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Activated carbon load CuO catalyzed persulfate oxidation degradation active bright red X-3B dye

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Abstract: In this paper, an advanced oxidation technology using activated carbon supported CuO as catalyst to catalyze persulfate to produce SO_4^- to degrade activity red X-3B dye was constructed. The effect of CuO load on dye chromaticity removal rate was studied by single factor variable method. The results show that activated carbon load CuO catalyzes persulfate can effectively remove active bright red X-3B, in mass ratio of activated carbon and CuO mass ratio of 1:5, 0.2 g, pH of 3, sodium sulfuric acid quantity 0.2 g, under conditions of reaction temperature at 40 ℃, the chromaticity removal rate and COD removal rate of active bright red X-3B reached 91.34% and 82.73%, respectively, indicating that the use of activated carbon load CuO catalyzed hypervulfate oxidation degradation active bright red X-3B dye effect is remarkable.

1. Introduction

At present, the azo dye is the most variety, the most widely used synthetic dyes[1], is widely used in the printing and dyeing, leather, chemical and other industries[2], is one of the main pollution sources of industrial wastewater. Among them, active bright red X-3B is a typical single nitrogen activated dye, its organic pollutant content, high COD concentration, and more difficult to degrade materials[3], the removal problem in printing and dyeing wastewater cannot be ignored.

Advanced oxidation technology is an ideal treatment for dye wastewater mineralization, which converts the refractorful macromolecular organic matter into small molecular substances by producing a strong oxidative active substance. SO_4^- based advanced oxidation technology has always been a hot spot studying at home and abroad in recent years. By light, heat, transition metal ions, alkali activation, inorganic anion and activated carbon, etc. can activate persulfate to produce persulfate free radicals. In addition to some traditional methods of activating persulfate, many new activation methods have gradually been studied[4]. Among them, in the transition metal, Co, Fe, Cu, Mn plasma catalyst can produce SO_4^-, and then treat contaminants, there is no additional energy, simple operation, extensive research and application; in non-metallic catalysts, activated carbon is predominantly attaind by the advantages of good adsorption performance and low cost. Anni and other discovery, when utilizing activated carbon activated PS degraded psmium hydrochloride, the activated carbon activation was produced, and SO_4^- was produced, and the oxidative degradation exerted mainly and the degradation rate exceeded 80%.

At present, the joint activation method is more concerned by its better oxidation effect and the removal effect on target pollutants. Zhao xuerui and others used zero valent iron and activated carbon to activate persulfate to treat organic waste liquid of alkaline high concentration electroplating tank[6], which greatly increased the reaction efficiency of the system activated persulfate and degradation of macromolecular organics. However, the combined activation mode of activated carbon supported CuO combined with persulfate has not been studied in specific literature. This paper simultaneously utilizes activated carbon adsorption and advanced oxidation techniques, attempts to catalyze the oxidative degradation of water-soluble azo dye in combination of activated carbon activation and CuO activation. Activated carbon is not only a catalyst or a good adsorbent, and CuO is loaded on activated charcoal to carrier and masking effect, promoting catalysis of persulfate and degradation of dyes.

2. Experimental part

2.1 Experimental materials and instruments

Scanning electron microscope (JSM-7500F, Japanese Electronics (JEOL)
X-ray diffraction analyzer (X'PERT Pro MPD, Netherlands Philips)

2.2 Experimental Method

2.2.1 Preparation of activated carbon load CuO catalyst

Treatment of activated carbon: 30 g of activated carbon, washed with distilled water repeated to the supernatant to clarify without suspension dust, and the concentration of 2 mol/L nitric acid was added, and 24 h was activated. Filter, wash with distilled water, remove nitric acid attached to the surface of activated carbon, put it into the oven for 12 h, and take it out for use.

Activated carbon load CuO: Tested the treated activated carbon 0.2 g, according to the mass ratio of activated carbon and CuO, 1:1, 1:5, 1:10, respectively, respectively, and configure copper nitrate into 100 mL solution, add activated carbon to it. In the copper nitrate solution, it allowed 24 h to allow the copper salt to be saturated on activated carbon. Put the activated carbon attached with copper nitrate into the oven at 50℃ for 24 h and take it out, and the tube furnace was placed, and the nitrogen atmosphere was treated to 350 ℃ for calcination (the heating speed was 5 ℃/min), and the heat preservation was 30 min, Remove natural cooling spare.

2.2.2 Activated carbon load CuO catalytic persulfate oxidation degradation active bright red X-3B dye

A solution of a concentration of 100 mg/L was configured with an active bright red x-3b dye, and 100 ml of the solution was placed in a 500 ml beaker, weigh 1:1, 1:5, 1:10 load CuO activated carbon, sodium persulfate To be used, the weighing activated carbon and sodium persulfate are added to each active bright red X-3B solution. The pH was then adjusted, and the solution was constantly oscillated 8 h, filtered, and the filtration was filtered, the absorbance was calculated, and the chromatic removal rate was calculated.

2.3 Active bright red X-3B chroma and COD analysis

The maximum absorption wavelength of reactive brilliant red X-3B dye wastewater is 538 nm. According to Lambert-Beer law, its absorbance is measured at 538 nm to indicate the concentration of dye in the solution, so as to characterize the removal of dye. Prepare 0.5 mg/L to 100 mg/L active

brilliant red X-3B standard solution, measure the absorbance of the solution with a visible spectrophotometer at the wavelength of 538 nm, and make the standard curve with the concentration of active brilliant red X-3B as the abscissa and the absorbance as the ordinate.

According to the measurement, the linear regression equation of the concentration and absorbance of the active bright red X-3B solution is as follows:

$$y = 0.014x + 0.004 \quad (1)$$

$$R^2 = 0.9994 \quad (2)$$

Through the standard curve, it is known that the concentration of the active bright red X-3B is linear with the absorbance in the measurement range, so the amount of removal rate of the active bright red X-3B can be expressed in the reduction amount of the solution absorbance. The specific calculation formula is as follows;

$$P_0 = [(A_0 - A_t) / A_0] \times 100\% \quad (3)$$

In the formula: P_0--the removal rate of active bright red X-3B wastewater; A_0-- absorbance of active bright red X-3B solution raw water; A_t-- absorbance of active bright red X-3B after degradation for th.

COD adopts national standard GB11914-1989 (potassium dichromate method).

$$P_1 = [(COD_1 - COD_2) / COD_1] \times 100\% \quad (4)$$

In the formula: P_1--COD removal rate; COD_1--COD value of printing and dyeing wastewater before treatment; COD_2--COD value of printing and dyeing wastewater after treatment.

2.4 Characterization of activated carbon load CuO catalyst

2.4.1 Characterization by scanning electron microscopy (SEM)

The catalyst scanning electron microscope (SEM) is characterized by JSM-7500F scanning electron microscope instrument produced by Japan Electronics (JEOL). The sample was fixed to the conductive rubber tape, and the sample on the conductive glue was further treated, and the treatment was fixed to the sample stage for the test of the scanning electron microscope. The BET specific surface area and pore structure of AC and CuO / AC were measured by asap2000 (microelectronics, USA) surface analyzer.

2.4.2 Characterization of X-ray diffraction (XRD)

Sample X-ray diffraction (XRD) is characterized by the X'Pert Pro MPD-type X-ray diffraction analyzer produced by Philips, the Netherlands. The test experiment is: pipe pressure 15 kV, tube flow 100 mA, Cukα target, scan range 5°~85°, scan rate 4°/min.

3. Results and discussion

3.1 Characterization of activated carbon load CuO catalyst

Fig. 1 is a electron microscope scan of activated carbon, and Fig. 2 is a scanning diagram of an electron microscopy under the condition that the mass ratio of activated carbon to CuO is 1:5. By comparison, it is clear that a large amount of CuO particles on the surface of the activated carbon in Fig. 2, and partially agglomerates to form larger particles. The microporous structure distribution did not change significantly compared to the activated carbon before the unlessned, but due to the

loading copper, the calcination process, the portion of the micropore collapsed, the number of micropores decreased and the average pore size was smaller, thereby compared to the surface area The load was 23.82% before the load (dropped from 718 m^2/g to 547 m^2/g). Fig. 3 is an XRD table illustrated of a load CuO activated carbon. There is a strong diffraction peak near 2θ=23.15 ° and 35.52 °, which is compared with the ASTM diffraction data card, and CuO is loaded on the activated carbon. There is a Cu2O diffraction peak near 2θ=42.26 °, and its effect can be ignored due to fewer generation.

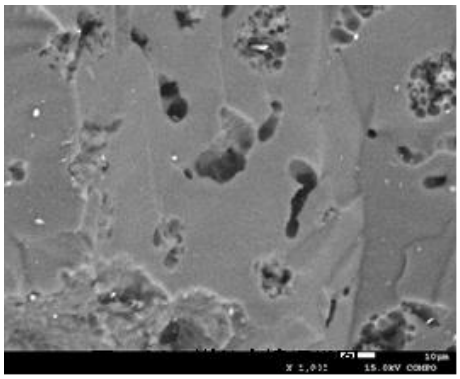

Fig. 1 SEM microscopy of prepared AC

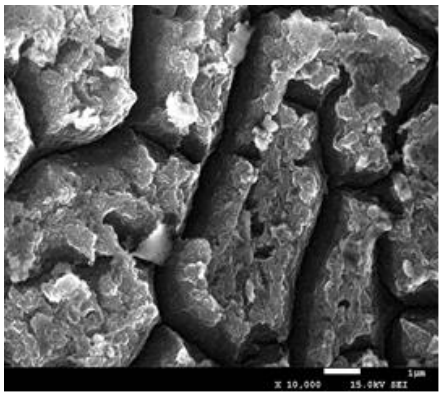

Fig.2 SEM microscopy of CuO/AC

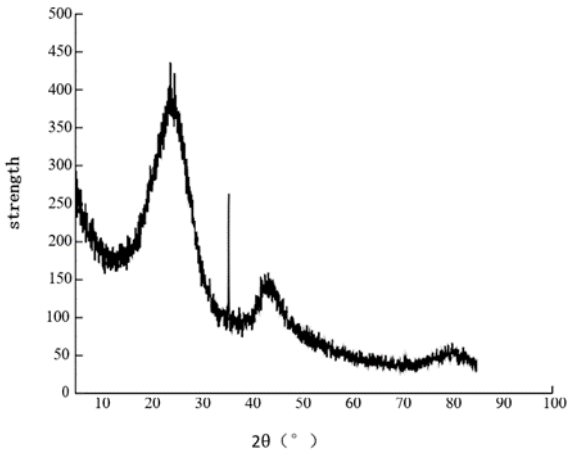

Fig.3 XRD patten of CuO/AC catalyst

3.2 Effect of CuO load on dye degradation effect

Three groups of active bright-red X-3B solutions with 100 ml of concentration of 100 mg/L were added to the solution from 1:1, 1:5, 1:10 loading of different activated carbon each 0.2 g, while all components 0.2 g of sodium persulfate, adjusted pH to 5, 20 ℃ constant temperature water bath 8 h, determined solution absorbance, investigating different CuO loads of activated carbon, COD removal rate, as shown in Figure 4:

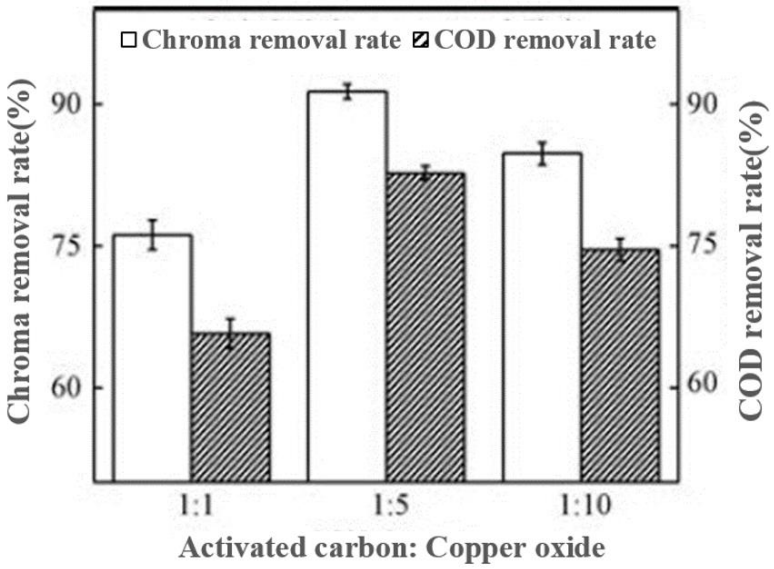

Figure 4 Effects of different CuO loading amounts of activated carbon on color and COD removal rate

It can be clearly seen that when the amount of catalyst is 0.2 g, the pH is 3, the amount of sodium persulfate is 0.2 g and the reaction temperature is 40℃, the color removal rate and COD removal rate of the dye reach the highest when the 1:5 CuO loaded activated carbon is used as the catalyst, and the color removal rate and COD removal rate of reactive brilliant red X-3B reach 91.34% and 82.73% respectively.

4. Conclusion

In this paper, activated carbon adsorption method and advanced oxidation technology based on SO_4^- are used to catalyze persulfate to produce SO_4^- to degrade reactive brilliant red X-3B dye with activated carbon and transition metal oxide CuO as catalyst. The results show that activated carbon supported CuO catalyzed persulfate can effectively remove activated brilliant red X-3B, and its catalytic degradation effect is affected by the amount of CuO loaded. The single factor method shows that this factor has better conditions: when the mass ratio of activated carbon to CuO is 1:5, the dosage is 0.2 g, pH is 3, the dosage of sodium persulfate is 0.2 g, and the reaction temperature is 40℃, the chroma removal rate and COD removal rate of reactive brilliant red X-3B reach 91.34% and 82.73% respectively. It is proved that the effect of activated carbon supported CuO catalyzed persulfate oxidation degradation of reactive brilliant red X-3B dye is remarkable, It can play a guiding role in the treatment of printing and dyeing wastewater.

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