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Single Acute Toxicity Test of Eight Pollutants in Reclaimed Water to Q67

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Abstract

Human development and water resources are inseparable, there is no shortage of water resources in the world, but there is a total amount of abundant, can directly use fresh water scarce. At the same time, the distribution of water resources in space and time is not uniform, and different regions have different development degrees and different utilization degrees of water resources.

Keywords

Large Flea; Photogenic Bacteria; Toxicity.

1. Introduction

China is one of the world's 13 water shortage countries, per capita freshwater resources only accounted for a quarter of the world's average level, on the one hand, mainly because of the large population in our country, on the other hand, due to the rapid development of China's economy in recent years, the level of urbanization gradually improved, the consumption of water resources increased year by year, Traditional forms of water saving or rationalization of water resources utilization can no longer meet the current situation of water demand for development. Seeking a new situation of water resources recycling has become a new way to rationalize water resources utilization, and the selection of pollutants and the allocation of reserve liquid.

The eight selected experimental drugs are all available in the market, with high purity and no physicochemical interaction between them. The selection in the experiment is mainly based on two conditions: first, there are reports of detection in recycled water and they belong to trace toxic pollutants; second, the detection rate and ecological risk in recycled water are considered in the selection. Based on the detection and toxicity test of reclaimed water pollutants in recent years and the solubility of pollutants, eight kinds of trace toxic pollutants in reclaimed water were identified as experimental compounds. Since all the other drugs except the three heavy metals are solid, they need to be dissolved in water when equipped with a reserve solution. However, since the three kinds of heavy metals are insoluble or insoluble in water, 0.1% dimethyl sulphone (DMSO), which does not have toxic effects on luminescent bacteria, is added as a co-solvent when the reserve solution is configured. Under this condition, all the five solid drugs are completely dissolved in water. All the configured reserves are stored in brown volumetric bottles and stored in the refrigerator at 4 ° C for use. The following are the basis for selecting each pollutant.

At present, most of the studies on DBPs are in drinking water, but the detection of DBPs in reclaimed water has attracted more and more attention in recent years. Halogenated aromatic compounds are a new type of DBPs, which were detected by Yang and Zhang in the waters

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discharged from the tailwater of sewage treatment plants [59]. This class of compounds has been shown to be toxic to certain Marine microorganisms, and more so than traditional HAAs. Under certain conditions, halogenated aromatic DBPs can also degrade into HAAs, posing a greater threat to the environment. The study showed that the biological toxicity of DBPs was emerging aromatic DBPs> iodoacetic acid > bromoacetic acid > chloroacetic acid, and the toxicity of emerging DBPs was much higher than that of conventional DBPs. Therefore, three representative halogenated aromatic DBPs were selected for toxicity experiments in this paper. With the continuous update of the physicochemical properties of the three DBPs and the water treatment process of the concentration of the configured reserve liquid, most of the pollutants can already be treated by the reclaimed water reuse technology. However, the toxic effect caused by the accumulation of low amount of toxic pollutants in the reclaimed water during the reuse process. As well as the risk to human health in the process of contact with the human body in the process of agricultural irrigation and landscape water can not be ignored, especially in recent years, the shortage of fresh water resources is becoming increasingly severe, people's utilization rate of recycled water is gradually increasing, and the attention of trace toxic pollutants in recycled water has become the focus of water environmental pollution.

Yan Mengjie et al evaluated 162 kinds of trace toxic and harmful pollutants in the reclaimed water of 5 sewage treatment plants in Beijing by gas chromatography mass spectrometry (GC-MS) and inductively coupled plasma mass spectrometry (ICP-MS) [1]. Phenols, steroid hormones and heavy metals such as Cu and Zn were detected. Yang Yifan et al. [2] used ultra-high performance liquid chromatography-time-of-flight mass spectrometry (UPLC-TOF-MS) to screen PPCPs in reclaimed water used for agricultural irrigation in Beijing, and detected a total of 16 PPCPs, including gamboflavin. Cao Zhonghong et al. [3] found A total of 9 endocrine disruptors (EDCs) including bisphenol A in the testing of the effluent from the reclaimed water plant, and tested the mean concentration of EDCs contained in raw water and ozone oxidation treatment, and the results showed that EDCs could not be completely removed in the process of reclaimed water treatment. In the waters discharged from the tailwater of sewage treatment plants, a variety of DBPs are usually detected at the same time, and the common emerging DBPs halogenated phenol as a disinfection by-product is detected at the same time [4].

The time-concentration response curves of eight compounds detected in reclaimed water against Vibrio Qinghai (Q67) were determined by microplate toxicity analysis, which provided theoretical support for risk assessment and prediction of mixtures in reclaimed water environment.

2. Pollutant Selection and Reserve Fluid Allocation

The eight selected experimental drugs are all available in the market, with high purity and no physicochemical interaction between them. The selection in the experiment is mainly based on two conditions: first, there are reports of detection in recycled water and they belong to trace toxic pollutants; second, the detection rate and ecological risk in recycled water are considered in the selection. Based on the detection and toxicity test of reclaimed water pollutants in recent years and the solubility of pollutants, eight kinds of trace toxic pollutants in reclaimed water were identified as experimental compounds. Since all the other drugs except the three heavy metals are solid, they need to be dissolved in water when equipped with a reserve solution. However, since the three kinds of heavy metals are insoluble or insoluble in water, 0.1% dimethyl sulphone (DMSO), which does not have toxic effects on luminescent bacteria, is added as a co-solvent when the reserve solution is configured. Under this condition, all the five solid drugs are completely dissolved in water. All the configured reserves are stored in brown volumetric bottles and stored in the refrigerator at 4 ° C for use. The following are the basis for selecting each pollutant.

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At present, most of the studies on DBPs are in drinking water, but the detection of DBPs in reclaimed water has been paid more and more attention in recent years. Halogenated aromatic compounds are a new type of DBPs, which were detected by Yang and Zhang in the waters discharged from the tailwater of sewage treatment plants [59]. This class of compounds has been shown to be toxic to certain Marine microorganisms, and more so than traditional HAAs. Under certain conditions, halogenated aromatic DBPs can also degrade into HAAs, posing a greater threat to the environment. The study showed that the biological toxicity of DBPs was emerging aromatic DBPs> iodoacetic acid > bromoacetic acid > chloroacetic acid, and the toxicity of emerging DBPs was much higher than that of conventional DBPs. Therefore, three representative halogenated aromatic DBPs were selected for toxicity experiments in this paper.

Endocrine disruptors (EDCs) exist widely in the natural environment and have been frequently detected in reclaimed water in recent years. As EDCs directly or indirectly enter the water environment, they can lead to changes in the normal hormone function and physiological status of humans and animals, which has a great impact on the health of humans and animals. The detection and toxicity evaluation of EDCs in reclaimed water are particularly important. Yan Mengjie et al. [56] studied the effluent from five wastewater treatment plants in Beijing and analyzed some pollutants such as endocrine disrupters and heavy metals. In this study, four EDCs with high concentrations detected were selected for pre-experiment, namely bisphenol A, triclosan, dicycloethyl phthalate and estrone. Triclosan, dicycloethyl phthalate, and estrone have no toxic effect on Q67 at low concentrations, while they are insoluble in water at high concentrations or need to be dissolved by adding excessive cosolvents. Meanwhile, bisphenol A (BPA) has the highest concentration (100-110 ng /L) among the detected phenols. Therefore, BPA was selected as the study pollutant in the EDCs category. Deng Hongmei et al. [34] specifically studied the pollution and ecotoxicological effects of BPA in water environment, and the study showed that BPA was often detected in reclaimed water, and the detected concentration tended to increase year by year. BPA has estrogen activity, and very small or trace amounts can cause adverse effects on the physiological and reproductive systems of humans and animals.

Research on the pollution of pharmaceuticals and personal care products (PPCPs) in water environment has become a hot topic in recent years. Since the end of last century, PPCPs have been continuously appearing in human production and life, and have been found in urban groundwater, surface water, reclaimed water, and even drinking water and tap water. The concentration ranges from ng/L to μg/L. In general, the removal rate of PPCPs in sewage treatment plants can only reach 50% to 99%, especially for some polar substances, which can not be removed. With the recycling of recycled water into the soil and human living environment, through the food chain and other contacts into the human body, the impact on human health can not be underestimated. Yang Yifan et al. enriched some reclaimed water for agricultural irrigation in Background city by solid phase extraction method and identified 16 major pollutants with high content in combination with pollutant database screening. In this paper, combined with the detected amounts of PPCPs in these 16, four compounds with the highest detected amounts and easy to produce ecotoxicity were selected for pre-experiment, namely gambaosin, telmisartan, atrazine and gliclazide. After dissolution, it was found that the other three compounds except gambaosin had no toxic effect on Q67 at low doses. High concentration is difficult to dissolve in water or excessive co-solvent is needed to dissolve in water. Therefore, this paper selected gamblin as a representative of PPCPs for the experiment.

3. Toxicity Data Analysis and Discussion

According to the experimental results, it can be seen that the fitting results of the concentration-effect curves of the eight pollutants on Q67 show that R2 is greater than 0.89 and RMSE is less

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than 0.090, indicating that the fitting effect is good and has good statistical property. The negative logarithms of EC50 of the eight pollutants on Q67 are 5.901, 4.306, 2.997, 1.990, 3.895, 6.034, 6.148, 4.131, respectively. The order of toxicity is as follows: Zn (6.148) >Cu (6.034) >BPA (5.901) > Gamblin (4.306) >Cr (4.131) > tribromoacetamide (3.895) > 4-bromo-2, 6-dichlorophenol (2.997) >2, 6-dibromo-p-chlorophenol (1.990).

According to the experimental results, the NOEC of the eight pollutants was 2, 6-dibromo-p-chlorophenol (0.0644 mg/L)> 4-bromo-2, 6-dichlorophenol (0.0283 mg/L)> tribromoacetamide 0.00911 mg/L)> Cr(0.00135 mg/L)> Bisphenol a(0.00117 mg/L)> Cu(0.000048 mg/L)> Zn(0.00000962 mg/L)> gambol (0.00000742 mg/L), According to the concentration of recycled water pollutants detected by Yan Mengjie [56], Yang Yifan [57], Cao Zhonghong [58], Wang Chenchen [46], Yang et al. [59], it can be preliminally concluded that gambol, 2, 6-dibromo-p-chlorophenol, tribromoacetamide, Cu, Zn and Cr in the actual environment will have toxic effects on Q67. The inhibition rates of Q67 were 9%, 23%, 9.4%, 100%, 100% and 32.2%, respectively.

Acknowledgments

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