

## Progress in Chemical Water Treatment Technology

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*Abstract: In recent years, with the rapid development of China's economy and the continuous improvement of national living standards, the use of water resources and the output of sewage had been increasing year by year [1]. As a large population country, China is faced with a wide range of water environment problems, such as the industry pollution of water, black and smelly water, and water quality deteriorated, they are very closely related to all people life. It is imperative to find out an excellent treatment method for sewage which is increasing year by year, physical, chemical and biological treatment of sewage are three common technologies. Chemical treatment of sewage has the advantages of good effect, easy to control, low cost and so on. This paper mainly introduces several common chemical technologies for sewage treatment effect [2].*

*Keywords: Sewage; water resources; chemical method.*

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### 1. INTRODUCTION

In recent years, China's economy has been developing rapidly, and the consumption of water resources has been increasing continuously. However, due to the restrictions of capital, energy and other aspects [3], the reuse rate of sewage is low, and the damage of sewage to the environment is more and more obvious. The increasing production of sewage corresponds to the increasing demand for water treatment technologies [4]. The traditional water treatment technology is divided into three categories: physical treatment, chemical treatment and biological treatment. Sewage treatment generally includes the following three-stage treatment: the primary treatment is to mechanically treat large amounts of pollutants by mechanical treatment [5], such as grid, sedimentation or air flotation to remove stone, sand, fat, grease and so on contained in the sewage. Secondary treatment is biological treatment [6]. The pollutants in sewage are degraded and transformed into sludge under the action of microbial catabolism. The tertiary treatment is the advanced treatment of sewage, which includes the removal of nutrients and the disinfection of sewage by chlorination, ultraviolet radiation or ozone technology [7]. Depending on the pollutions and water quality, some sewage treatment processes may not include all of these processes [8]. As a basic method of water treatment, chemical method has many advantages different from the others, such as easy control and good

recovery [9]. In the traditional process, the chemical method mainly refers to the chemical reaction, which changes the properties of the substances in the sewage or generates new substances to react with the pollutants in the sewage so as to change the properties of the pollutants and purify the sewage.

## 2. THE BASIC PRINCIPLE OF CHEMICAL TREATMENT OF SEWAGE [10]

Chemical treatment of wastewater is a method of separating waste water by chemical reaction and mass transfer effect that removing soluble, colloidal pollutants or transforming them into harmless substances [11]. The treatment units based on chemical reactions produced by adding agent include coagulation, neutralization, REDOX, etc. The treatment units based on mass transfer include extraction, stripping, adsorption, ion exchange, and reverse osmosis [12].

### 2.1 Chemical disinfection [13]

The process of chemical disinfection is based on the introduction of free chlorine or other oxidizing agents in a gaseous, liquid or powdered form. Chlorine disinfection has been established for more than a century as a cost-effective and robust disinfection process, and it is likely to remain as such. The biggest undesired side effect of the introduction of chlorine into water is the formation of halomethanes. These compounds arise from the reaction of free chlorine with organic matter present in the feed water [14]. As a result, typical concentration of free chlorine in water is limited to avoid the formation of trihalomethane, and thus is less successful in disinfecting some modern pathogens [15]. When chlorination treatment method is used, liquid chlorine or gaseous chlorine is added to water, and a hydrolysis reaction rapidly occurs to produce hypochlorous acid (HClO), which is ionized into hypochlorite ion (ClO<sup>-</sup>) in water. The basic ionic reaction formula when using liquid chlorine or chlorine is as follows [16]:

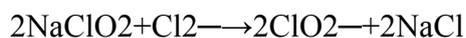
Local oxidation:



Complete oxidation:



Chlorine dioxide (ClO<sub>2</sub>) is the product of the reaction of sodium chlorite with chlorine or hydrochloric acid.



## 3. SEVERAL COMMON METHODS OF CHEMICAL TREATMENT

### 3.1 Electrochemical treatment of wastewater [17]

The basic principle of electrochemical treatment of wastewater is to use electrolysis to transform harmful substances into harmless substances directly or indirectly through electrochemistry in order to achieve purification. The electrolytic treatment of wastewater includes electrochemical action on electrode surface, indirect oxidation and reduction,

electro-flotation, electro-flocculation and so on [18], which can remove pollutants from wastewater by different actions.

Taking cyanide containing wastewater as an example, the electrochemical oxidation process on the anode surface is as follows:



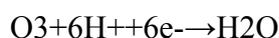
Electrochemical process in chemical process to remove organic matter in sewage is a new technology emerging in recent years [19]. With increasingly stringent emission standards, electrochemical treatment of wastewater technology has been widely paid attention by researchers, and the advantages of electrochemical treatment technology have been constantly revealed. As an environmentally friendly technology, electrochemical method has a good removal effect on organic matter in sewage.

### 3.2 Oxidation treatment of wastewater [20]

Wastewater oxidation treatment is a method of using strong oxidant to oxidize and decompose pollutants in wastewater to purify wastewater. Strong oxidants can gradually degrade organic matter in wastewater into simple inorganic substances, and also can oxidize pollutants dissolved in water into substances that are insoluble in water and easily separated from water. Common oxidants: 1) chlorine, gaseous chlorine, liquid chlorine, sodium hypochlorite, calcium hypochlorite, chlorine dioxide and so on; 2) oxygen, oxygen in the air, ozone, hydrogen peroxide, potassium permanganate, etc.

Ozone treatment of wastewater is a method of purifying and disinfecting waste water by using ozone as oxidant. Ozone treatment of wastewater is a method of purifying and disinfecting waste water by using ozone as oxidant. The treatment of wastewater by this method uses air or oxygen containing a low concentration of ozone. Ozone is a highly unstable, easily decomposable, strong oxidant that needs to be manufactured on site. Application of ozone in water treatment water can achieve the purpose of reducing COD, sterilizing, increasing dissolved oxygen, decolorizing and deodorizing, and reducing turbidity by ozone treatment. Ozone is more sterilizing than chlorine [21].

The main mechanism of action is as follows:



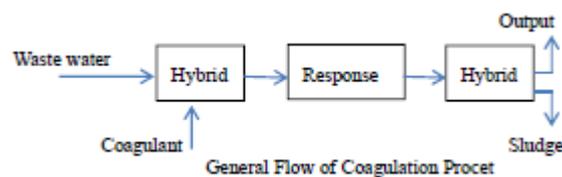
### 3.3 Wastewater chemical precipitation treatment [22]

The chemical precipitation treatment method of wastewater is a method for purifying wastewater by adding a soluble chemical agent to the wastewater to chemically react with the inorganic pollutant in an ionic state to form a precipitate which is insoluble or poorly soluble in water. There are many kinds of precipitants in the sewage, and lime, sulfide and barium salts are commonly used [23]. The principle of the chemical precipitation method is to convert a heavy metal in a dissolved state into a heavy metal compound which is insoluble in water by a chemical reaction, and remove the precipitate from the aqueous solution by filtration and separation, including neutralization precipitation method, sulfide precipitation method, iron Carbon co-precipitation method and the like [24].

### 3.4 Coagulation treatment of waste water [25]

Wastewater coagulation treatment is a method of purifying wastewater by adding coagulant to the wastewater to make the colloidal particles coagulate and flocculate. Coagulation is a combination of coagulation and flocculation. The former is mainly to add electrolytes to reduce or eliminate the electromotive force of the colloidal particles, so that the colloidal particles lose stability, and the destabilizing colloidal particles are coalesced together; the latter is the use of high-molecular materials to adsorb bridges, so that the colloidal particles coalesce with each other. Application of coagulants in wastewater treatment: Larger coarse suspensions in granules can be removed by natural precipitation, but smaller suspensions, even some harmful chemical ions, especially colloidal particles, settle slowly. It can even maintain a dispersed suspension state in the water for a long time without naturally sinking, and it is difficult to separate and remove it from water by natural precipitation [26]. The principle of the coagulant is to destroy the stability of these fine particles, bring them into contact with each other, form a floc, and sink and separate.

Waste water



### 3.5 Waste water neutralization treatment [27]

The neutralization treatment of wastewater is a method of purifying wastewater by neutralization. The basic principle is to make  $H^+$  in acidic wastewater interact with  $OH^-$ , or  $OH^-$  in alkaline wastewater with  $H^+$ , to produce weakly dissociated water molecules, and to produce other salts that are soluble or insoluble, thus eliminating their harmful effects. The reaction obeys the law of equivalents. This method can treat and recycle acidic and alkaline wastewater, and adjust pH value of acidic or alkaline wastewater.

## 4. NEW WATER TREATMENT TECHNOLOGIES

### 4.1 Technology of magnetic separation [28]

Magnetic separation technology is a treatment technology of adding magnetic species to waste water and using magnetic particle to separate impurities in waste water. Direct magnetic separation method is used to treat iron and steel wastewater with magnetic particles. The indirect magnetic separation method mainly adds magnetic particles of  $Fe_3O_4$  and adds coagulant to make them coagulate with magnetic species to form magnetic flocs. By the action of external magnetic field, the solid is suspended and separated.

### 4.2 Low-temperature plasma water treatment technology [29]

Non-thermal plasma NTP (non-thermal plasma NTP) is a kind of advanced water oxidation technology. By producing plasma or active particles through discharge, it induces the reaction

of organic molecules in waste water, which can excite, ionize, thoroughly oxidize and decompose pollutants in water [30]. Plasma technology without catalyst, reactor form can be adjusted flexibly, low maintenance cost.

## 5. OUTLOOK AND CONCLUSIONS

As a common pollutant, sewage has become an important part of hindering social progress. The development of wastewater purification technology is necessary. For the treatment of different types of sewage, efforts should be made to determine the optimum operating conditions and the best economic benefits. Today, with the rapid development of technology, sewage treatment must not only meet basic emission standards, but also strive to remove clean pollutants and ensure the improvement of water quality after treatment.

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