Discussion on Printing and Dyeing Wastewater Treatment Methods

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Abstract. With the rapid development of the printing and dyeing industry, a large amount of industrial wastewater will be produced in the production process of the printing and dyeing industry. If these wastewaters are not treated, they will pose a serious threat to the ecological environment and human health. This article summarizes the characteristics and research progress of the physical, chemical, and biological methods currently used in the treatment of printing and dyeing wastewater, and provides a good basis for future research and development.

1. Introduction

Printing and dyeing wastewater mainly refers to the wastewater discharged at various stages of the printing and dyeing process, including mercerized wastewater, desizing wastewater, printing and dyeing wastewater, printing and dyeing wastewater and finishing wastewater. These wastewaters directly discharged by small printing and dyeing enterprises have high organic matter concentration, high salinity, and organic matter is difficult to degrade, which has become a problem in the field of industrial wastewater treatment. Untreated discharge will seriously affect the local ecological environment and cause turbid water quality. Healthy growth of aquatic organisms [1]. Therefore, it is very important for us to study the treatment methods of dye wastewater. This article briefly summarizes the characteristics and research progress of various printing and dyeing wastewater treatment methods, and prospects the development direction of printing and dyeing wastewater treatment methods.

2. Sources and characteristics of dye wastewater

2.1. Sources of printing and dyeing wastewater

At present, China's printing and dyeing enterprises are developing rapidly, which brings certain economic benefits and also brings some pollution to our environment, such as dye wastewater. Dye
wastewater mainly comes from the production and use of dye, namely dye production wastewater and printing and dyeing wastewater. Dye production wastewater mainly includes dye intermediate production wastewater and dye production wastewater. The main pollutants contained in it are basic raw materials and their by-products from the reaction. The two together form the dye production wastewater. Printing and dyeing wastewater mainly refers to the wastewater generated during the printing and dyeing process, such as bleaching wastewater, mercerizing wastewater, dyeing wastewater, printing wastewater, finishing wastewater etc.[2], where the pollutants are mainly composed of dyes, slurries, and additives.

2.2. Characteristics of printing and dyeing wastewater

(1) High salt content: In the production of dyes, the concentration of salts in the discharged wastewater is mainly caused by the addition of production processes and process additives, such as the need to add salt to enhance the color on the fabric during the production process. The color and dye can be evenly distributed on the surface of the dyed object and inside the fiber, so it will cause a high salt content and cause the bacteria to survive and die.

(2) High concentration of CODcr: The basic synthetic raw materials of dyes are benzene, phenols, cyanides, and so on. The raw materials lost in the production and use process increase the concentration of CODcr in water, and some dye wastewater have a CODcr of up to several Ten thousand milligrams per liter, and poor biodegradability.

(3) Large chromaticity: dye manufacturers produce a wide variety of dyes, some wastewater can have chromaticity as high as tens of thousands of times, and the color is darker. In addition, due to the different types of fabrics, dyes and processes, the wastewater quality is complicated and the fluctuations are very large. It is difficult to find a suitable method to deal with them uniformly, causing technical difficulties in treatment.

(4) Dye wastewater contains toxic substances such as heavy metals: some toxic heavy metals such as copper, zinc and arsenic will exist in the production process of dyes, half of these heavy metals come from dye raw materials (benzenes and phenols) and are discharged into water Will cause serious pollution.

3. Development Trend of Printing and Dyeing Wastewater Treatment Technology

3.1. Physical treatment

(1) Adsorption method: Adsorption methods mainly include exchange adsorption, physical adsorption and chemical adsorption. The adsorption effect is influenced by factors such as the structure, properties and operating process of the adsorbent. At present, the most widely used adsorbents are activated carbon, activated coal, diatomaceous earth, bentonite, slag, wood chips, fly ash and biomass carbon. The adsorption method has the advantages of low equipment investment, good treatment effect, and small footprint, but its adsorption capacity is limited, which is easy to cause secondary pollution [3]. Zhou Yangkai and others used bentonite modified by high-temperature roasting and aluminum salt activation method for printing and dyeing wastewater treatment. The research results show that when other conditions are certain, the adsorption capacity of modified bentonite for methyl orange is significantly higher than that of the original soil. The dosage is 20-25 g / L, the temperature is 20-40 ° C, and the pH value is 6.0 ~ 8.0, the treatment time is 10 ~ 15 min, the decolorization rate of methyl orange can reach 95% [4].

(2) Membrane separation method: This method has a good effect on the removal of salt and CODcr in dye wastewater. It is through the membrane to penetrate the components in the dye wastewater to treat the wastewater.

(3) Ultrasonic method: Ultrasonic treatment method requires high technical content, and the current application is not extensive. This method needs to operate the molecules in the waste water by ultrasonic waves, so that the macromolecular organic matter becomes small molecules, and then the water molecules in it condense together again to achieve the purpose of treating waste water.
(4) Extraction method: The extraction method is to use a non-aqueous solvent that is incompatible with water but has a strong ability to dissolve organic pollutants. After it is fully mixed with wastewater, the pollutants in the wastewater are transferred to the non-aqueous solvent. Thereby removing organic pollutants in the water body. At present, the extraction method is only applicable to the treatment of a small number of organic wastewater, and the treatment effect and cost mainly depend on the extractant used. In addition, because the extractant inevitably dissolves a small amount into the water body during the treatment process, it may be difficult for the treated wastewater to reach the discharge standard, so it is often necessary to combine other methods for further treatment [5]. Zhang Li et al. Used extraction to treat the acid violet-10B printing and dyeing wastewater, and investigated the effects of n-octanol fraction, oil / water volume, trioctylamine fraction, solution pH, standing time and stirring time on extraction efficiency [6]. The research results show that the extraction agent n-octanol composition fraction and oil / water volume ratio have a significant effect on the extraction efficiency, and the extraction rate can reach 99.26% under the optimal process conditions.

(5) High-energy physics method: The high-energy physics method has not yet officially entered into use. The technical content required for this treatment method is relatively high, and the operating cost of putting it into use is very high. It takes a while to use.

3.2 Chemical method

(1) Chemical oxidation method: Chemical oxidation method is a treatment method that uses KMnO₄, ClO₂, H₂O₂ and other strong oxidizing agents to degrade organic pollutants in water due to oxidation. The advantages are simple process and equipment, and the disadvantages are high processing cost, general organic effect, and easy to cause secondary pollution. In the actual wastewater treatment process, chemical oxidation is often used as a pretreatment method or in combination with other methods. Li Mu et al. Used potassium permanganate pre-oxidation and coagulation to treat wastewater from printing and dyeing, which effectively improved the removal of dissolved organic matter in wastewater [7]. The study pointed out that the removal rate of dissolved macromolecular organic substances by this method is particularly significant, but the content of small molecules of hydrophilic soluble organic substances in the coagulated effluent increases. Combined to improve overall removal efficiency.

(2) Electrochemical method: A method of using active radicals generated by amphoteric electrodes to oxidize organic matter in water, thereby destroying the molecular structure of organic matter and achieving a decolorizing effect. This method does not produce secondary pollutants and is suitable for the treatment of organic matter that is difficult to degrade. But the removal of CODcr is not good, this method can be used as a pretreatment before biological treatment.

(3) Photocatalytic oxidation method: Photocatalytic oxidation method refers to the removal of pollutants in water through the oxidation of catalyst under the action of ultraviolet light or visible light. This method has the advantages of high efficiency, simple process, and no secondary pollution of products. However, due to the characteristics of the pollutants in the printing and dyeing wastewater, toxic substances are easily produced in the reaction process. In addition, the degradation of catalyst performance and recovery issues also limit the application of this method to a certain extent. At present, the improvement of the photocatalytic oxidation method mainly focuses on the preparation of new catalysts and modified traditional catalysts. Wang Guangyou and others used graphene as a new type of photocatalyst to study the removal effect of photocatalytic oxidation on methylene blue printing and dyeing wastewater [8]. Through single factor and orthogonal design studies, it was found that under the best process conditions (graphene dosage 2.68 mg, solution pH 12, initial wastewater concentration 19.34 mg / L), the degradation rate of methylene blue reached 100%. Zhang Liyuan et al. Modified TiO₂ nanotubes by N-doping and used them to degrade methyl orange printing and dyeing wastewater by photocatalytic oxidation [9]. The results show that, compared with undoped TiO₂, the degradation efficiency of N-doped TiO₂ for methyl orange is increased by 11.1%. It further pointed
out that the main reason for the improved photocatalytic activity is that N-doping effectively reduces the band gap of TiO₂ and the recombination probability of photogenerated electron-hole pairs.

3.3. Multi-technology joint use
At present, the printing and dyeing industry is also developing rapidly, and printing and dyeing raw materials have become complex and diverse. Traditional single treatment methods are difficult to achieve efficient treatment of wastewater, so multiple treatment technologies are required to ensure the treatment effect. The application of technology must consider the environment in which it is used, and the treatment effect of wastewater is the key to the choice of treatment technology. In addition, the choice of multiple technologies must consider processing costs. Studying how to realize the efficient treatment of printing and dyeing wastewater at low cost is the main direction of future technical research.

4. Conclusion and Outlook
In the production process of the printing and dyeing industry, a large amount of industrial wastewater will be generated. If these wastewaters are not treated, they will directly affect the environment. Therefore, corresponding treatment methods should be adopted according to the characteristics of the printing and dyeing wastewater to ensure that the water quality discharge meets the standards. Therefore, to make full use of the advantages of various treatment methods, the development of combined use of multiple methods is the future development trend of printing and dyeing wastewater treatment methods. In addition, the printing and dyeing industry should also actively take measures to reduce the amount of wastewater generated, and achieve the standard discharge of printing and dyeing wastewater through the improvement of processes and equipment.

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