

## Supplementary Material

### **Photocatalytic Performance of Biochar Modified TiO<sub>2</sub> (C/TiO<sub>2</sub>) on Ammonia Nitrogen Removal**

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## **Standard methods for determination of NH<sub>3</sub>-N, NO<sub>3</sub><sup>-</sup> and NO<sub>2</sub><sup>-</sup> concentration**

Determination of NH<sub>3</sub>-N concentration is in accordance with the standard method HJ 535–2009 (Nessler's reagent spectrophotometry). NH<sub>3</sub>-N reacts with Nessler reagent to form a light red brown complex. The absorbance of the complex is proportional to the content of NH<sub>3</sub>-N and measured at the wavelength of 420 nm.

The standard method HJ/T346-2007 (Water Quality-Determination of nitrate-nitrogen Ultraviolet spectrophotometry) is used to determine the concentration of NO<sub>3</sub><sup>-</sup>. NO<sub>3</sub><sup>-</sup> and dissolved organic matter are quantitatively determined by the absorption of nitrate ions at a wavelength of 220 nm. While nitrate ions are not absorbed at 275 nm. Therefore, another measurement at 275 nm can be used to correct the nitrate nitrogen value.

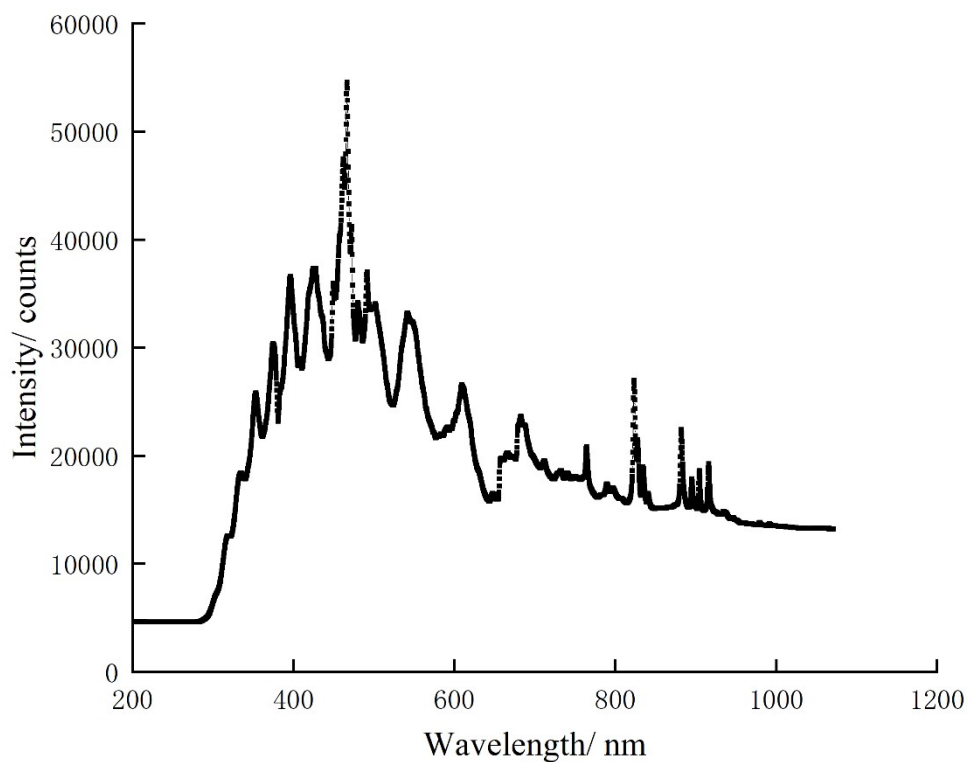
GB 7493-87 (Water Quality-Determination of nitrogen(nitrite)-Spectrophotometric method) is used to determine the concentration of NO<sub>2</sub><sup>-</sup>. In phosphoric acid medium, NO<sub>2</sub><sup>-</sup> in the sample reacts with 4-aminobenzenesulfonamide to form diazonium salt at pH=1.8. It will couple with N-1-Naphthylethylenediamine dihydrochloride to generate a red dye, and the absorbance is measured at 540 nm. If a cuvette with an optical path length of 10 mm is used, and the concentration of NO<sub>2</sub><sup>-</sup> is within 0.2 mg/ L, its colour conforms to Beer-Lambert Law.

## Preparation of C/TiO<sub>2</sub>

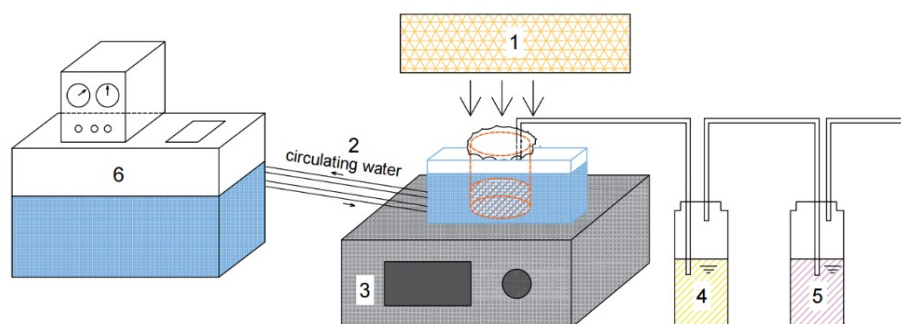
Sewage sludge was collected from a municipal wastewater treatment plant in Sichuan Province (China) and had undergone traditional secondary biological treatment, gravity condensation and mechanical dewatering processes. Raw sludge was first dried in an oven (105°C, 5 d) and then ground into powder through a 160-mesh sieve and stored for further use. The chemical reagents of zinc chloride (ZnCl<sub>2</sub>) and sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) were used as activator.

## References

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- [23] Wang, G., Wang, J., Yu, T., Guo, X., and Chen, Y. (2022). "Efficient removal of humic acid in water using a novel TiO<sub>2</sub> composite with biochar doping." *RSC Advances*, 12(49), 31966-31975.



**Fig.S1 Spectrogram of Xenon Lamp**



1-a high pressure xenon lamp, 2-an exterior circulation cooling water system,  
3-a magnetic stirrer, 4-dilute sulphuric acid, 5-phenolphthalein solution,6-water-circulation multifunction vacuum pump

**Fig.S2 Schematic diagram of the reaction system reaction**

### **Application of C/TiO<sub>2</sub> on NH<sub>3</sub>-N removal in nature waters**

After initial assessment of natural samples, the samples were spiked with known concentrations of NH<sub>4</sub>Cl to check the removal efficiency in real applications.

Jiang'an River: NH<sub>3</sub>-N=1.44 mg/L, pH=7.44, TOC=3.99 mg/L

Mingyuan Lake: NH<sub>3</sub>-N=1.68 mg/L, pH=7.81, TOC=2.95 mg/L

1 g/L C/TiO<sub>2</sub> and commercial TiO<sub>2</sub> were added into 100 mL natural water respectively, with adding a certain amount of NH<sub>4</sub>Cl. Thus, the initial concentration of NH<sub>3</sub>-N in Jiang'an River and Mingyuan Lake were adjusted to 59.16 mg/L and 64.95 mg/L, respectively. and the photocatalytic reaction was carried out under a Xenon lamp (AM1.5, high light intensity) for 1 h. Then, samples were taken out and filtered at designed time intervals, and NH<sub>3</sub>-N concentration of the supernatant was analyzed and discussed.