

Treatment of Wastewater containing zinc by steel slag adsorption

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Abstract. Taking the steel slag as the adsorbent, the paper studied the treatment of zinc in the simulated wastewater. Results show that steel slag has good adsorption removal effect on Zn^{2+} solution. For 50ml, 100 mg /l Zn^{2+} solution, under the condition of room temperature, when adding 1.0g 100 mesh steel slag, adsorption time is 50 min, the removal rate of Zn^{2+} can reach 95%. In alkaline conditions, steel slag has better zinc removal effect on wastewater, the removal rate was about 95%.

Introduction

As a typical representative of waste residue, the steel slag comprehensive utilization rate is about 35%, so a lot of waste residue not only occupied a large area of land, but also pose a serious threat to the environment because of the inability to use, the application, environmental protection and processing issues of steel slag are also increasingly prominent^[1-3]. Zinc wastewater discharge has serious harm to human health and agriculture activities and which is lasting, toxic, polluted and other hazards, therefore zinc wastewater treatment is still a major research topic in the field of environmental protection in the world. Owing to high mechanical strength, high basicity and a porous structure, steel slag has strong adsorption capacity and other characteristics, which has good application prospect in the wastewater treatment^[4-5]. The paper used 100 mesh steel slag to treat zinc wastewater, investigated impact of slag dosage, temperature, pH, adsorption time and other factors on the effect of zinc containing wastewater treatment, and obtained the optimum condition and provide a scientific reference for the further study of zinc wastewater treatment by steel slag.

Experimental

Materials. The steel slag powder used in the experiment is taken from the local Steel Corp, and its composition is shown in Table 1.

Table 1 Main Components of Steel Slag

Component	SiO ₂	Fe ₂ O ₃	Al ₂ O ₃	CaO	MgO	MnO	TiO ₂	Loss on ignition
content (%)	26.10	2.49	10.60	50.39	0.34	0.26	1.02	0.21

Methods. Added a volume of 10% sulfuric acid solution into a beaker with a certain amount of steel slag, stirred for 30 min, filtrated and washed three times with distilled water, dried the steel slag and for spare.

A certain concentration of simulation wastewater containing zinc was prepared with zinc chloride, added a certain amount of steel slag to wastewater, oscillated for a period of time with a certain speed and temperature, filtered, determined concentration of Zn^{2+} in leachate using dithizone spectrophotometric method, and simulated the removal rate of zinc in wastewater.

Results and discussion

Effect of steel slag content on the removal rate of Zn^{2+} At room temperature, weighed

different quality of steel slag and added it to 50ml ,100mg / l of Zn^{2+} solution separately , stirred for 60 min, determined ion concentration of upper clear liquid after stewing, results are shown in Figure.1.

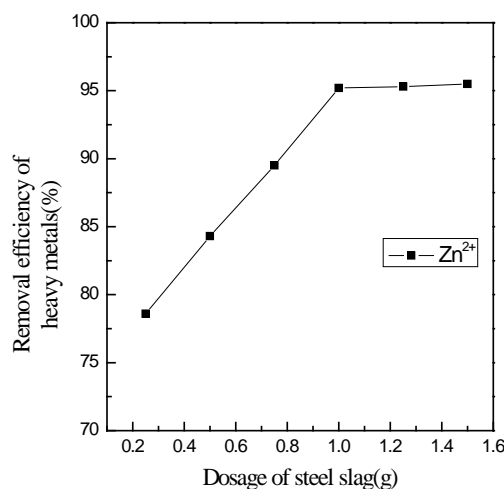


Fig.1 Effect of steel slag's dosage on the adsorption efficiency of heavy metals

According to the results of figure 1, the removal rate of Zn^{2+} increased with the increase of the amount of slag. when the dosage reached 1.0g, the change of removal rate tended to be gentle, all reached more than 95%. So the appropriate dosage of steel slag was 20 g/l.

Effect of adsorption time on removal rate of Zn^{2+} At room temperature, weighed 1.0g steel slag adsorption and added it to 50ml, 100mg /l Zn^{2+} solution, stirred for different time, determined ion concentration of upper clear liquid after stewing. The adsorption results are shown in Figure 2.

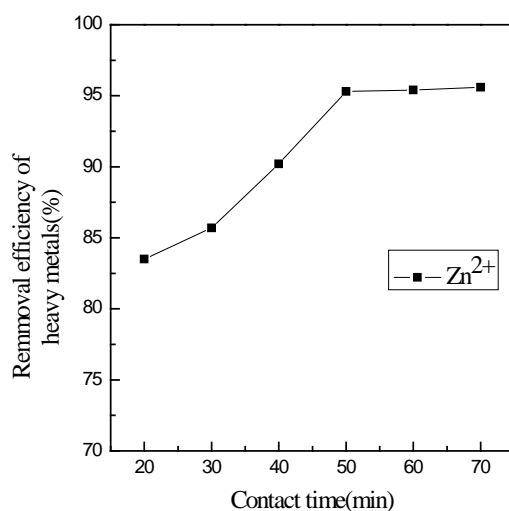


Fig.2 Effect of contact time on the adsorption efficiency of heavy metal

Figure 2 shows that the removal rate of Zn^{2+} increased with the increase of the adsorption time, when the adsorption time was 50min, the removal rate of Zn^{2+} tended to be stable, reaching 95.3%, so the best adsorption time was 50min.

Effect of pH value on the removal rate of Zn^{2+} At room temperature, weighed 1.0g steel slag, and added it to 50ml , 100mg/l Zn^{2+} solution, adjusted of the pH value of the solution ,oscillated 50min, static, determined ion concentration of upper clear liquid after stewing. the results are shown in Figure 3.

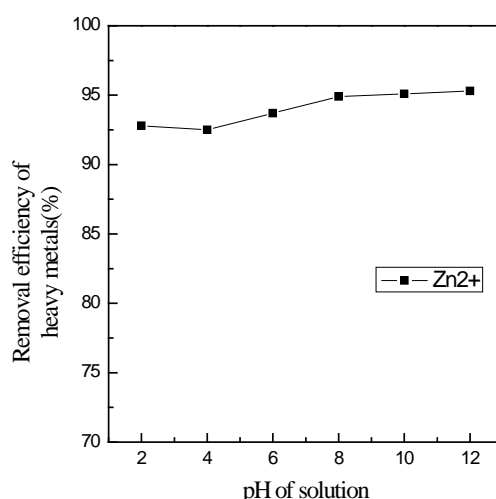


Fig.3 Effect of solution's pH on the adsorption efficiency of heavy metal

Figure 3 shows when PH is lower, Zn^{2+} removal rate is low due to adsorbed H^+ , when the solution is alkaline, Zn^{2+} will form precipitation, the removal rate increased, so the best PH range is 8-12.

Effect of adsorption temperature on the removal rate of Zn^{2+} Weighed 1.0g steel slag, and added it to 50ml, 100mg/l Zn^{2+} solution, stirred at different temperatures, determined ion concentration of upper clear liquid after stewing. The adsorption results are shown in Table 2.

Table 2 Effect of adsorption temperature on removal rate

Adsorption temperature [°C]	Removal rate [%]
20	94.7
30	94.9
40	95.2
50	95.2
60	95.3

Table 3 shows that the removal rate of Zn^{2+} increases slowly with the increase of temperature, so the temperature has little effect on the adsorption rate of steel slag, adsorption of zinc can be processed at room temperature.

Conclusions

The removal ability of Zn^{2+} in wastewater with steel slag is strong, and the adsorption rate is high. Using 100 mesh steel slag to process 50ml, 100mg/l simulated wastewater containing Zn^{2+} , the optimum conditions are: input quantity of steel slag is 20g/l, adsorption time is 50min, adsorption temperature is room temperature, The pH range is 8-12, the removal rate of Zn^{2+} can reach about 95%.

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