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Study on Optimum Selection of Coagulant in Low Temperature and Low Turbidity Polluted Water Treatment Based on Conventional Treatment

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ABSTRACT. *The treatment of low temperature and low turbidity water has always been one of the most concerned problems in water supply industry. Under the condition of low temperature and turbidity, the content of macromolecule particles in water decreased significantly. The amount of impurities in the whole floc has also been greatly reduced, which makes it difficult for the micro flocs formed to achieve the purpose of precipitation through collision. The main effect of low turbidity on water treatment is that impurity particles in water dissolve in a fine state in water. The role of the coagulant is to assist the coagulant to adsorb the bridging of the flocs, so that the small scorpion flocculation is integrated into the dense and compact striate. The small volume of flocs formed by coagulation is light and easy to penetrate the filter layer during filtration to increase the turbidity of the effluent. How to strengthen the treatment effect of low temperature and low turbidity water under the premise of reducing the treatment cost has become the main target in the domestic water resources field.*

KEYWORDS: *Low temperature, Low turbidity, Coagulant, Water.*

1. Introduction

The treatment of low temperature and low turbidity water has always been one of the most concerned problems in water supply industry. When the number of impurities in water reaches a certain level, the cohesion can be improved by using its own viscous effect, and then larger particles can be filtered out [1]. Low temperature and low turbidity water has relatively less impurities because of its low turbidity. Based on these water quality characteristics of low temperature and low turbidity water, more effective methods than conventional processes are needed. The current conventional water treatment process is difficult to meet the water quality standards. At present, domestic low temperature and low turbidity water treatment technologies

mainly include air flotation, sludge reflux, micro-flocculation and so on. Under the condition of low temperature and turbidity, the content of macromolecule particles in water decreased significantly. The amount of total impurities has also dropped significantly, which makes it difficult for the formed microflocs to collide by colliding to achieve the purpose of sedimentation [2]. Choosing a high-quality and efficient coagulant suitable for treating water is one of the important ways to improve the efficiency of coagulation. The treatment with conventional coagulant aluminum sulfate or polyaluminum is not ideal, and it is difficult to reduce the turbidity [3]. Strengthening the conventional process is one of the ways to eliminate pollution, and it is found that strengthening the coagulation and sedimentation is the key to improving the efficiency of water treatment system.

Choosing a high-quality and efficient coagulant suitable for treating water quality and adding a suitable coagulant is a more cost-effective way to improve the coagulation effect [4]. In the research process of low temperature and low turbidity water, people found its characteristics and many factors. Impurities that have been stably suspended have caused great difficulty in the process. Coupled with the large number of various organic pollutants in winter water, the number of viruses increased [5]. These small particulate matter easily pass through the filter membrane along with the water and continue to exist in the water and are difficult to remove. Choose coagulant considering both turbidity removal and pollution removal effect, and determine the best coagulation conditions. The main effect of low turbidity on water treatment is that impurity particles in water dissolve in a fine state in water. The flocs formed by coagulation are small in volume and light in density, which can easily penetrate the filter layer in the process of filtration, thus increasing the turbidity of the effluent [6]. It will be of great significance to strengthen the conventional process of water treatment and to solve the problem of pollution removal of drinking water. These characteristics of low temperature and low turbidity water become the key problems in the treatment process. How to strengthen the treatment effect of low temperature and low turbidity water on the premise of reducing the treatment cost has become the main goal in the field of water resources in China.

2. Treatment Technology of Low Temperature and Low Turbidity Water

The impurities in low temperature and turbidity water are dissolved in water by fine colloidal dispersion system. The coagulation stability and dynamic stability of colloidal particles are very strong, and neither filtering nor natural precipitation can meet the treatment requirements. Coagulation refers to the aggregation of colloids and fine suspended solids in raw water, which is mainly embodied in the properties of colloids, hydrolysates of coagulants and their interactions. Coagulation is usually divided into two processes, that is, the content and composition of pollutants in different raw water vary greatly, which will affect the type and dosage of coagulants. The process of colloidal destabilization and destabilization of colloids is usually considered to be coagulation and flocculation. The coagulant is first dissociated into an ionic state in water and then hydrolyzed with water molecules. The hydrolysis

process is greatly affected by the water temperature, and the raw water temperature is low. The dynamic viscosity coefficient of water increases, which reduces the particle motion of the colloid in the water and reduces the chance of collision between them. Hydraulic conditions affect the diffusion of the coagulant in the water, which in turn prevents the hydrolysate from interacting with the colloidal particles and removing it from the water.

The amount of negatively charged colloidal particles in low temperature and low turbid water is relatively small, and the amount of coagulant added to reach the neutralization point is low, and the formed flocs are fluffy. Coagulation plays an important role in the process. Its processing results directly affect the choice of subsequent processes and the cost of the whole process, and also have a certain impact on the quality of the effluent. Higher flocculation speed is a necessary condition for the rapid formation of larger flocs. The rate of condensation depends on the number of particle collisions per unit time and the effective collision rate, and the number of particle collisions is related to its rate of motion. When the water temperature decreases, the thermal motion between water molecules decreases and the Brownian motion slows down naturally. Orthogonal test method is mainly used to determine the optimum hydraulic conditions, which affect the determination of the optimum conditions of coagulation experiment results. For low temperature and turbidity water, there are few suspended particles in the water, and the collision probability between particles is very small. Moreover, because of the influence of low temperature, the viscosity of water is relatively high, which is not conducive to the collision, coagulation and floc growth of micro-particles in water.

When the settling velocity is less than the interception velocity, the particles flow out of the pond with water. When the settling velocity of particles is greater than the interception velocity, it will settle in the sedimentation tank. Different doses of coagulants were added to raw water to observe their respective coagulation turbidity removal effects. Figures 1 and 2 show the removal rates of raw water under different turbidity conditions.

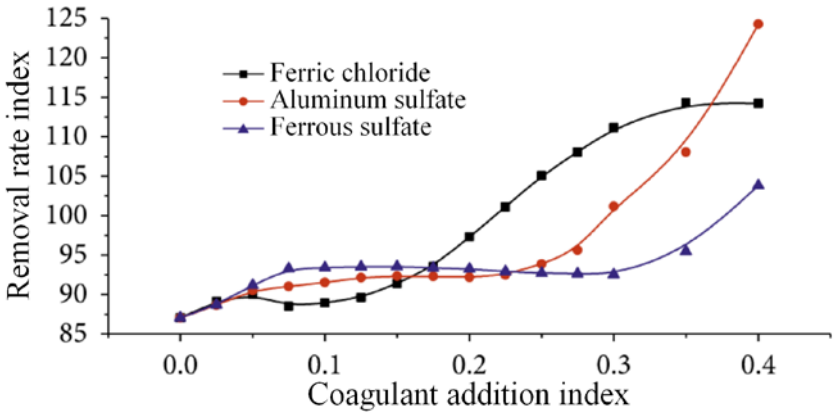

Figure 1. Removal rate of raw water turbidity of 18.5NTU

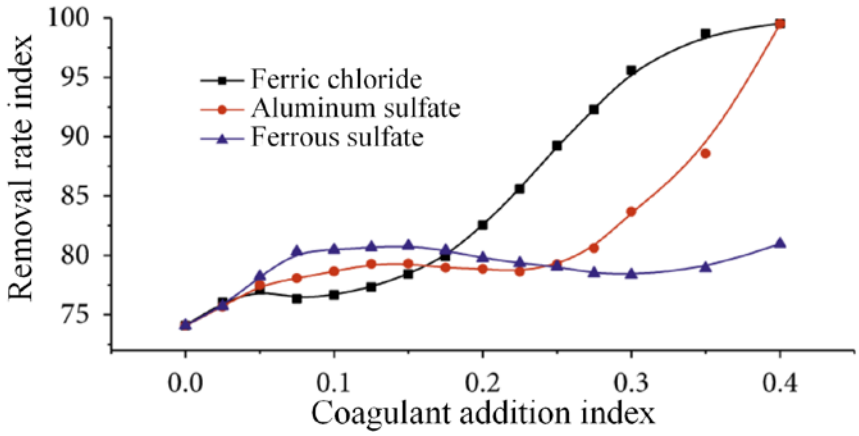

Figure 2. Removal rate of raw water turbidity of 17.3 NTU

The clean water of the filter is due to the small gap of the filter material, which can intercept the impurities with large particle size, and the physicochemical adsorption also plays a considerable role. In the whole process of the coagulation stage, the optimum stirring intensity and mixing time are different in each stage, and the value of the value will have a significant influence on the coagulation result [7]. Increasing the water temperature of the entire system is too costly to improve the overall process. Not only does it cost a lot of energy, but it also has to stop production. Only by selecting a reasonable coagulant can colloid be destabilized better. With the difference of pH value and dosage time, dosage will change accordingly. Experiments prove that different quantities and different types of coagulants have different effects in the process of solution coagulation aid. The removal of turbidity by coagulant aid shows a trend of decreasing first and then increasing. The main reason is that too much coagulant aid is added, resulting in colloid protection which is not conducive to the formation of floc sedimentation and thus increases the residual turbidity. Coagulation is always a dominant mechanism when it occurs.

3. Selection of Coagulant for Low Temperature and Low Turbidity Water Treatment

High activity electrolyte is put into the solution to generate high concentration of positive and negative ions. The counter ions can neutralize the charge on the particle surface and reduce the thickness of the diffusion layer. From the point of view of

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water treatment, bone glue not only has the common good characteristics of organic polymer flocculant, but also has its own unique excellent performance. Aggregation precipitation can occur between particles through Brownian motion, provided that the repulsive energy peak between particles is reduced. If the colloid impurity content in water is high, only a little coagulant is needed. On the contrary, if there are less impurities in the water, more coagulant is needed, which is actually a mechanical precipitation method. After determining the influencing factors and their levels, the appropriate orthogonal table is selected according to the factors and the level. When the water temperature is lowered, the hydration of the colloidal particles is more powerful, resulting in a decrease in the cohesive properties of the colloid. It affects the adhesion between the particles and is not conducive to the generation of flocs. Too much activated silicic acid will cause the polymerization rate to be too fast and cause the polysilicic acid to form a jelly prematurely and fail. Insufficient dosage of activated silicic acid and too low free silicic acid concentration will directly affect the coagulation effect.

After incubation for half an hour at 25 ° C, the coagulant activity was 0.196. When the culture was carried out at 30 ° C for half an hour, the coagulant activity was 0.213, which was a large increase. Continue to raise the culture temperature, the increase in coagulant activity is not large, when the temperature rises to 35 ° C, the coagulant activity only rose from 0.213 to 0.265 at 30 °C. When the temperature is further increased, the coagulant activity is greatly increased. When the temperature is raised to 45 ° C, the coagulant activity is increased to 0.428. At this time, if the temperature rises again, the coagulant activity begins to decrease. The experimental data is shown in Table 1.

Table 1 Relationship between temperature and coagulant activity

Temperature (°C)	Active(μgTF/mg)
25	0.196
30	0.213
35	0.265
40	0.317
45	0.428
50	0.374

It can be seen from the equation of coagulation dynamics that when the concentration of colloidal particles in water is lowered, the probability of collision of particles is greatly reduced, making it difficult for the coagulation solution to form flocculent substances. Due to the pollution of water sources, the wide variety of wastewaters and the increasing requirements for treatment, traditional coagulants have not met the requirements. The comprehensive balance method refers to the primary and secondary order and the optimal horizontal combination of the various influencing factors obtained in the visual analysis. In combination with these practical problems to be solved, comprehensive analysis is based on relevant professions and experience. Polysilicic acid is a tetrahedral high molecular polymer

and can be developed into a spherical shape, a linear shape, or a branched chain shape. The characteristics and morphology of the products depend on the reaction time, the initial concentration of polysilicic acid and the acid-base environment of the reaction. Polysilicic acid products are intermediate products of precipitation kinetics, and gel will be formed after a longer period of reaction. The fractal dimension of flocs decreases as the cohesion point between flocs decreases. The decrease of recovery ability leads to the increase of total residual particles and turbidity after static precipitation.

4. Conclusion

The low temperature and low turbidity water quality will have sedimentation limit in the process of coagulation and sedimentation. After reaching the sedimentation limit, the coagulant will continue to be added, which will not improve the sedimentation efficiency. When activated silicic acid is used as coagulant aid of aluminium sulfate, the coagulation synergistic effect of the two is significantly affected by the dosage and mode of the activated silicic acid. The turbidity of effluent is highly positively correlated with residual aluminium. With the increase of dosage, turbidity and Residual Aluminium will gradually decrease. But when the optimum dosage is reached, the precipitation effect begins to weaken. The function of coagulant aids is that coagulant aids can adsorb flocs and build bridges, so that small alum flocs can be coagulated into dense and compact alum flocs. The coagulation process treats low temperature and low turbidity water, and it is not feasible to increase the coagulant and coagulant alone. The increased pharmacy results in an increase in production water consumption, production wastewater volume, and sludge production. Production costs have also risen as a result, so increasing the amount of dosing cannot be used as a way to improve the water quality of surface water plants in the long-term. Through the size and compactness of the floc body, the change of the water flow into the plant. Adjust the dosage and the proportion of the drug to provide reasonable data for the central control system.

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