

# Ozone-Biological Activated Carbon. AdvancedREmoval. Typical Persistent Organic Pollutants from Micro-polluted Source Water. yangtze DeltaREgion

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**Abstract:** Ozone-Biological Activated Carbon(O<sub>3</sub>-Bac). Studied. Advanced Removal. organics from micro-polluted Source Water. water supply plant P located. J City. yangtze DeltaREgion.: Show, 19. 2%. permanganate Index10. 4%. total organic carbon23. 0% UV<sub>254</sub>. Removed. advanced treatment. O<sub>3</sub>-Bac.Eight types. polycyclic aromatic Hydrocarbon(PAH)16 types. organochlorinated pesticides(OCPs), Five types. haloacetic Acids(Haas). Detected. Source Water.. Total concentrations. 53. 9-100. 06. 5-41. 8, 2. 5 × 10<sup>3</sup>-1. 1 × 10<sup>4</sup>Ng in L<sup>-1</sup>... Advanced O<sub>3</sub>-Bac treatment removed 32. 5%. PAHs 25. 9%. OCPsGreatly improving. effluent. conventional Water Supply Process.HoweverHaas. mainly removed. conventional process. A removal. 33. 8%-0%.After. advanced treatment. O<sub>3</sub>-Bac. Chloroacetic acid slightly decreasedWhile the concentration of bromokinetic acid slightly created.

**Keywords:** Ozone-Biological Activated Carbon(O<sub>3</sub>-Bac);Polycyclic aromatic hydrocarbons(PAHs);Organic Pesticides(OCPs);Halal kids(Haas);Yangtza DeltaREgion;Persistent organic pollutants(POPs)

With the development of industry and agriculture, organic pollution of water resources is becoming more and more serious.,Refractory,High Toxicity persistence, sex, organic, substance(Persistent organic pollutants, Jiang,Tai Lake,Qiantang River,Jiaying River Network,The analysis of typical pops in drinking water source water of Yangtze River Delta, including Huangpu River shows that (VOCs),Organochlorine Pesticides (OCPs),Polycyclic aromatic hydrocarbons (PAHs (PAHs)The detectable concentration range is0. 5x10<sup>3</sup>~4. 2x10<sup>4</sup>,1. 5~339,4. 3~406 ng · L<sup>-1</sup>Among which Taihu LakeVOCsThe highest pollution, Jiaying River NetworkOCPs,PAHsHigher than the Lower Yangtze River and

Other water sources.Li weimei and others were detected in the Lower Yellow River and the Lower Yangtze River respectively.95And121Species of organic matter, including Polycyclic Aromatic Hydrocarbons Detection of organic matter in drinking water of Lianyungang City30Species, in which priority control of Persistent Organic Matter10Seed.Therefore, the deep removal of Persistent Organic Matter in Micro-polluted raw water is particularly important and urgent..

Ozone-Biological Activated Carbon(O<sub>3</sub>-Bac)Process is integrated ozone oxidation,Activated Carbon Adsorption,Biodegradation,Ozone Disinfection in one, can effectively remove ammonia nitrogen in Water,Permanganate Index>Total organic carbon (TOC)Improve color,Taste and other sensory indicators to improve the water quality.

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Domain is widely used. Past O<sub>3</sub>-Bac There have been many reports about the removal and improvement of conventional indicators. O<sub>3</sub>-Bac There are few studies on the removal efficiency of persistent organic matter from organic micro-polluted raw water. Based on the Yangtze River Delta Municipal typical micro-polluted water source PO<sub>3</sub> in Waterworks-Deep Treatment Process of Biological Activated Carbon (O<sub>3</sub>-Bac) As the research object, the effects of PAHs on typical pops in raw water were investigated. In order to provide data basis for the upgrading and transformation of the micro-polluted raw water.

## 1. Materials and Methods

### 1.1 Overview of Waterworks

The city is located in the center of the Yangtze River Delta and downstream of Taihu Lake, River Network water is the main source of drinking water. The water quality is affected by the upstream pollution and the development of industry and agriculture. Waterworks is located Southwest of the city, the water supply scale is 10 Wan M<sup>3</sup> · D<sup>-1</sup>. Raw Water Quality 1. Shown.

2004 Years in conventional processing process based on increase ozone-Biological Activated Carbon depth processing facilities now the whole water purification process for Biological Contact Oxidation Pretreatment, Strengthen conventional processing and two-level ozone-Biological Activated Carbon depth processing as shown in Figure 1. Shown in. Ozone contact pool the convection contact style ozone contact time 12 min. A, Secondary ozone contact Pool Design ozone dosage respectively 3 mg in L<sup>-1</sup>, 2 mg in L<sup>-1</sup>. Activated carbon filter V Style Filter Form. Design filter super 10 m in H<sup>-1</sup>. Carbon Filter Using a carbon, Sand double-layer filter material upper 30~80 The broken carbon layer thickness 2 m Lower Using Quartz Sand Layer Thickness 0.3 m. The empty bed contact time 12 min. Filter Backwash the first gas at after water style gas at strength 55~60 m<sup>3</sup>In · (H In m<sup>2</sup>)<sup>-1</sup> Water strength 27 m<sup>3</sup>In · (H In m<sup>2</sup>)<sup>-1</sup> The Rinse Cycle 5~7/d.

### 1.2 Analysis Method

Jordan, Alpha-Jordan, Dieldrin, Ideldrin, Endosulfan, Aldehyde, Isdione, Methoxyddt, OCPs] Sample pretreatment method and analysis method according to the national standard<sup>[12]</sup> And literature [17], Using gas chromatography (Japan Shimadzu Company, Plus for GC-2010) Detection. Detection conditions: Electron capture detector (ECD); Detector temperature 300; Agilent HP-5 Chromatographic Column (30 m x 0.25 x 0.25 μM); Pretreatment Method: Liquid-liquid extraction with n-hexane, internal standard method for quantification, with decachlorobenzene as internal standard.

9. Haloacetic acid (Monochloroacetic acid, 1-bromoacetic Acid, DICHLOROACETIC ACID, Trichloroacetic Acid, 1) monochloroacetic acid, Two dibromoacetic Acid, Monobromodichloroacetic Acid, Dibromomonochloroacetic Acid, Tribromoacetic acid, Haas) The sample pretreatment and analysis methods are in accordance with the national standards.<sup>[12]</sup> And literature [18], Using gas chromatography (Japan Shimadzu Company, Plus for GC-2010) Detection. Haas Detection conditions: ECD Detector, detector temperature 300 Inlet Temperature 250, Agilent HP-5 Chromatographic Column (30 m x 0.25 mm x 0.25 μM). Pretreatment was carried out by liquid-liquid extraction derivatization, methyl tert-butyl ether extraction, and methanol Derivatization with sulfuric acid acidification. 2 h Internal standard method for quantitative analysis 1,2-Dibromopropane.

Dichloromethane for experiment, Methanol, All organic solvents, such as hexane, are chromatographic pure, PAHs, OCPs, Haas Mixed standard and internal standard goods are purchased Yu USA Accustandard Company.

### 1.3 Quality Control

For quality control, samples of all test indicators are collected every Sample settings 1. A parallel sample, sample analysis, PAHs, OCPs And Haas Parallel Test of a negative control sample (Ultra pure water) and positive control samples (known concentrations of mixed standard solution), the mixed standard continuous sample 7. Ensure the precision of the instrument within the scope of the national standard method. Select on Standard Curve 2. Blank and spiked samples were analyzed at different

## 2. Results and discussions

### 2.1 Change of conventional water quality index

2015 Year 1. Month and 8. Moon P Raw Water of Waterworks, Effluent from conventional process, O<sub>3</sub>-Bac Effluent, Test results of routine water quality indicators of factory water 2. Shown. The raw water quality has obvious seasonal variation (TOC, UV<sub>254</sub>, Permanganate index), Ammonia Nitrogen, Turbidity winter (1. Month) In the summer (8. Month) Slightly higher, this with Song Yali etc.<sup>[19]</sup> The report shows that the results of Huangpu River source water are consistent. P Water Source Water is river network water, winter is dry season, the water temperature is low, Less water increases organic pollution in Water. Permanganate index of finished water, Ammonia Nitrogen, Turbidity, PH All meet 《Hygienic Standard for Drinking Water》 (GB 5749-2006) Requirements.

Removal rate of ammonia nitrogen and turbidity by conventional water treatment 95% Around, the effluent ammonia nitrogen and turbidity were as low 0.02 mg · L<sup>-1</sup>, 4 NTU Following. Organic Matter Index of the whole

process TOC, UV<sub>254</sub>. The average removal rate of permanganate index was 32.6%, 5%, 67.0%. Average removal rate of conventional treatment. Don't be 22.3%, 27.8%, 39.9%. O<sub>3</sub>-Bac Deep treated effluent TOC, UV<sub>254</sub>, Permanganate index concentrations dropped 2.59 mg · L<sup>-1</sup>, 0.065 cm<sup>-1</sup>, 2.0 mg · L<sup>-1</sup>. Average removal rate was improved on the basis of conventional treatment process. 10.4%, 23.0%, 2%, Visible O<sub>3</sub>-Bac Significant for stabilizing and improving organic removal. Especially UV<sub>254</sub> The organic compounds represented by the aromatic ring structure or the conjugated double bond structure contribute a lot. Oxygen can selectively destroy unsaturated bonds, which is conducive to their biodegradation.

China also on which 120 of PAHs The key control. 2015 Years 1, 4, 6, 8 Months respectively on P Water plant raw water and the section water in EPA Priority Control 16 of PAHs The analysis results as shown in Figure 2 And table 3 Shown in. Raw Water in PAHs Total concentration in 53.9~0 ng in L<sup>-1</sup> Which 1 Month significantly higher than in 8 Month this and conventional organic matter detection results consistent. Different Month raw water in detection PAHs Style Change not main 2~4 Ring PAHs Main accounted for total 80.6%~93.9% 5 Ring of benzo [A] Pyrene have a small amount of inspection

The. Gao Xu and study reported Three Gorges Reservoir Area City 6A Water Plant PAHs Raw Water in detection total concentration in 1~40 ng in L<sup>-1</sup> Detected style main For naphthalene, Anthracene, Fluoranthene 2~3 Ring PAHs. And of compared, P Water plant raw water PAHs Of pollution level is high.

P Water Plant the whole process PAHs The removal rate 45.7%~2% Factory water detection PAHs Total concentration in 29.3~46.8 ng in L<sup>-1</sup> Not more The 《 City Water Supply Water Quality Standard Of (CJ/T 206-2005) PAHs Total concentration 2 μg In L<sup>-1</sup> Of limit meet The 《 Life drinking water Health Standard Of (GB 5749-2006) Of requirements. 8 Month the Section PAHs Removal rate were is 1~6 Months slightly worse may is by temperature shadow

The because PAHs Of adsorption for heat release process temperature increased [25] PAHs Was adsorption reduce. Conventional process PAHs Removal Effect poor removal rate in 7/. 4%~15.0% Which of Acenaphthylene, The Philippines, Benzo [A] Pyrene even slightly rise. This is due to conventional process. But sedimentation tank or filter in Adsorption PAHs Of sediment if less than shi qing % Which Level O<sub>3</sub>-Bac And secondary O<sub>3</sub>-Bac, Respectively, to enhance removal rate 12.8%~25.5%, 8.8%~17.8%. Because ozone in reaction process of hydroxyl free radical (In OH) Make PAHs Oxidation Decomposition and PAHs Has hydrophobic strong and octanol-Water Distribution PAHs Chemical properties more stable degradation difference. Chlorine disinfection after

Water different form of chlorine will and PAHs Position in, Open-Loop, Addition and reaction and transformation for other organic matter.

## 2.2 Changes in Organochlorine Pesticides

OCPs Is one of the earliest use, the most widely used, Strong toxicity, [30,31] Long-lasting chemical insecticides. Most of those already under key control under the Stockholm Convention 21. Species persistence [32] Machine things. 2015 Year 1, 4, 6, 8. Separately on the month P Raw Water of waterworks and effluent of each section 19 Seed OCPs Analyze the results as shown in Figure And table 4. Shown. P Raw Water of Waterworks 1.~8. Moon OCPs All are detectable, of various types, total 16 Species, total, concentration, in 6.5~41.8 ng · L<sup>-1</sup> To Six, Endosulfan, The main part is Total 63.2%~80.4%. Among them 1, 4, 6. Month and routine The study found that there are many kinds of water in Nanjing section of Yangtze River OCPs Interior Qiandao lake reservoir area and Qiantang River (Hangzhou Section) China 10 Total amount of organochlorine pesticides in 1.9~7.6 ng · L<sup>-1</sup> And 1.31~6.7 ng · L<sup>-1</sup>. This shows that P Raw Water of Waterworks OCPs Relatively high levels of pollution.

Still in the water 12 Seed OCPs Detection, total concentration in 7.4~13.6 ng · L<sup>-1</sup>. The whole process OCPs Removal rate 20.0%~69.3%. Conventional treatment OCPs Removal rate is low, only 0.9%~26.8%. Especially 8. Moon raw water OCPs Content

Under Low conditions, the conventional OCPs Little Removal Effect. OCPs To a certain extent, the conventional water treatment Water-based, the conventional process is mainly removed by co-deposition with flocs in coagulation, and low temperature is conducive to the adsorption reaction. OCPs Reduced adsorption capacity. O<sub>3</sub>-Bac Deep Processing pair OCPs The removal effect is remarkable. O<sub>3</sub>-Bac To Yun OCPs The removal rate is 5.4%~18.5%, Level 2 O<sub>3</sub>-Bac Okay.

OCPs The removal rate is 9.7%~18.2%, Whole O<sub>3</sub>-Bac

Deep Processing to total OCPs Removal rate 15.1%~36.6% And improved the safety of finished water., Six, Lin Dan, DDT indicators met 《Hygienic Standard for Drinking Water》 (GB

Electron Reactive agents attack aromatic rings, Unsaturated double bond and triple bond, And including N, S Reducing chemical groups, etc. OCPs Decompose into small molecule organics, improving BAC Stage biodegradability, but on [41] Carbon Adsorption will have a slight impact .

## 2.3 Changes of haloacetic ACID IN WATER

Haloacetic acid in drinking water (Haas) It mainly comes from the Disinfection by-products produced by chlorination (CL-DBPs) And industrial and agricultural development. [42]

Water Pollution . Some research shows Haas Embryonic toxicity And teratogenic effects, mainly for reproductive damage and developmental damage, and

City to Yellow River source water plant raw water in 40 of Haas. The 8 Times research found Haas were not detected. P Conventional Water Process Water Haas Concentration in 0.3~7.1  $\mu\text{g L}^{-1}$  Removal Rate in 33.8%~87.0% Removal effect significantly. Two Level  $\text{O}_3$ -Bac Depth Processing Research results consistent due Haas Of generation reaction by temperature influence is big temperature the higher the reaction speed the fast, Haas Production [50] And. Factory water Haas In with bromoacetic acid concentration in 12.7~0  $\mu\text{g L}^{-1}$  Between accounted for halogen acetic acid total 38.7%~3% Of proportion and concentration were higher than that of Shanghai,, Beijing, and City By-product precursor of content is high; on the other hand may is river network raw water containing is high BR In chlorine disinfection process in BR Can and hypochlorite ( $\text{HOCl}$ ) Reaction generated  $\text{HOBr}$  And  $\text{HOBr}$  Than  $\text{HOCl}$  Chemical live Of more easy to and organic matter happened halogenated reaction formation is more [5152] Of brominated by-product This for the further to study.

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