ATLANTIS PRESS

Advances in Engineering Research, volume 94

2nd International Conference on Sustainable Development (ICSD 2016)

Study on Adsorption of Cd^{2+} by Manganese Modified Diatomite

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***Abstract*—Diatomaceous earth itself has a large specific surface area, porous structured, large aperture and uniform, modest, stable skeleton structure of hole wall, easy to modify, high adsorption capacity, good thermal stability, mechanical stability and water, etc. Make it will benefit the adsorption of heavy metal ions, but single diatomite adsorbing heavy metal ions adsorption rate is not high, this article with manganese oxide modified diatomite, used for adsorption of Cd2+, with a series of characterization methods analyze adsorption principle..Provide a theoretical study for the adsorption of heavy metal ions principle**

Keywords- Diatomite; Cd^{2+}; Manganese oxide modification.

I. INTRODUCTION

Guangxi is the home of non-ferrous metals, non-ferrous smelting industry is very developed, the Smelting Wastewater with silver, lead, zinc, cadmium, mercury, arsenic and other heavy metals are the heavy metals pollution has toxic effect lasts for a long time, non biodegradable and other characteristics, can enter the body through the food chain, the survival and development of human [1] Yan triple threat and influence.

Single diatomite on the adsorption efficiency of heavy metal ions is not high, this experiment using manganese oxide to diatomite modified, the modified diatomite characterization, analysis of adsorption mechanism.

II. EXPERIMENTAL

A. Sewage Sample Source

The experiment of electrolytic zinc plant wastewater wastewater reference a mineral processing plant in Hechi city of Guangxi, the conventional concentration determination of the workshop wastewater for cadmium 4mg/L, on the basis of reference to this data, the experiment uses the $Cd(NO_3)_2.4H_2O$ to configure the concentration of cadmium containing wastewater 4mg/L.

B. Adsorption of Sample Preparation

Modified method: take 15g dry diatomite earth to 50 4mol/L, NaOH mL solution, to maintain the temperature of 90 degrees Celsius oscillation 2h.Then remove the upper solution, then add 100mL concentration of 2 mol/L MnCl2 (use HCl pH to prevent the precipitation of manganese) solution, static 2h, stirring 1h, static 24h, removing the

supernatant. Then add 2mol/L, MnCl2 25mL solution stirring, standing, repeat the above operation [2]. Remove the supernatant, the samples are fully exposed to 24h in the air, and then pure water washing to neutral, centrifugal solid-liquid separation, after taking the centrifugal solid at 105 degrees in the oven drying, grinding, over 60 mesh sieve, save backup.

C. Adsorption Results

The use of Cd^{2+} concentration before and after adsorption of ICP were determined[3], the results showed that the modified diatomite on the removal rate of Cd^{2+} was 98.69%, while the unmodified diatomite on the removal rate of Cd^{2+} was 58.30%, showed that the modified diatomite adsorption effect of Cd^{2+} was obviously improved.

III. CHARACTERIZATION

A. SEM

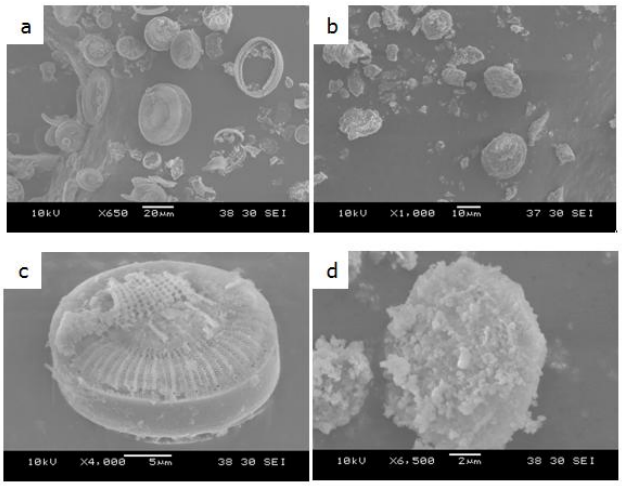

Figure 1. Diatomite modified before and after SEM(a,c Diatomite ;b,d Diatomite modified)

Using scanning electron microscopy (SEM) to test the modified diatomite samples before and after treatment, as shown in Figure.1, the modified diatomite (a,c) are mostly circular sieve, holes are distributed on the surface of the nanometer scale, modified diatomite (b,d) the overall shape is a flat disc, covered with uniform surface modifier, between diatomite and modified to form a good interface.

B. XRD

As shown in Figure 2, the modified SiO_2 in the Y-Mn amorphous bread bag disappeared, The intensity of SiO_2 diffraction peak is somewhat weaker than that of the former, and the surface SiO_2 diffraction peak intensity can be reduced by the surface modification, while the organic matter 3 mark between 5~10 diffraction peaks disappeared. That the organic matter is removed in the process of modification, or the structure is damaged; reduce the intensity of a diffraction peaks of cristobalite, montmorillonite and the diffraction peaks of b almost disappeared[4-6], indicating that both the content decrease in the amount of modifying process. After the modification of diatomite, the diffraction peak of manganese phase was shown in Figure 2 mark 4, which could be combined with the surface material of diatomite, and the manganese content was grafted on the surface of diatomite[7].

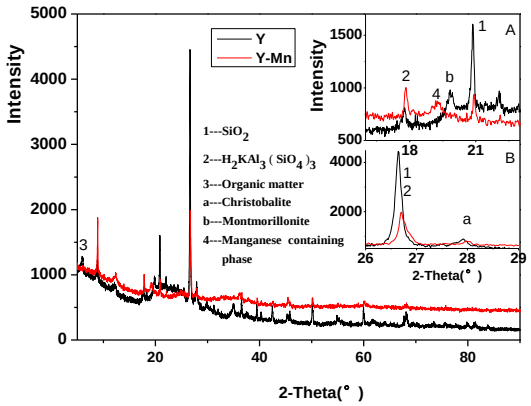

Figure 2. Diatomite modified before and after XRD(Y Diatomite ;Y-Mn Diatomite modified)

C. Specific Surface Area Analysis

TABLE I. SPECIFIC SURFACE AREA TEST RESULTS

	Diatomite	Modified diatomite
Specific surface area (BET/m^2/g)	19.302	148.253
Average pore diameter (BJH/nm)	7.498	7.758

From table 1 shows that the modified diatom specific surface area than the unmodified diatom specific surface area increased by nearly 8 times, but only increase the aperture 0.26nm, combined with SEM map, diatomite through manganese oxide modified, significantly increasing the specific surface area, but after the grafting of manganese oxide and the pore structure of diatom surface grafting like memory type growth, pore structure did not change significantly [8].

Figure for diatomite liquid nitrogen adsorption desorption curve and pore size distribution curve, anti S type curve, the first half of a convex shape, as shown in figure A, the nitrogen adsorption by diatom monolayer to multi molecular layer over the stage, the relative pressure P/P0 in the adsorption capacity between 0.15 to 0.8 increase. Overall, the pore size distribution of diatomite is even [9]. The second half of the rapid rise in the relative pressure isotherms, P/P0 close to 1, the adsorption capacity increases obviously, showing no adsorption limit, a part of medium and large pore existed in diatomite, the typical adsorption isotherms belong to type ii. There is an obvious hysteresis loop in the curve, which belongs to the H3 and H4 type composite adsorption

regression line, which indicates that the earth contains a certain narrow pore channel. Said modified diatomite liquid nitrogen adsorption desorption curves and pore size distribution, adsorption desorption curve also has an obvious hysteresis loop, belongs to the type II isotherms, which belongs to the adsorption of H3 and H4 composite regression line, there are cracks in holes[10]. In a there is a small bend, and the initial stage of adsorption, the adsorption showed that the adsorption line near the longitudinal axis, the initial stage, strong liquid nitrogen and diatomite adsorption capacity, adsorption speed. The relative pressure P/P0 between 0.2 and 0.8 diatomite adsorption desorption slope ratio increased significantly, the relative pressure of P/P0 is close to 1 times, showed no adsorption limit, and from the beginning to the end, the amount of adsorption of nitrogen modified diatomite increased significantly than that of modified diatomite raw diatomite, compared with the original diatom specific surface the area will be increased [11-14].

IV. CONCLUSIONS

As can be seen from the SEM, modified diatomite surface grafting after a large number of manganese modified diatom, the matrix is not changed, manganese modified onto the surface of diatomite; from specific surface area test results show that diatomite itself has large surface area, the pore size in nanometer range, modified specific surface area of diatomite increased nearly 8 times, and the modified diatomite samples pore size after the diatomite still in the nanometer range and pore size of unmodified is only 0.26 nm, grafting modification manganese present memory type graft growth in diatoms surface; the XRD spectrum analysis results show that the manganese modified in diatom is formed on the surface of a manganese containing phase, once again proved the modified diatomite and manganese surface grafting, grafting mode of surface grafting, graft replacement. Manganese modified diatom surface, diatom and manganese modified form synergistic adsorption effect, adsorption Cd^{2+}.

In this study, we do some theoretical research on removal of heavy metal ions Cd^{2+} in sewage. It is hoped to provide some technical solutions for the removal of Cd^{2+}; to reduce the harm of Cd^{2+} in the metallurgical wastewater to the natural ecology.

ACKNOWLEDGMENT

The work was supported by National Natural Science Foundation of China (NO. 41662005), Guangxi Science and Technology Project (14124004-5-5), The Project of High Level Innovation Team and Outstanding scholar in Guangxi Colleges and Universities (002401013001) and Guangxi Scientific Experiment Center of Mining, Metallurgy and Environment (KH2012ZD004), Innovation project of GLUT graduate education (BS201602).

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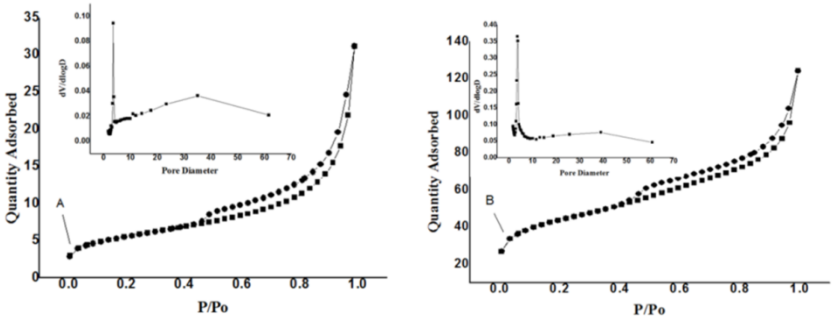

Figure 3. Adsorption desorption curve and pore size distribution of Diatomite modified before and after