutions with solution concentrations of 12.5mg/L and 40mg/L were configured respectively, and the absorbance of the two solutions at the optimal absorption wavelength was measured by violet spectrophotometer. Take 100mL of each solution, add 20mg WC-M sample, and measure its absorbance at the best wavelength with a violet spectrophotometer at 10min, 20min, 30min, 40min, 50min, 60min, 70min and 80min respectively. The absorbance curves of the two solutions were plotted with time, and the adsorption capacity of the prepared material WC-M was explored.

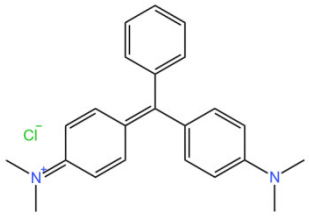
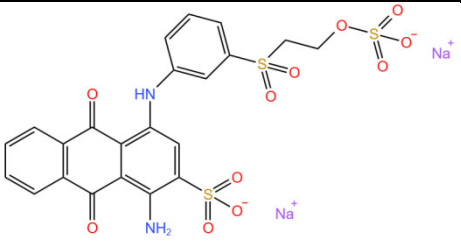
The adsorption capacity was calculated and the percentage removal was calculated as follows:

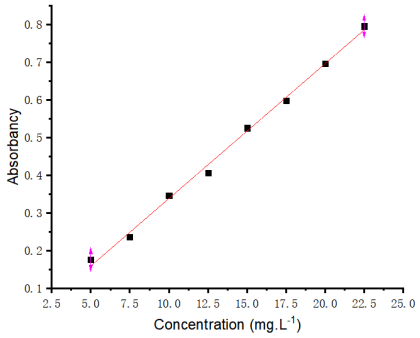
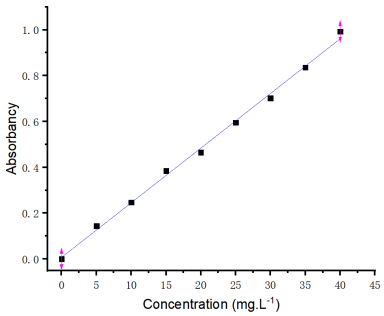
$$q_e = \frac{(C_i - C_e)V}{m} \quad (1)$$

$$R\ (\%) = \frac{C_i - C_e}{C_i} \times 100 \quad (2)$$

Among them, q_e is the adsorption capacity, R is the removal percentage, C_i is the initial concentration of the solution, C_e is the equilibrium concentration of the solution, m is the mass of adsorbent used, V is the volume of dye used.

Table S1. Basic parameters and fitting standard curve equation of three organic dyes

Name	Malachite Green	Active Black
Molecular formula	$C_{23}H_{25}ClN_2$	$C_{22}H_{16}N_2O_{11}S_3 2Na$
Molecular weight	364.91	626.549
Purity	98%	99%
Structural type		
Type	Cationic type	Anionic type
Maximum absorption wave/nm	664	596

Standard		
Standard curve equation	y=0.03578x+0.0199	y=0.02386x+0.0069
Correlation coefficient R^2	0.998	0.996