

Effect of waste ceramic adsorbent on wastewater treatment

Yao Zheng*, Qun Yuan, ZiYing Yan, Jiacheng Liu, Jingying Liang, Linjiang He, Jianjun He, Min Yan, L He

School of Environmental and Chemical Engineering, Foshan University, Foshan, China

Abstract: The preparation of porous ceramic with waste porcelain powder as aggregate research. The influence of the amount of Sesbania powder and the calcination temperature on the adsorption performance of porous ceramics was investigated. The effect of the amount of porous ceramic and the adsorption time on the removal rate of Cu in wastewater containing Cu was investigated. The results showed that the adsorption properties of porous ceramics were related to the calcination temperature and the amount of Sesbania powder. The suitable calcination temperature and the amount of Sesbania powder were 600 °C and 4 wt%, respectively. The removal rate of Cu in water samples increases with the increase of the amount of porous ceramics and the increase of adsorption time. The suitable amount of porous ceramics is 10 g/L and the adsorption time is 35 min. XRD characterization showed that the crystal particles were grown by calcination, and the properties of porous ceramics were stable before and after adsorption.

1 Introduction

Since the reform and opening to the outside world, China's ceramic industry has been developing by leaps and bounds, especially the ceramic industry in Guangdong. In 2015, the output of industrial ceramics in Guangdong accounted for about 30% of the world's total, accounting for more than 60% of the total, of which nearly 70% of exports, and the annual rate of 30% growth. However, with the rapid development of ceramic industry, ceramic industry waste generated is also increasing, it not only caused great pressure on the environment, but also restricts the sustainable development of the ceramic industry, and many of the waste ceramic components can not be reasonably utilized, resulting in a waste of resources two. At present, China's ceramic industry waste treatment and utilization is relatively low, a large number of waste land crowding, so that water and air are seriously polluted. Therefore, with the gradual attention of the society to environmental protection work, the treatment and comprehensive utilization of waste materials in ceramic industry has become a common concern of the ceramic industry and environmental protection departments.

The adsorption method is used to treat wastewater containing heavy metal ions, and activated carbon is usually used as adsorbent. Because the activated carbon has a strong adsorption capacity, high removal efficiency, but the price is expensive, the application subject to certain restrictions, but the ceramic industry waste ceramics for daily use, the original clay composition is kaolin, which is suitable for used as adsorption medium in water treatment. The waste domestic ceramics are re sintered into porous ceramic [4-5] by adding pores, adhesives and other materials. Because of its internal porous, large specific surface area, good chemical and

thermal stability, it has better adsorption properties, and this porous ceramic is easy to regenerate, easy to reuse [6-7]. This shows that waste ceramics in wastewater treatment has a wide range of applications and development of space [8-13]. In this paper, the treatment of Cu containing wastewater by fired porous ceramics is studied.

2 Experiment

2.1 Experimental reagents, materials, instruments and equipment

The Experimental reagent: Cu(NO₃), CuCl₂, HCL, HNO₃, NaOH, they are both analytical pure, and the manufacturers are Guangzhou Chemical Reagent Co., Ltd. Experimental material: Sesbania powder, replaced by starch in the supermarket. Clay: Chaozhou porcelain factory. Discarded ceramics for daily use. Experimental instruments and equipment: ball mill pulverizer, electronic analytical balance, pH meter, air bath thermostats oscillator, digital electric thermostatic drier, muffle furnace, type 4510 atomic absorption spectrophotometer (Shanghai precision scientific instrument factory).

2.2 Analysis method

Although the porous ceramic with water treatment can be naturally settled, in order to save time, the water samples are separated and separated by centrifugal separator for digestion and detection. The pH values of water samples are measured with a pH meter. The concentration of Cu ion in raw water and treated effluent was determined by

*Corresponding author: 331538792@qq.com

atomic absorption spectrophotometer. The properties of raw porcelain powder and samples before and after adsorption were examined by X ray diffractometer.

3 Experimental results and discussion

3.1 Preparation and selection of porous ceramics

The experiment used the waste daily ceramic powder with a quality amount of 50 wt %. With 2 wt %, 4 wt %, 6 wt %, 8 wt % of sesbania powder, a percentage of China clay powder, mixed into circular block body, keep calibration of the sample after, to be put in the oven at 105 °C drying, and then in the muffle furnace at 600 °C, respectively, 800 °C, 1000 °C calcination 5 h shape. The serial number of porous ceramics prepared under different conditions is listed as follows:

Table 1 Porous ceramics prepared in different conditions

Sesbania powder dosage Calcination temperature	2 wt%	4 wt%	6 wt%	8 wt%
600°C	#1	#2	#3	#4
800°C	#5	#6	#4	#8
1000°C	#9	#10	#11	#12

Experimental methods:(1)Crush samples and screen them by 100 mesh screen.(2)Take 50 mg/L Cu containing water sample (instead of Cu containing wastewater) 100 mL in 250 mL conical flask, add 2 g porous ceramic powder, oscillate 90 min on the oscillator, and place it slightly, centrifugal separation. The amount

of residual Cu was determined by proper supernatant, and the removal rate of Cu was calculated according to the following formula: $Cu\text{ removal rate} = (C_0 - C) / C_0 \times 100\%$ In formula: C_0 — Cu^{2+} concentration in Cu bearing water samples, mg/L. C —after treatment, the Cu^{2+} concentration of water samples, mg/L.

Table 2 Adsorption effect of porous ceramics

Sample	#0 porcelain	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
Concentration of Cu after adsorption/ mg/L	16.2	10.8	5.16	8.80	8.26	7.72	7.82	8.26	8.9	9.3	8.5	8.8	10.2
Removal rate of Cu / %	67.6	78.4	89.68	82.4	83.48	84.56	84.36	83.48	82.2	81.4	83	82.4	79.6

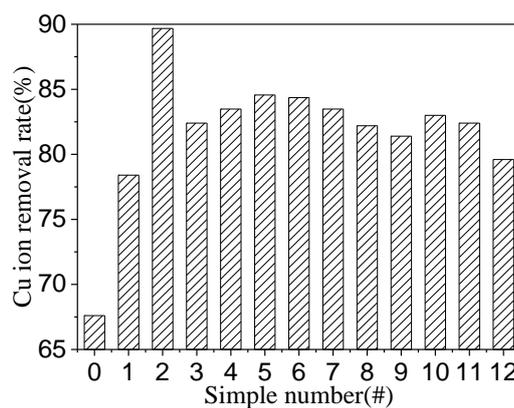


Fig. 1 Adsorption effect of porous ceramic sample on Cu

From Sesbania powder mixture on the dosage, moderate dosage can produce more porous channel and surface area, is conducive to the adsorption of metal ions to a certain temperature; roasting, baking to make ceramic porosity increases, so as to enhance the adsorption effect, but if the calcination temperature is too high, the surface will form a sintered ceramic sample that

is not conducive to the porosity and the specific surface area increased. From the above Table 2 and Fig. 1 shows that the porous ceramic samples of #2 containing 4 wt% Sesbania powder calcined at 600 °C for molding, the best adsorption of simulated wastewater containing Cu, the removal rate of Cu^{2+} reached 89.68%, the relative waste porcelain powder on the removal rate of Cu^{2+} is higher

than 22.08 percentage points, so the best of porous ceramics, the next step adsorption experiment.

3.2 The influence of the amount of porous ceramic on the removal rate of Cu

#2 porous ceramics determined by the above experiments were selected, That is, it prepared by calcination of 4 wt% Sesbania powder at 600 °C .The weighing of porous

ceramic powder were 2 g/L, 4 g/L, 6 g/L, 8 g/L, 10 g/L, 12 g/L, 14 g/L, 16 g/L, 18 g/L, on the concentration of 25 mg/L (the pH test is neutral) containing Cu solution of oscillating adsorption, with 100 mL of water with Cu, explore the optimal dosage of porous ceramics. The oscillation adsorption in this series is 90 min, and the experimental results are shown in Table 3 and figure 2:

Table 3 Effect of the amount of porous ceramic on the removal rate of Cu

Consumption (g/L)	2	4	6	8	10	12	14	16	18
Cu concentration after adsorption / mg/L	15.2	11.3	7.00	2.72	2.28	1.52	1.25	1.65	1.68
Cu removal rate / %	39.2	54.8	72	89.12	90.88	93.92	95	93.4	93.28

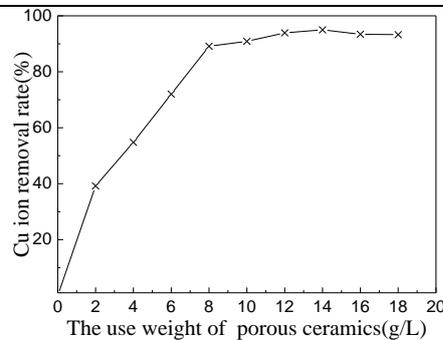


Fig. 2 Effect of the amount of porous ceramic on the removal rate of Cu

From table 3 and Figure 2, it is found that the removal rate of Cu increases rapidly with the increase of the amount of porous ceramics. However, when the amount of porous ceramic reaches 10 g/L, the removal rate of Cu in water samples tends to be mild, and the removal rate of Cu reaches saturation at 90.88%. In order to ensure better treatment effect of wastewater and save the amount of porous ceramics, the amount of porous ceramic was chosen as 10 g/L to treat wastewater containing Cu.

4 Conclusions

(1) Using the waste ceramics from the ceramics factory as the raw material to produce porous ceramics, the utilization rate of waste is high, and the social and economic benefits are good.

(2) The adsorption properties of porous ceramics are related to the calcination temperature and the amount of doped Sesbania powder. The suitable calcination temperature and the amount of doped Sesbania powder can greatly improve the adsorption efficiency of porous ceramics.

(3) At the baking temperature of 600 °C and the dosage of 4 wt% Sesbania powder, the porous ceramic with the highest cost performance ratio.

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