

Notice of Retraction

After careful and considered review of the content of this paper by a duly constituted expert committee, this paper has been found to be in violation of IEEE's Publication Principles.

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Study of propylene oxide wastewater treatment with scrap iron-H₂O₂

Lan Shanhong Wu Xiuwen
College of Chemistry and Environmental Engineering;
Dongguan University of Technology;
Dongguan, China;
llssshhh@126.com

Abstract: In this paper, a new technology with lower cost but more effective than treating propylene oxide wastewater with scrap iron-H₂O₂ was studied. The effects of the pH of initial reaction, the concentration of scrap iron and H₂O₂ and the reaction time on the treatment of propylene wastewater were also studied. The results showed that COD_{Cr} removal rate could achieve 70% on the reaction conditions which the pH of early

reaction was 2, the iron powder capacity 12 g · L⁻¹, the concentration of H₂O₂ 3.2 mL · L⁻¹, and the reaction time 40 min. It indicated that the cost was 3.5 Yuan to treat one ton Propylene oxide wastewater by economic analysis.

Keywords-Propylene oxide waste water; Fe⁰-H₂O₂ system; COD removal rate

I INTRODUCTION

It will cause a huge waste of the water and a large damage on the ecological environment when the wastewater of propylene oxide discharged directly into the water environment. Considering the high salinity and the serious inhibition on microorganisms, this kind of wastewater can not be treated well with economy biological treatment technology. At present, advanced oxidative process is commonly applied for this kind of wastewater, such as Fenton reagent oxidation which was widely used in the wastewater treatment because it was very effective. However, the high costs of oxidation technology limit its application in industry^[1-3].

In this paper, scrap iron was used to treat the wastewater of propylene instead of ferrous reagent, forming a system similar to Fenton with H₂O₂, in order to bring out the waste controlled by waste, and lower the treatment cost.

II EXPERIMENTAL

A Materials

The quality of the waste water, collected from the outfall of the process producing propylene oxide of a Petrochemical Company in Shandong province, is depicted in Table 1:

TABLE I. PROPYLENE OXIDE INDICATORS OF THE QUALITY OF WASTE WATER

pH	Solids concentration/g·L ⁻¹	COD concentration /m g·L ⁻¹	Cl ⁻ concentration / mg·L ⁻¹
14.0	28-35	1000-1500	30000

B Characterization

In this experiment, pH was measured by Sension 6 pH Instrument, and the COD of the samples was sub-measured^[4] for high Cl⁻ concentration of wastewater which was determined by GB11896-89^[5].

III RESULTS AND DISCUSSION

A Effect of pH on wastewater treatment

The removal of COD_{Cr} with different pH was shown in Figure 1 by treating 100mL of samples with 1.0g of scrap iron and 0.4mL of H₂O₂ during 60min.

This research was funded by Significant Science and Technology Special Fund of China (2009ZX07211-005-02) and the Significant Science and Technology Special Fund of Guangdong Province (2009A080303004)

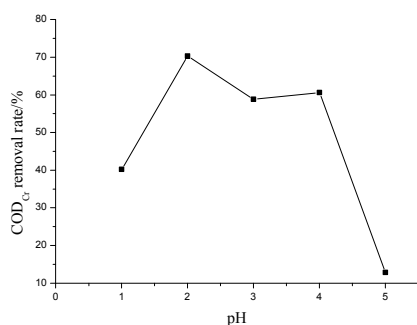


Fig.1 pH of the wastewater on the removal of COD_{Cr}

Keeping the time and the quantity of iron and H₂O₂ added to the reaction constant, the Figure 1 shows that the removal of COD is up to the maximum 70.3% at pH is 2 and the minimum 12.8% at pH is 5 respectively. It indicates that the pH plays an important role on the removal of COD. The reaction of $\text{Fe}^{3+} + \text{H}_2\text{O}_2 \rightarrow \text{Fe}^{2+} + \text{HO}_2\cdot + \text{H}^+$ can be limited by low pH which leads that Fe(III) can not be easily deoxygenized into Fe(II) with catalytic ability, thus the oxidation ability of Fenton reagent is influenced, while the reaction of $\text{Fe} + \text{H}^+ \rightarrow \text{Fe}^{2+} + \text{H}_2$ can be limited when pH increases to a certain extent. Therefore, the optimal pH is 2.

B Effect of H₂O₂ dose on wastewater treatment

The experiment was carried out by adding 1.0g of scrap iron into 100mL wastewater during 60min when pH was 2. The curve of the removal of COD as a function of H₂O₂ dose was shown in Fig. 2.

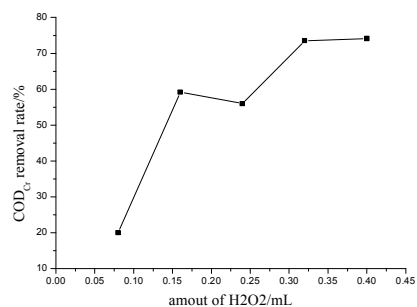


Fig.2 Amount of hydrogen peroxide on the removal of COD_{Cr}

Figure 2 shows that the COD removal increases generally with increasing the amount of H₂O₂. The removal of COD_{Cr} achieves 75.2% when 0.4mL H₂O₂ was added. The COD removal increases rapidly when the quantity of H₂O₂ added from 0.08mL to 0.16mL. Because the OH⁻ concentration increases rapidly with increasing the amount of H₂O₂. Although the removal of COD_{Cr} is up to the maximum 73.5%

when 0.32mL H₂O₂ was added, and after that it increases so slowly that the hydrogen peroxide cost required to be considered. As a result, the optimal H₂O₂ dose is 0.32mL.

C Effect of scrap iron dose on wastewater treatment

The experiment was carried out by adding 0.32mL of H₂O₂ into 100mL wastewater during 60min when pH was 2. The effect of scrap iron dose on wastewater treatment was shown in figure3:

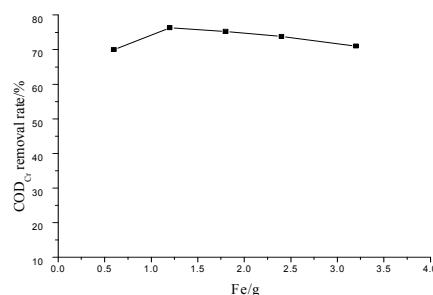


Fig.3 Amount of Fe on the removal of COD_{Cr}

As shown in figure 3, COD_{Cr} removal rate is up to the highest 76.5% at 1.2g of iron was added. However, it decreases with more addition of iron. Because of that there is not enough catalyst in the reaction system when a small amount of scrap irons were added that the Fenton can not be catalyzed well by Fe (II). In contrary, while more doses of iron were added, Fe (II) was oxidized into Fe (III) by some H₂O₂ in the system. Therefore, The concentration of ·OH reduced, so did the COD_{Cr} removal rate. The optimal scrap iron dose is 1.2g.

D Effect of reaction time on wastewater treatment

The removal of COD at different time was shown in Figure 4 when keeping the pH, the quantity of iron and H₂O₂ as 2, 1.2g and 0.32ml, respectively.

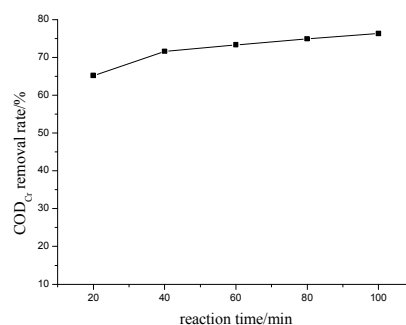


Fig.4 Reaction time on the removal of COD_{Cr}

The Figure 4 shows that the removal rate of COD_{Cr} increased gradually with increasing of the reaction time. The removal rate of COD_{Cr} is up to the highest 76.3% at 100min, while it is up to 71.6% at 40min. During this time from 40min to 100min, the removal rate of COD_{Cr} increased slowly. Considering of the cost, the optimum reaction time is determined for 40min.

E Economic Analysis

The amount and price of reagent used in the experiment is shown in Table 2 and Table 3 respectively. By the way, the amount of iron is what has been reacted in experiment actually. Wastewater treatment capacity is 100mL.

TABLE II. INDUSTRIAL RATES OF VARIOUS REAGENTS

Reagent	Price/Yuan/t
Industrial Sulfate	200
Industrial Base	800
H_2O_2 (30%)	750
Scrap Iron	120

TABLE III. CONSUMPTION OF VARIOUS REAGENTS

Reagent	Dosage
H_2SO_4 ($2\text{mol}\cdot\text{L}^{-1}$) /ml	0.32
NaOH ($2\text{mol}\cdot\text{L}^{-1}$) /ml	0.96
H_2O_2 (30%) /ml	0.32
Scrap Iron /g	0.12

Tab.4 has shown the price of the reagents used to treat one ton wastewater according to Tab.3.

TABLE IV. PRICE OF VARIOUS REAGENTS

Reagent	price/Yuan
Industrial Sulfate	0.12
Industrial Base	0.61
Industrial H_2O_2 (30%)	2.6
Scrap Iron	0.2
Total	4.53

Table 4 shows that the funds are mainly spent on H_2O_2 and pH conditioning agent, and the scrap iron costs very low in the

process of propylene oxide wastewater treatment with scrap iron- H_2O_2 . While the Ferrous Reagent used in Fenton oxidation costs as high as H_2O_2 . This process is compensates for Fenton oxidation which with the shortcoming of high cost.

IV CONCLUSIONS

According to the experiments, COD_{Cr} removal rate can achieve 70% under the conditions that the initial pH is 2, the iron powder capacity $12\text{ g}\cdot\text{L}^{-1}$, the volume of H_2O_2 $3.2\text{ mL}\cdot\text{L}^{-1}$, and the reaction time 40 min. The treatment cost is only 3.5 Yuan /ton.

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