Research on the Removal of Humic Acid by Enhanced Coagulation

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Abstract: The effect on the removal of humic acid by enhanced coagulation with $Al_2(SO_4)_3$ and $FeCl_3$ was investigated. The results show that the efficiency of humic acid removal by enhanced coagulation is high. The pH and the dosage of coagulant are the main factors to the removal of humic acid. But the pH adjustment is a predominant factor. The optimal pH to $Al_2(SO_4)_3$ is 5 around. The optimal pH to $FeCl_3$ is 4 around. When the dosage of $Al_2(SO_4)_3$ is 4mg/L, the removing rates of DOC, COD_{Mn} and UV_{254} are 69.7%, 84.8% and 96.9% respectively. When the dosage of $FeCl_3$ is 5mg/L, the removing rates of DOC, COD_{Mn} and UV_{254} are 78.1%, 89.3% and 97.8% respectively.

Key words: enhanced coagulation; humic acid; $Al_2(SO_4)_3$; $FeCl_3$
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Nature organic matters (NOM) are main components of surface water. It is important to remove the NOM. The purpose of this paper is to study the feasibility of enhanced coagulation for humic acid.

1 Materials and methods

1.1 Chemicals and apparatus

Humic acid is biochemical reagent. $Al_2(SO_4)_3$, $FeCl_3$, HCl, NaOH are analytical reagents.

Agitator, pH meter, spectrophotometer, TOC analyzer.

1.2 Water sample

DOC=7.184mg/L, COD_{Mn}=4.2mg/L, UV_{254}=0.291 cm^{-1}.

1.3 Methods

The sample volume is 400mL. The operational condition is shown as following: rapid mix at 120 r/min for 1 min, slow mix at 20 r/min for 5 min, settlement for 10 min. Finally, the treated water was siphoned from 2~3 cm below the surface for analysis. After the filtrating by 0.45μm filtermembrane, its DOC, COD_{Mn} and UV_{254} were measured.

2 Results and discussion

2.1 Effect of pH on coagulation efficiency of humic acid

At the condition of certain coagulant dosage, the test was conducted through changing the pH of the samples.

The results show that pH has a significant impact on the coagulation efficiency. When pH was high, the removing rate was relatively low. When pH was higher than 8, the coagulant almost lost its efficiency. The removing rates increased rapidly as pH dropped. The optimal pH to aluminum sulfate was 5 around. The optimal pH to ferric chloride was 4 around. Furthermore, the optimal pH range was related with the dosage of coagulant. Along with the increasing of coagulant dosage, the removing rates of DOC and UV_{254} increased accordingly. When the dosage of aluminum sulfate was lower than 5mg/L, pH should be adjusted to 5. When the dosage of aluminum sulfate was higher than 50mg/L, the optimal pH range got broader.

A number of researches have shown that pH is a significant factor to the removal of humic acid[1-3]. It was reported that the effect of pH on coagulation was related to the mechanism of coagulant[4]. The removing efficiency of UV_{254} by enhanced coagulation was obviously higher than that of DOC. Because DOC and UV_{254} represented different organic matters[5-6].

2.2 Effect of coagulant dosage on coagulation efficiency

At the condition of weak acidic and neutral, the test was conducted through changing the dosage of co-

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agulant.

For the two coagulants, the removing rates of DOC, COD_{Mn} and UV_{254} increased as coagulant dosage increased. When the coagulant dosage reached a certain amount, the removing rates were not fluctuate acutely as coagulant dosage increased. The results show that different coagulant has different optimal dosage. The optimal dosage of aluminum sulfate was 4 mg/L and the optimal dosage of ferric chloride was 5 mg/L. For aluminum sulfate, the optimal removing rates of DOC, COD_{Mn} and UV_{254} were 69.7%, 84.8% and 96.9% respectively. For ferric chloride, the optimal removing rates of DOC, COD_{Mn} and UV_{254} were 78.1%、89.3% and 97.8% respectively. The fact can be seen that removing rate of humic acid at the condition of neutral pH is obviously lower than that in the condition of weak acidic pH. When the removing rate of UV_{254} was 79%, the dosage of aluminum sulfate at pH 7 was 7 times of that at pH 5. So the pH adjustment is more predominant than the increasing coagulant dosage.

3 Conclusions

Enhanced coagulation is feasible and effective for the removal of humic acid. The pH and the dosage of coagulant are the main factors to the removal of humic acid. But the pH adjustment is a predominant factor. The optimal pH to aluminum sulfate is 5 around. The optimal pH to ferric chbride is 4 around.

When the dosage of aluminum sulfate is 4 mg/L, the removing rates of DOC, COD_{Mn} and UV_{254} are 69.7%, 84.8% and 96.9% respectively. When the dosage of ferric chloride is 5 mg/L, the removing rates of DOC, COD_{Mn} and UV_{254} are 78.1%, 89.3% and 97.8% respectively.

References:

[1] CHAI X L, ZHAO Y C. Study on removal of humic acid by coagulation-flocculation [J]. Environmental Pollution and Control, 2003, 25 (5): 268—270.

[2] WEI S Q, LIU Y, SHI J W, et al. An Experimental Investigation on Removal of Humic Acid from Water by Coagulation and Coagulation in Combination with Powdered Activated Carbon [J]. Contemporary Chemical Industry, 2003, 32 (4): 204—207.

[3] WAN J L. A Study on the Characteristics of Coagulation and Metal-Humic Co-precipitation Using Different Coagulants [Master al Dissertation] [J]. Xi' an University of Architecture and Technology, 2005.

[4] FRANCESCHI M, GIROU A, CARRO-DIAZ A M, et al. Optimisation of the coagulation-flocculation process of raw water by optimal design method [J]. Water Research, 2002, 36: 3561—3572.

[5] WANG L, GAO N Y, ZHU B, et al. Analysis on Ozone-Biological Activated Carbon Process from the View of Molecular Weight Distribution [J]. China Water & Wastewater, 2005, 21 (3): 12—16.

[6] LIU C, GAO N Y, CAI Y L. Study on Removal Effect of organics from Huangpu River Water by Enhanced Coagulation [J]. China Water & Wastewater, 2006, 22 (1): 84—87.

强化混凝去除腐殖酸的试验研究

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摘 要: 选用 $Al_2(SO_4)_3$、$FeCl_3$混凝剂对腐殖酸的强化混凝试验表明, 强化混凝对腐殖酸有很好的去除效果。 pH值和混凝剂投加量是影响腐殖酸处理效率的主要因素, 其中调整 pH值更有效。 $Al_2(SO_4)_3$混凝的最佳 pH值在 5左右, $FeCl_3$在 4左右。 $Al_2(SO_4)_3$投加量为 4mg/L时, DOC、COD_{Mn}及 UV_{254}去除率可分别达到 69.7%、84.8%和 96.9%。 $FeCl_3$投加量为 5mg/L时, DOC、COD_{Mn}及 UV_{254}去除率可分别达到 78.1%、89.3%和 97.8%。

关键词: 强化混凝; 腐殖酸; 硫酸铝; 三氯化铁

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