

Effect on the concentration and metal ion concentration for the degradation of wastewater

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Abstract. The advanced oxidation technology based on the theory of sulfate radicals has been extensively studied. In this paper, the degradation of methyl orange over the transition metal catalysts and the catalytic effect on various metal ion catalysts were investigated. The wastewater degradation experiments were judged by the degradation rate and pH under the optimal conditions. In this study, the methyl orange was used as the simulation of the printing and dyeing wastewater, and the experiment was carried out. The vary concentration of methyl orange and metal ions were carried out.. The results showed that persulfate were activated by the metal salts the cobalt metal ions exhibited the strongest performance. The resulted indicated that the methyl orange degradation of 40 mg/L was the appropriate concentration. from varied from 40 mg/L to 120 mg/L interval 20 mg/L, and the catalytic activity of 2g m/L is the best dose at six metal concentrations of 0.5 mg/L, 1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L and 5 mg/L, which provided a very rational basis for the treatment of the practical wastewater.

1. Introduction

In recent years, with the rapid development of Chinese economy and the rapid growth of social environment at the same time, the dye textile technology rapidly developed, which promoted Chinese annual dyes production and ranked first in the world. Looking around the domestic and foreign printing, dye, plastic, fiber and other related industries rapid development, the demand increased rapidly as same with the type and quantity of dye, while the printing and dyeing wastewater has several features containing the high concentration^[1], A wide range of pH value, the main partial reduction of the complex, and volatile organic substances. Water is the most important need material basis for the human, and at the same time, the social environment was became more and more difficult to meet the demand with the increasing of the people's material life level. Thus the water purification technology was attracted as resources of hot water^[2]. In order to improve the treatment process of the industrial wastewater, it is very important to study economic, reasonable, harmless, reduction and recycling methods for the social life.

In general, the main processing technology for treatment of printing and dyeing wastewater was the physical chemical method and biological method. However the degradation rate of organic pollutants was only 50%, so the printing and dyeing wastewater of high color need to use chemical method^[3].

The advanced oxidation process is the use of as oxidant, catalyst, optical and electrical ultrasonic technology^[4], resulting in a large number of strong oxidation of active substances in the reaction, the degradation of water pollutants with strong oxidizing free radicals^[5]. Based on the advanced oxidation process for sulfate radical production by persulfate activation, it is a newly developed treatment technology for the wastewater, which will studied and applied to practice.



2. Experimental method

2.1 Samples and materials

The methyl orange simulated printing and dyeing wastewater, the catalyst was used cobalt sulfate.

2.2 Equipment and instruments

The constant temperature magnetic stirrer, collector type constant temperature heating magnetic stirrer, high speed table centrifuge, ultraviolet visible spectrophotometer, PHSJ-5 pH meter, electronic precision balance, and so on.

2.3 Experimental detection

The absorbance carried out by the spectrophotometry, and the degradation rate can be calculated by

$$\text{followed: } \eta = \frac{A_0 - nA}{A_0} \times 100\%$$

Where A was determined at the maximum absorption wavelength of methyl orange 464nm, and the absorbance of the original water sample was A_0 .

The pH value was tested by the glass electrode method with the PHSJ-5 laboratory in this experiment. PH indicates the strength of acidity and alkalinity in water, which is the negative logarithm of the activity of hydrogen ion in the solution:

$$pH = -\lg a_{H^+}$$

3. Results and discussion

3.1 Blank experiment

The allocation of the concentration of methyl orange was 80 mg/L equipped with 200 mL solution in a beaker of 250 mL, the peroxymonosulphate (PMS) concentration was 160 mg/L, which weighed 0.0098g methyl orange solution peroxymonosulphate in 200 mL, and the beaker was put on the 85-2 temperature magnetic force stirrer produced by Shanghai sile Instrument Co. Ltd, the magnetic stirring times of 0.5 min, 1 min, 2 min, 3 min, 4 min, 6 min, 8 min, and 10 min, extraction of water and methanol with 3 mL in 50 mL centrifuge tube, the data as shown in Fig.1 and Fig.2.

As we can see from the above diagram, the results of the blank experiment showed that the efficiency of persulfate activation is almost no, and the efficiency of the degradation of methyl orange is very low in the methyl orange solution without any catalyst.

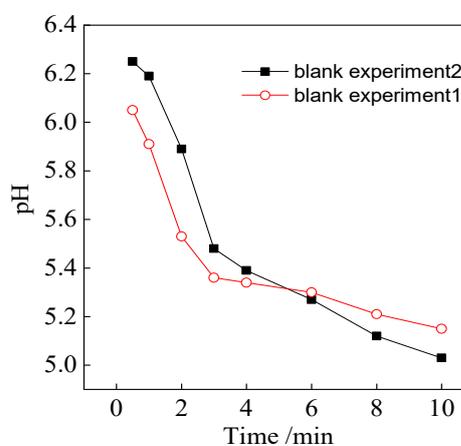
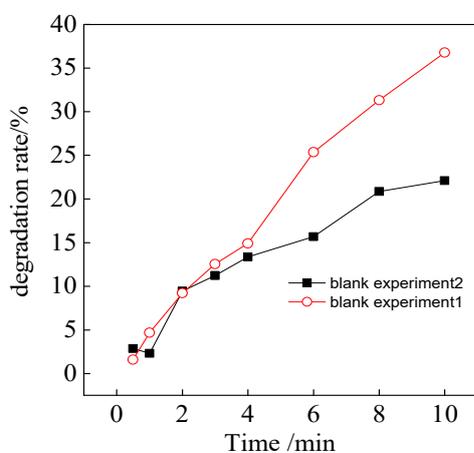


Figure 1. the degradation rate in the blank experiment **Figure 2.** pH in the blank experiment

3.2 Effect of dye concentration on degradation of wastewater

The sampling time was 9 minutes followed by 0.25 min, 0.5 min, 1 min, 3 min, 5 min, 7 min, and 9 min. Under these conditions, the concentration of methyl orange was 40 mg/L, 60 mg/L, 80 mg/L, 100 mg/L and 120 mg/L, respectively. The absorbance and pH were measured and recorded in turn. The extracted water was added to a 50mL centrifuge tube containing 5 mL methanol. The experimental conditions were the PMS concentration of 160 mg/L, and the dope absorbance of 1.683, the liquid pH of 7.02, considering the dye concentration in 40 $\mu\text{m/L}$.

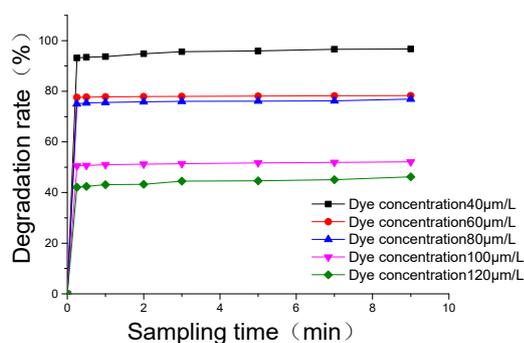


Figure 3. Change the degradation rate of the treated water samples

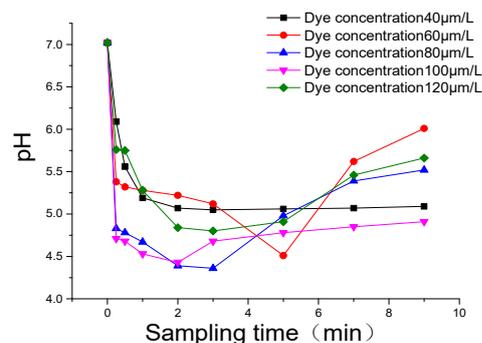


Figure 4. Change the pH of the treated water sample

3.3 Effect of concentration of metal ion on degradation of wastewater

By adding 0.1 g/L ferric sulfate, cerium nitrate, cobalt chloride, copper sulfate, cobalt sulfate, cobalt acetate, zinc nitrate and ferric chloride in the same dye concentration of methyl orange was 40 mg/L, the peroxy monosulphate dosage reaction for 0.0098g methyl orange solution 200mL in the constant temperature magnetic stirrer the same in different time of 5 s, 10 s, 20 s, 30 s, 40 s, 60s, respectively, the absorbance and pH value were measured and recorded. The extracted water samples are added to the 50mL centrifuge tube containing 5mL methanol. The concentration of the liquid was 80 mg/L, and the concentration of PMS was 160 mg/L. Besides the absorbance of the solution was 1.683, and the liquid pH was 7.02, and the experimental data are shown in Fig.5

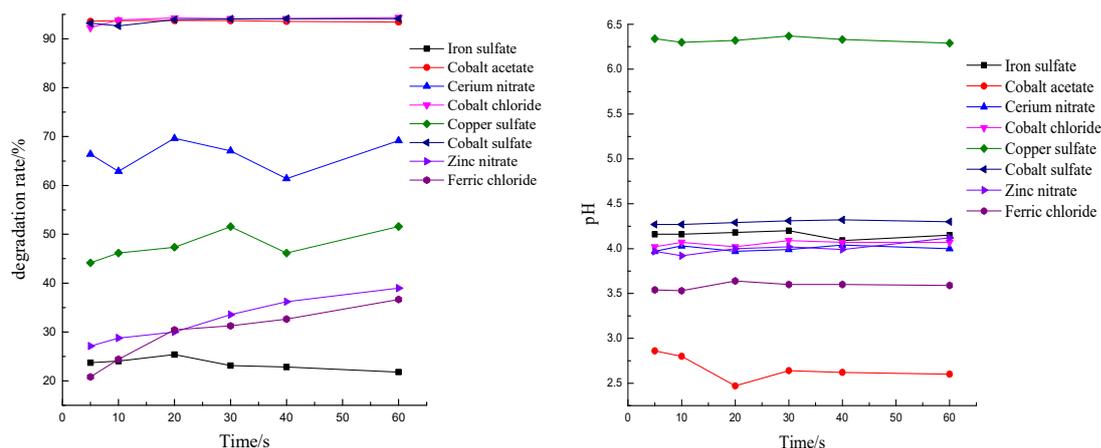


Figure 5. The curve of the transition metal catalyst performance with time

By the above knowledge, the wastewater degradation of simulated by the methyl orange over the homogeneous catalyst of increased significantly. With the increase of time, the degradation rate of methyl orange has also been raised. Compared with other salts of homogeneous, the cobalt salts of homogeneous catalyst showed the best results. Thus the Cobalt sulfate was selected as the research object.

The sampling time is 9 minutes, followed by 0.25 min, 0.5 min, 1 min, 3 min, 5 min, 7 min, and 9

min. Under these conditions, the concentration of metal ions was 0.5 mg/L, 1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L, and 5 mg/L, respectively. The absorbance and pH were measured in turn. The extracted water was added to a 50 mL centrifuge tube containing 5 mL methanol. The experimental conditions were the methyl orange concentration of 40 mg/L, and the PMS concentration of 160 mg/L. the absorbance of 1.683 and the liquid pH of 7.02. The experimental data was showed in Fig.6. As can be seen from the above chart, when the metal ion concentration is 2 $\mu\text{m/L}$, and the treatment effect is the best.

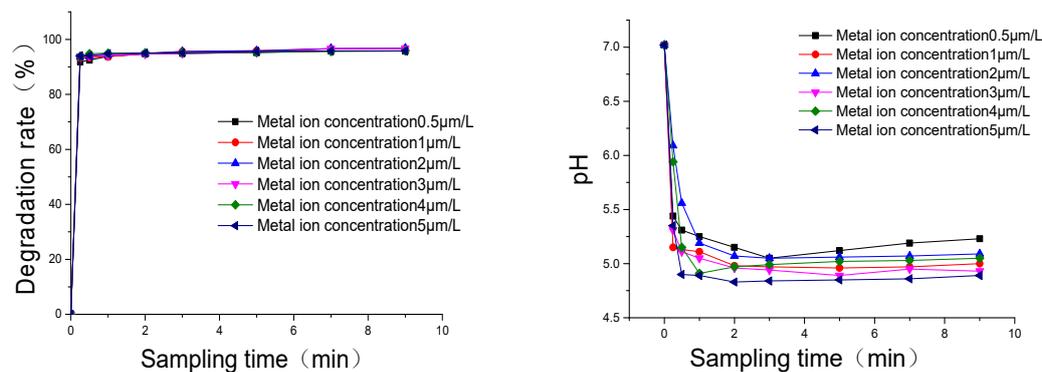


Figure 6. The curve of the performance of the catalyst with time is added to the metal ion concentration

4. Conclusions

The methyl orange solution as typical printing and dyeing wastewater as the research object, and the homogeneous metal salt, metal ions by ferric sulfate, cerium nitrate, cobalt chloride, copper sulfate, cobalt sulfate, cobalt acetate, zinc nitrate and ferric chloride was explored in the activated persulfate to produce sulfate radical for the treatment of the printing and dyeing wastewater. The degradation of the wastewater simulated by the methyl orange over various catalysts was studied on the various influencing factors, reaction kinetics, and degradation reaction mechanism. The resulted indicated the cobalt sulfate as selected as the main metal catalyzed in aqueous solution, and the effect of degradation of wastewater from different concentrations of methyl orange was discussed in water, which evaluated the stability of the catalyst. The conclusion was followed:

- (1) Under the five concentration of 40 mg/L, 60 mg/L, 80 mg/L, 100 mg/L and 120 mg/L, the methyl orange degradation of 40 mg/L concentration is the best.
- (2) At six metal ions concentrations of 0.5 mg/L, 1 mg/L, 2 mg/L, 3 mg/L, 4 mg/L and 5g m/L, the catalytic activity of 2 mg/L is the best.

Acknowledgments

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