Feasibility Analysis of Manufacturing Wastewater Treatment Reagent based on Coagulation-Fenton Oxidation Method

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Abstract: Since the 21st century, with the rapid development of the world economy, China's comprehensive national strength has been continuously strengthened. The production speed of economization, urbanization and industrialization has greatly increased, thus the sewage generated in daily life and industrial production has increased substantially. Therefore, it is necessary to improve the efficiency of sewage treatment in time to solve the complex problems in sewage. In this paper, the sewage treatment reagent produced by coagulation-Fenton oxidation method is analyzed, the main factors influencing its effect are discussed, its application in sewage treatment is described, the mechanism of coagulation-Fenton oxidation method is summarized, and the advantages and feasibility of coagulation-Fenton oxidation method compared with other methods for sewage treatment are also discussed and analyzed.

Keywords: Coagulation; Fenton reagent; Influencing factors; Application

1. Introduction

Under the background that China's economic level is steadily rising, as well as the speed of industrial construction, the rapid growth of sewage discharge has led to increasingly serious water pollution, which poses a serious threat to the ecological situation. Sewage treatment has also become a focus of our attention.

Hydrophobic impurities can be effectively solved by coagulation, while hydrophilic impurities can be better degraded by Fenton reagent oxidation. Because of its strong oxidation performance, and including almost all organic matter which is difficult to remove by traditional sewage treatment method, it can be effectively oxidized and degraded by low-dose Fenton reagent, which helps for coagulation. Therefore, sewage treatment reagents produced by the coagulation-Fenton oxidation plays a very important role in sewage treatment.

The main factors affecting the effect of sewage treatment reagent produced by coagulation-Fenton oxidation process, its application in sewage treatment, and the skills and feasibility of sewage treatment agent produced by coagulation-Fenton oxidation process are described below.

2. Coagulation, Fenton Oxidation and Oxidation Mechanism of Coagulation-Fenton Reagent

2.1. Coagulation

Because the coagulant is an electrolyte, after the coagulant is put into the sewage, it neutralizes with the colloidal substance in the sewage electrically and produces a compression double layer effect. Under this effect, micelles can be formed in the sewage and they are coagulated into floccules which can be separated and gotten rid of.

2.2. Fenton oxidation

In the environment of Fe2+, H202 can produce OH. The free radicals of the product have certain characteristics. Using the free radical reaction of the product to degrade the pollutants requires the reaction environment to be acidic; the trivalent iron ion colloids formed in the reaction have the functions of flocculation and adsorption, and can remove part of the organic matter by coagulation and precipitation.

2.3. Coagulation-Fenton reagent oxidation method

The coagulation and coagulation aids are added to the wastewater. First, the wastewater is pretreated by coagulation method, and then combined experiments are carried out by using Fenton's characteristics, so as to achieve the effect of wastewater treatment.

Both of them can treat wastewater. Fenton reagent oxidation method is more effective for hydrophilic substances, but has little effect on hydrophobic substances; coagulation method is effective for hydrophobic substances, but has no effect for water-soluble substances. Thus these two methods can be combined to make sewage treatment achieve better results.

3. Main Influencing Factors of Coagulation-Fenton Reagent for Wastewater Treatment

Because they are combined together, the change of one will definitely change the effect of their combination. Thus there will be many and complex factors influence the effect of coagulation-Fenton reagent. Then analyze the factors influencing will be analyzed correspondingly.

3.1. Coagulation

3.1.1. Temperature of the environment

The temperature of the water will influence treatment of sewage by coagulation. Firstly, the coagulation reagent is endothermic in the hydrolysis process. On the premise of lower temperature, the hydrolysis will converge, the coagulation rate will slow down, which will affect the coagulation effect and make it worse. Secondly, lower temperature and higher viscosity of water will reduce the effective collision of substances in water, thus the flocculation effect of coagulant will be worse. The results show that the coagulant has the best coagulation effect at the temperature of 20℃-30℃.

3.1.2. PH value

In the process of coagulation, on the one hand, different coagulant will have PH value; on the other hand, the hydrolysis products of the same coagulant in different PH environments will be different. For example, the reaction of PAC is the best under the condition of its PH value being from 6 to 9. Aluminum salt coagulants have different hydrolysis products due to different pH values. Therefore, in wastewater treatment, we should choose suitable coagulant, and also consider the PH value environment.

3.1.3. Coagulant dosage

One of the main factors affecting the coagulation effect is the amount of coagulant. Different types of coagulants will have their best dosage under certain appropriate conditions, and higher or lower than the best dosage will not lead the best coagulation effect. Too small dosage will lead to incomplete coagulation, while too large dosage will lead to re-stabilization after flocculation, which will reduce the coagulation effect. That is to say, in order to achieve the best coagulation effect, experiment can be carried out for an adjustment before using different coagulants.

3.1.4. Hydraulic condition

Under this premise, the two key factors that affect the coagulation efficiency are the stirring time and intensity. At the mixing stage, the mixing of coagulant and sewage should be fast and regular, with the stirring intensity of 8.3-16.7 min-1 and the mixing time of 0.17-0.5 min, respectively. At the reaction stage, not only the floccules should be kept intact, but also they should be given enough growth opportunities to create suitable adsorption environment and more collisions. At this time, the reaction time will be longer with the stirring intensity of 0.33-1.17s-1 and time of 4500-1800s, respectively.

3.2. Fenton reagent oxidation

3.2.1. Temperature of the environment

According to the reaction kinetics, the positive and negative reactions of Fenton reagent will be accelerated with the increase of temperature. When t is appropriate, it activates OH free radicals, and when t is large, it decomposes hydrogen peroxide into water and oxygen. When using Fenton reagent to treat desizing wastewater, the researchers finds that the reaction is the strongest when t=30; probably because the reaction of ferrous sulfate and hydrogen peroxide is too slow, the COD of the effluent of water lower than 30 ℃ increases rapidly; because of the negative effect caused by the easy decomposition of hydrogen peroxide, the speed of revoming COD becomes slow when t>30. When Fenton reagent is used to solve trichlorophenol, the researchers find that when T < 60, the reaction proceeds faster, and when t > 60, the reaction is inhibited. In summary, the researchers believe that different results may be due to different components in sewage.

3.2.2. PH value

If H202 is wanted to produce OH, Fe2+ can be catalyzed only under restrict environmental requirements. The premise of Fenton reagent reaction can only be acidic. Researchers generally believe that when PH = 3, COD removal rate can reach 80%, when the oxidation capacity is the strongest. The PH value is in the range of two to four, and the effect of oxidized sewage treatment is considerable.

3.2.3. The ratio of Fenton reagent

In the process of Fenton catalyzing hydrogen peroxide to produce free radicals, ferrous ions should not be absent, for which plays a very strong catalytic role. It is difficult for hydrogen peroxide to decompose to produce free radicals without ferrous ions. When ferrous ion is insufficient, the process of producing OH in the first step will be slow, and the amount of free radicals will be inhibited. And because the first step is very slow, the whole process will be limited. When the ratio of ferrous ions is too high, the color will increase, because Fe2 + reduces the hydrogen peroxide and oxidizes it to Fe3 +. As mentioned earlier, Fenton reagent has different effect for sewage treatment at different doses of ferric ions and hydrogen peroxide. When ferrous sulfate is excessive, Fenton reagent has the effect of chemical flocculation. When there is too

much hydrogen peroxide, Fenton reagent has the function of chemical oxidation.

4. Application of Coagulation-Fenton Oxidation Method in Manufacturing Wastewater Treatment Reagents

It is found that the coagulation-Fenton oxidation method can not only effectively solve sewage, but also has the advantages of low cost, simple operation, low energy consumption and no secondary pollution, which is worth popularizing.

4.1. Practical application of wastewater treatment reagent based on coagulation-Fenton oxidation in printing and dyeing wastewater treatment

Textile printing and dyeing wastewater contains complex substances, which are extremely difficult to degrade. Researchers have been paying great attention to how to reduce the environmental pollution of textile printing and dyeing. It is found that sewage treatment reagents produced by the coagulation-Fenton oxidation method can solve complex printing and dyeing wastewater with considerable effectiveness. The COD removal rate was 85% and the chroma removal rate was 96% with low dose coagulation-Feton reagents.

Ye Zhaolian and Chen Youhong had done experiments on scarlet dyes under acid conditions. They used Fenton oxidation to imitate the environment of sewage. It was found that the mass ratio of hydrogen peroxide to ferrous sulfate was between 3 and 6 when COD degradation was the best.

4.2. Practical application of wastewater treatment reagent based on coagulation-Fenton oxidation in oily wastewater treatment

Oily wastewater from petrochemical oilfields, which are mainly discharged petrochemical district, is treated by coagulation-Fenton oxidation method. In order to achieve the highest COD removal efficiency, the influencing factors such as PAC dosage, PAM dosage, PH value, ratia of reagent, reaction temperature and time are analyzed.

At present, there are many ways to form oily sewage. Oilfield has been exploited on a large scale at home and abroad, and a large number of substances containing oil have flowed into the water at the same time. This kind of sewage is difficult to remove, and water temperature and salinity are high. Besides, because of the accompanying production of a large number of bacteria, it is toxic to certain degree. Chemical substances and other substances exist because of the loose surface tension. Oily wastewater is characterized by large area and large quantity, and many pollutants are contained in it. Water quality and soil are easily polluted, thus it has strong harmfulness. Therefore, effective treatment and rational utilization of this part of wastewater is very important.

The researches show that the coagulation-Fenton oxidation method has a higher removal rate of pollutants in oily wastewater and can effectively degrade COD concentration in wastewater. At the same time, when using the sewage treatment reagent based on coagulation-Fenton oxidation to treat sewage, it is found that Fenton reagent mainly reduces the quality of organic matter to reduce the COD in sewage. Therefore, coagulation-Fenton oxidation method requires strictly on the molecular weight of organic matter. Therefore, in order to achieve the best results when using wastewater treatment reagents based on coagulation-Fenton oxidation process, it is also necessary to screen the reaction conditions according to the water quality of the test wastewater.

5. The Advantages of Coagulation-Fenton Oxidation Method Compared with Other Methods for Sewage Treatment

At present, there are many traditional wastewater treatment technologies. In order to find out more characteristics of coagulation-Fenton reagent oxidation method, researchers have carried out deeper research and practical application, and compared it with other wastewater treatment methods as follows: Potassium permanganate is often used in disinfection of drinking water. It has good bactericidal performance, but its cost is relatively high. In the process, Mn02 deposition may occur, which has an impact on the following steps and increases the cost of secondary treatment. It is seldom used in sewage treatment. In the terms of disinfection of drinking water, ultraviolet can effectively remove bacteria. When water is treated by ultraviolet radiation, if the impurity content in water is high, the disinfection effect will be worse. Ultraviolet lamp has a certain length of using time, so dose its power, thus the cost of investment is higher, so making it hardly been applied to sewage treatment. Hydrolysis acidification method can improve the biodegradability of sewage, and has a certain removal effect on COD degradation. However, HRT is longer, usually one to two days, and it needs to occupy a larger area of land, which has certain limitations in areas where sewage plants are not big enough. In addition, the improvement of biodegradability is not significant, and the degradation effect of COD is not obvious. Ozone oxidation method has good performance in controlling the production of disinfection by-products in drinking water. O3 has good disinfection performance. However, in wastewater treatment, the cost is large. And in the removal of THMs, O3 is easily decomposed because of its instability, making the disinfection cannot last for a long time. Coagulation-Fenton oxidation method combines the advantages of coagulation method and Fenton oxidation method. In wastewater treatment, it has two functions: oxidation and

coagulation. In industrial wastewater treatment, it makes wastewater treatment more economical and effective. At the same time, it also improves the rate of removing COD. Moreover, it asks for lower requirement for the environment of wastewater treatment, which saves time and land. It is flexible and simple, and has unique properties for industrial sewage treatment. Therefore, coagulation-Fenton oxidation method can be strongly advocated to solve the sewage problem.

6. Conclusion

Coagulation-Fenton oxidation method, as a combination technology of advanced wastewater treatment, combines the advantages of coagulation and Fenton method in wastewater treatment, and has been widely used with good effects in wastewater treatment, especially in refractory wastewater. The influencing factors of its effect are: PH value, reaction time and temperature, mix ratio and catalyst, etc. It is low cost, easy to operate, and worthy of universal application.

The application of wastewater treatment reagent based on coagulation-Fenton oxidation method in the treatment of refractory wastewater, especially in oily industrial wastewater, has achieved good results. In the future, it is bound to play an indelible role in the treatment of wastewater in the above areas.

However, there are still some areas to be improved in wastewater treatment reagents based on coagulation-Fenton oxidation method:

When the ratio of Fe2+ is too high, it may affect the chroma of the effluent, and subsequent decolorization treatment is needed, when COD in the wastewater will cause secondary pollution.

In some difficult wastewater treatments, the range of PH value is too narrow, which limits the range of pollutant treatment.

The research of coagulation-Fenton combination is not deep enough, so it needs to widen the field and do more in-depth research to make its economic effect more perfect.

Manufacturing wastewater reagent based on coagulation-Fenton oxidation method is bound to be widely used at home and abroad as an economical and efficient sewage treatment technology with more in-depth and detailed research and exploration by researchers.

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