Research Development of Fenton Oxidation and Its Combined Technology in Substation Wastewater Treatment

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Abstract. The research progress of Fenton oxidation and its composite technology in substation wastewater treatment is introduced. Study the appropriate conditions for the Fenton oxidation process. The application prospect of Fenton oxidation method in substation wastewater treatment is discussed. The development trend of Fenton oxidation combination technology in substation sewage treatment.

1. Introduction
There are many kinds of pollutants in substation wastewater, such as phenols, esters and organics. The general characteristics of substation wastewater are high concentration of phenols and oils, and it is difficult to achieve complete degradation of organic pollutants in biochemical process, resulting in serious environmental pollution. Substation wastewater is characterized by high concentration of pollutants, difficult to biodegrade, and great harm to the environment.

China's substation is usually in the municipal underdeveloped areas with poor infrastructure facilities. Many substation sewage treatment methods are extensive, so the waste water is not treated or simply precipitated after discharge. Its water quality is far lower than the national standard, so it also seriously affects the ecological environment around the substation. From another point of view, the organic matter in waste water can be used as plant nutrients. Therefore, the direct discharge of unused resources are also a waste of resources. Therefore, reasonable purification and utilization of sewage is the key to substation sewage treatment, but also the implementation of ecological construction to the practical application.

Although the substation is unattended, there cannot be no toilet and it requires environmental protection, which means that sewage cannot discharge at will. The characteristic of toilet sewage is as follows: contain high COD, N, P amount and pathogenic bacterium, and organic matter in excrement and urine and nutrient substance concentration are higher. According to chemical analysis, the contents of N, P and K in human feces are 1%, 0.5% and 0.37% respectively, and the contents of organic matter are 2%. The contents of N, P and K in human urine are 0.5%, 0.13% and 0.19%, respectively. The contents of urea are 1-2% and the water content was 95%.

2. Common sewage treatment methods
Anaerobic fermentation is a complex biological process. Carbohydrates, fats and proteins in faeces can be converted to methane under the action of hypoxia and microorganisms. In the process of anaerobic
fermentation, temperature difference can be divided into: room temperature anaerobic fermentation (i.e. low temperature anaerobic fermentation); under the temperature of anaerobic fermentation, the average temperature is controlled at 36 ~38 °C; under the temperature of high temperature anaerobic fermentation, the temperature is generally controlled at 52 ~55 °C.

Aerobic treatment: The process of aerobic bacterial fermentation is called aerobic fermentation. When the scale of aerobic treatment is small, only aeration and precipitation after final dilution can be carried out; after pretreatment and secondary dilution, medium and above scale can be treated according to the standard activated sludge process. Secondary treatment is anaerobic treatment. Aerobic fermentation is much faster than anaerobic fermentation, but requires a large capacity of digester. A lot of oxygen is needed in this process, so a lot of energy is used.

Chemical method: The excrement is flocculated by adding appropriate chemical agents into the excrement, and then separated into liquid and dewatered sludge by precipitation. The main characteristic of this treatment method is that it can form solid-liquid separation of feces in a short time. The disadvantages are: complex operation and numerous mechanical equipment; the BOD of the separating liquid is about 5000mg/L, which is much higher than that of the separating liquid in the anaerobic fermentation tank (2500mg/L). In addition, the cost of capital construction and daily operation management is higher than that of other methods. The equipment varies according to the type of chemical reagent (such as iron salt, lime, etc.) and the input method. Drug feeding equipment. There are two types of wet and dry reactions that work better because they mix evenly. The dosage of additives should be 0.2%~2% of fecal substances.

Therefore, due to the low cost, simple operation and obvious effect of Fenton oxidation method, it is further applied in substation wastewater treatment. The Fenton oxidation method requires high acidity and alkalinility. When in an acidic environment, Fe2+ catalyzes the decomposition of H2O2 to generate a radical chain reaction. It also produces a hydroxyl radical with higher oxidizing power, which can decompose other difficult-to-degrade organic matter into biodegradable substances.

3. Fenton reagent combined with flocculant
Due to the high COD of the substation sewage, the treatment effect of using Fenton's reagent is not very good. If the coagulant is used at the same time, the treatment effect will be better, and there is a synergistic effect between the two. The main use of the flocculant is to hydrolyze to produce a colloid such as a hydrated complex ion, which neutralizes the charge on the surface of the pollutant in the waste oil, and the charged contaminant is agglomerated and precipitated and removed. At present, there are many types of flocculants commonly used in substation wastewater treatment. The most used ones are FeCl3, PAM and self-made coagulants.

Li Tianxiang used Fenton oxidation combined with FeCl3 coagulation and sedimentation to treat substation wastewater. The experimental results show that when the pH is about 3 and the reaction temperature is 80 °C, the turbidity and color of NH3-N removal are 89.4%, 91.1%, 89.7, respectively. % and 92.5%. Wu Chunfang treated the substation with Fenton oxidation/wastewater coagulation. The dosage of H2O2 was 219 mg / L, the price of 176 mg / L, the dosage of PAM was 4.7 mg / L, the reaction time was 0.6 h, and the pH was 7.3. The COD removal efficiency is as high as 44.5% and the chroma can be reduced by 28 times. Liu Xiaolan used Fenton oxidation-coagulation method to treat substation wastewater. The removal rates of color, COD and NH3-N reached 79.2%, 95.7% and 87.3%, respectively. The sewage met the national emission standards after treatment. Baifei used Fenton reagent combined with PASS to treat substation wastewater. The test results show that the use of Fenton oxidation combined with coagulation treatment wastewater can reduce COD from 1160mg / L to 49.3 mg / L, and the removal rate can reach 94.7%.

4. The Fenton reagent binds to the adsorbent
Fenton reagents and adsorbents are combined to treat substation wastewater. There are many kinds of adsorbents used in substation wastewater treatment, mainly activated carbon, lime and ester. Activated carbon is the most widely used at present. There are two main ways of doing this: one is by adsorption,
followed by oxidation using the Fenton reagent. This high concentration adsorption method can make full use of the adsorption capacity of activated carbon. The activated carbon shall not absorb residual organic pollutants, cyanide, sulfur and other inorganic pollutants, and then use Fenton reagent for oxidation, which can greatly reduce the consumption of Fenton reagent; The adsorption of saturated activated carbon can be regenerated by using H2O2 reagent without secondary pollution. Another method is to use Fenton reagent oxidation, then activated carbon adsorption treatment. Achieve the ideal processing effect.

Cheng hui used Fenton reagent combined with activated carbon adsorption technology to treat substation wastewater. The experimental conditions were set as follows: in the oxidation stage of Fenton reagent, H2O2 increased by 61 mmol/L, [Fe2+] / [H 2O2] = 1:12, and the initial pH was 3. Activated carbon 3.0g/L was added in the carbon adsorption stage, pH = 3, and the adsorption time was 30 minutes. In the experimental environment, the COD of substation wastewater decreased from 1721 mg/L to 50.31 mg/L, and the removal rate reached 95.2%. After treatment, the water quality reached the national discharge standard. Zheng xiao quan used Fenton reagent and lime adsorption technology to treat substation wastewater. Under the set experimental environment, the removal rate of pollutants from the substation waste oil was nearly 98%, the removal rate of COD was 81.68%, and the BOD5 / COD in the wastewater increased to 0.18/0.11.

5. Fenton reagent combined with ultrasonic treatment
Ultrasonic technology refers to the use of ultrasonic energy to water toxic, difficult to degrade organic pollutants into carbon dioxide and water or less toxic organic pollutants or non-polluting substances. The principle is simple and the equipment is easy to operate. The disadvantage is that the energy conversion rate is low and the energy consumption is large, so the scope of application is small. This defect can be effectively avoided through the synergistic effect of ultrasonic technology and Fenton reagent. The ultrasonic cavitation effect and the temperature rise effect are used to generate large amount of hydroxide ions rapidly, and the refractory organic compounds are effectively treated.

Gao minshan used ultrasonic technology and Fenton reagent to treat substation wastewater. The initial COD concentration was 1023 mg/L, the initial pH was 3.31, the Fe2+ and H2O2 were 106mg/L and 1430 mg/L, respectively. The degradation time was 240 min, and the COD degradation rate was 96.35%. Wang jing uses us-fenton oxidation/coagulation to treat substation wastewater. The experimental results showed that under the specified experimental conditions, the removal rates of COD, nh3-n, cn-and chromaticity were 77.4%, 61.3%, 58.9% and 76.2%, respectively, and COD decreased from 4,799mg/L to 1,195mg/L. BOD5 / COD increased from 0.213 to 0.401. Therefore, the us-fenton oxygen method can be used as an effective pretreatment method for substation wastewater.

6. Fenton reagent combined with Microwave
Microwave is an electromagnetic wave with a wavelength of 1 mm~1 m. Microwave irradiated liquid can make polar molecules rotate at high speed and generate heat, change thermodynamic function, reduce activation energy and molecular bond strength. Microwave can effectively improve the reaction conditions, speed up the reaction speed, shorten the reaction time. At present, many researchers have begun to use microwave sewage treatment, and achieved good results.

At present, there are few studies on combined treatment of substation wastewater by microwave combined with Fenton oxidation. Experimental data showed that the combined degradation of phenolic compounds by microwave and Fenton oxidation was better than that by Fenton alone, and the effect was better under the condition of acid-base balance. However, Fenton method has a good effect only when the pH is about 3.

Jin shaomiao studied the degradation of phenol by Fenton reagent. The experimental results showed that Fenton reagent could degrade the influence of phenol reaction system on microwave, reduce activation energy, improve reaction rate, and increase microwave radiation power, so as to accelerate the degradation of TOC. When the microwave radiation power reaches 600 W, the activation energy of
pollutant degradation reaction is 20.157 kJ/mol, and the reaction activation energy is reduced by 26.85% compared with the conventional condition. The experimental effect is significant.

7. Other Fenton reagent combination technology research
There are also a variety of Fenton reagent combination techniques. Such as iron filings, titanium dioxide, related to ozone, and related to magnetic fields. Although there are few studies on actual substation wastewater treatment, with further research, I believe that more mature and effective technologies will be applied to substation wastewater treatment.

8. Conclusions
Fenton reagent method is a promising wastewater treatment technology. It can effectively degrade the pollutants in the substation wastewater, especially some difficult biodegradable pollutants. However, due to the disadvantages of Fenton reagent method and its related technologies, such as high cost and high requirements, it has not been widely used at present. Other technically difficult contaminants can be treated with Fenton reagents. Further application of Fenton method in substation sewage treatment still requires a lot of research work. The main research direction includes: the suitable condition of processing device, the cost of processing technology and so on. Through the continuous accumulation of experimental research, it can provide reliable data support for the promotion and application.

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