

Application of PFSC in seawater desalination pretreatment

Jun Cheng^{1, a}, Si Cheng^{2, b}, Xiaofan Cao^{3, c}

^{1, 3} Environmental management college of China, Qinhuangdao, China

² Qinhuangdao Institute of Technology, Qinhuangdao, China

^achengjun81612@163.com

^b174881614@qq.com

^ccaoxiaofan2006@163.com

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Abstract. The optimal condition of polysilicon ferric chloride (PFSC) flocculant was established by thinking of the factors, such as Si/Fe molar ratios, the reaction temperature and the pH value of the solution. When the molar ratio of Si and Fe = 1, pH value = 0.6, curing temperature at 30 ~40 °C, poly ferric chloride dosage of 0.75mg/L, the rate of turbidity removal of seawater is up to 96.5%. Experimental results show that poly ferric chloride seawater turbidity removal effect is obvious.

Introduction

Desalination of seawater desalination is the process of obtaining fresh water, is one of the effective measures to solve the global freshwater crisis, fresh seawater reverse osmosis membrane technology is relatively mature [1-3]. Reverse osmosis desalination, to extend the life of the reverse osmosis membrane can effectively reduce the operating costs of desalination facilities; usually flocculation pretreatment of seawater.

Flocculation can effectively remove total suspended solids (TSS) and chemical oxygen demand (COD) in the water, has been widely used in water treatment processes. Flocculation treatment using sea water, flocculant choice is the key. According to the composition and nature of the flocculant can be divided into inorganic, organic and biological flocculant three categories. Low molecular weight inorganic low molecular flocculant, causing it to invest a large amount in the course of the sludge volume, loose floc produced high moisture content, sludge dewatering difficulties. The study of Fe (III) flocculant is currently a heated issue in the field of water treatment[4-6]. The experiment was prepared poly ferric chloride (PFSC) flocculant, and compare the effect of treatment of seawater through further optimization of preparation conditions on PFSC.

Experimental

1.1 Experimental materials and pharmaceutical

Sodium silicate; hydrochloride; ferric chloride (AR); pH meter (PHS-3D-type), electric mixer (JJ-1 type)

1.2 Preparation of poly ferric chloride

1.2.1 Preparation of poly-silicic acid

Quantitative configuration silicate crystals weighed solution under stirring at room temperature was slowly added hydrochloric acid (37%) to maintain a pH of 3 or less. Curing at room temperature 4 ~ 6h, you can get a certain concentration of poly-silicic acid.

1.2.2 Preparation of Poly ferric chloride (PFSC)

Poly lactic acid solution was added dropwise FeCl₃ solution with continuous stirring; FeCl₃ solution after completion of the dropwise addition, the solution was stirred at a certain speed, a temperature, a polymerization time, the pH of the polymerization reaction under certain conditions; After completion of the reaction the solution polymerization, standing for some time to get PFSC products.

2 Seawater flocculation study of poly ferric chloride

2.1 Seawater flocculation experiments

Experimental Methods: Laboratory beakers flocculation method.

The actual water samples: seawater taken from Qinhuangdao Bohai offshore seawater turbidity is 25 NTU, the water temperature is 23 °C, pH value of 7.5, COD 9.11 (alkaline permanganate method).

2.2 Seawater flocculation Results and Discussion

2.2.1 Influence of the ratio of Si and Fe on the Seawater flocculation

The molar ratio of Si and Fe is an important factor affecting the flocculation of PFSC. For this reason, flocculation results using seawater ferrosilicon molar ratio of single factor, the results shown below.

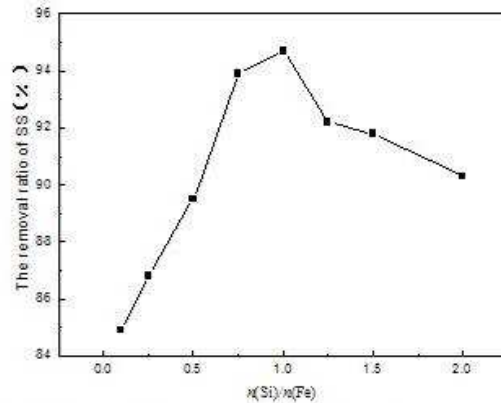


Fig. 1 Influence of the ratio of Si and Fe on the exenterate of turbidity

As can be seen from Fig. 1, the molar ratio of ferrosilicon large effect on turbidity removal, in which $n(\text{Si}):n(\text{Fe}) = 1:1$, the optimal flocculation. During the experiment found that with increasing molar ratio of ferrosilicon, PFSC significantly enhanced the effect of turbidity, floc increased sedimentation rate accelerated; But when the molar ratio of greater than 1 ferrosilicon, turbidity removal rates have declined; Meanwhile, in the product using the same flocculation treatment after two weeks the sample was found that when the molar ratio is greater than 2 ferrosilicon, decreased chemical stability, and prone to gelation.

2.2.2 Effects of aging temperature on the flocculation performance

After acid activation is mixed with a solution of ferric chloride, it is necessary under certain temperature conditions for further curing, the curing temperature PFSC not affect the stability, and has a degree of polymerization of silicic acid produces a certain reaction, thereby affecting the flocculation PFSC effect. To investigate the effect of curing temperature on the flocculation properties PFSC prepare PFSC at different curing temperatures, water turbidity was measured after removal of the flocculation.

Table 1 Aging temperature in relation to flocculation

Curing temperature	Floc size	Sedimentation rate	Turbidity removal %
20	Comparatively Larger	Slow	94.3
30	Larger	Fast	96.2
40	Larger	comparatively Slow	95.8
50	Comparatively Larger	Slow	94.7
60	Comparatively small	Slow	93.4
70	Small	Slow	92.2

As shown in Table 1, when the curing temperature is 30~40 °C, PFSC good flocculation effect, as the curing temperature increases the flocculation PFSC decreased. After several experiments, the reaction was found to control the temperature at around 30 °C, the product prepared PFSC better flocculation, when the reaction temperature is low, the reaction does not sufficiently slow; temperature, the

reaction is too fast, strong iron hydrolysis, water performance poor chemical stability is decreased. Considering these factors, choose the curing temperature is 30 °C, reaction sufficiently good flocculation performance prepared.

2.2.3 Dosage of flocculant impact on flocculation

In the water treatment process, not only attach importance to the presence of water to be treated in the nature of colloidal and suspended solids, the amount of flocculant flocculation process is an important factor and cost impact. Lack of flocculant dosage, flocculation is not complete; optimum amount exceeds flocculant will lead ξ potential becomes negative, flocculation decreased. Coagulant dosage and suspended solids content of the solution on. During the reaction the molar ratio of a ferrosilicon, aged at 30 °C prepare poly ferric chloride, changing the amount of flocculant in parallel experiments.

In order to investigate the influence of PFSC dosage of flocculant flocculation, only change the dosage of flocculant flocculation measured before and after the change in turbidity, the results shown in Fig 2.

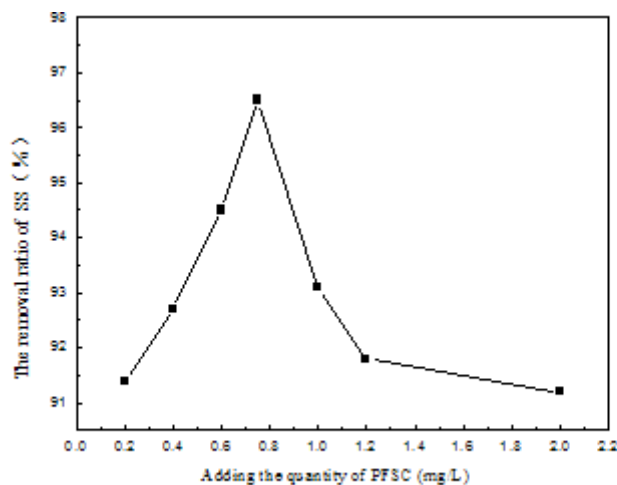


Fig.2 Influence of PFSC mass concentration on the exenterate of turbidity

Initial flocculation in water, increase the amount of flocculants as turbidity increases, when the amount of flocculant to a certain value, a peak turbidity; further increase the amount of flocculants, but lower turbidity. From the flocculation mechanism analysis, poly ferric chloride rely mainly on electricity neutralization and adsorption, the seawater colloidal particles and microbial disinfectant to kill bacteria flocculation down, when adsorption saturation, etc., will gradually increase the turbidity of the water large iron color will further turbidity interference. Experiments show that when the flocculant in a molar ratio of ferrosilicon, when the aging temperature is 30 °C, the dosage is 0.75mg / L, the turbidity of seawater up to 96.5%.

Results and Discussion

In this study, oxidation, polymerization, curing and other processes for preparing the PFSC inorganic polymer flocculant. When the molar ratio of 1,30 °C ferrosilicon aging 1.5h, pH value of 0.6 for the preparation of products turbidity of seawater have a good effect, the formation of floc fast, coarse particles dense, easy settlement, in favor of the subsequent water treatment process running smoothly.

Acknowledgements

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