

Experiment and Study On Effect Of Sludge External Reflux Ratio On The Dosage Of Micro Vortex clarifier

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Key words: micro vortex clarifier, external sludge reflux, reflux ratio, dosage

Abstract: In order to solve some problems about selecting blindly and randomly design and operational parameters of micro vortex clarifier. By studying the raw water from Kongmu-Lake, this experiment chooses PAC as the best coagulant, and its best dosage is 25 mg/L. Meanwhile the influence of micro vortex clarifier dosage in different sludge external reflux ratios is researched. Experiments are conducted in three kinds of reflux ratios respectively 10%, 30% and 50%. Inlet flow is 10m³/h, the flocculation time is 6.8mins, adding the quantity of PAC gradually increased from 20 mg/L to 45 mg/L, when external reflux ratio is 30%, micro vortex clarifier has the best treatment effect. The lowest turbidity, total phosphorus, COD_{Mn} and ammonia nitrogen of the water are respectively 0.376NTU, 0.102mg/L, 2.44mg/L, 7.76mg/L. At this time, the best dosage is 30 mg/L, and the best reflux ratio is 30%. The test provides scientific data to support the application of micro vortex clarification technology.

1 Introduction

For traditional clarifier have encountered in the operation of the bottleneck problem such as high cost and inefficiency, basing on the micro-whirling reactor, East China Jiaotong University research team respectively develop the micro vortex clarifier[1], which has been widely used in recent years, and achieved good social benefits and economic benefits[2]. However due to the studies about micro vortex flocculation mechanism and key technology[3] are not comprehensive and thoroughly, and in the practical engineering application, for the selection of design and operational parameters is relatively blind and random, which hinders the further expansion of the technology in water treatment engineering. Especially for micro vortex clarification process in terms of return sludge's influence on the treatment effect[4], remains to be further studied, so as to provide guidance for the production practice and fully excavate the potential of micro vortex clarification process. By researching the influence of dosage of micro vortex clarifier in different sludge external reflux ratio, it provides scientific data support for popularization and application of micro vortex clarifier treatment process.

2 Materials and methods

2.1 Testing apparatus

In this test, the micro vortex clarifier is on the basis of the traditional hydraulic circulating clarifier, belongs to the sludge circular clarifying pool. The tank of micro vortex clarifier is made of PE plastic, including flocculation reaction unit and inclined tube sedimentation separation unit. As shown in figure 1.

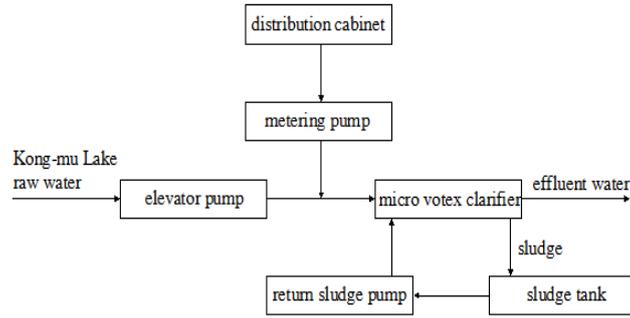
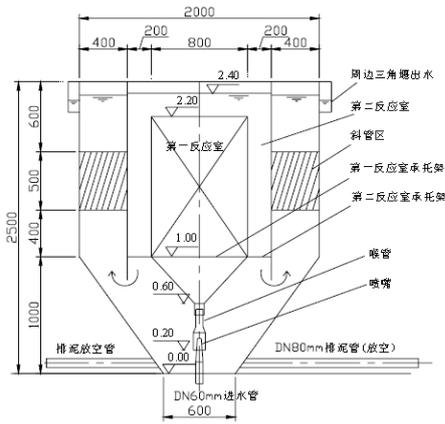


Fig.1 Schematic Diagram of the Whirlring Clarifier Fig.2 Flow diagram of process

2.2 Technological process

The process is shown in figure 2.

3 Results and Discussion

Test is conducted on the condition of the inlet flow is $10 \text{ m}^3 / \text{h}$ and the flocculating time is 6.8 min, at three kinds of reflux ratio, respectively 10%, 30%, 50%, and the dosing amount of coagulant is 20 mg/L, 25 mg/L, 30 mg/L, 35 mg/L, 40 mg/L and 45 mg/L respectively. By measuring the inflow water and effluent water's water turbidity, TP, COD_{Mn} and $\text{NH}_3 - \text{N}$ of micro vortex clarification pool, comparing the treatment effect and reach a conclusion that the influence of dosage of micro vortex clarifier in different sludge external reflux ratio.

1) Under different sludge external reflux ratio, the influence of the dosing amount of coagulant on turbidity, as shown in figure 3.

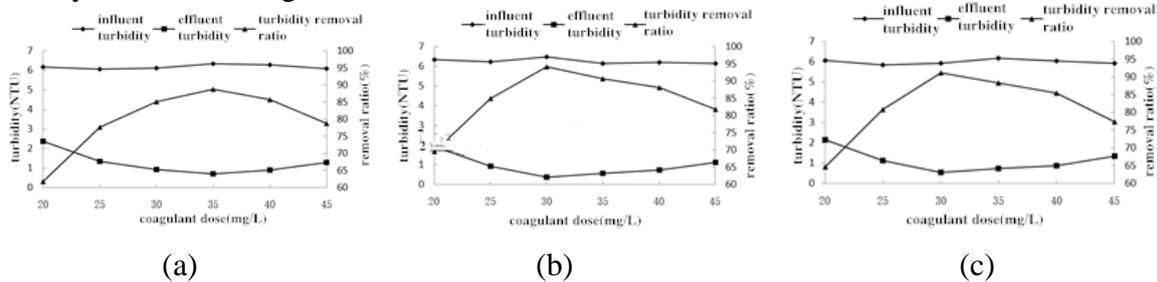


Fig.3 Turbidity removal in different dosage By Sludge Recycle Ratio of 10%, 30%, 50%

The figure 3 shows that with the increase of coagulant dosage, under different reflux ratio, effluent turbidity are increased at first and then decreased. Different sludge reflux ratio have an effect on the treatment effect of turbidity. When the reflux ratio is 10%, 30%, 50% respectively, the effluent turbidity of micro vortex clarifier are 0.711 NTU, 0.376 NTU, 0.525 NTU, the biggest removal ratio can reach 88.76%, 94.19% and 88.76% respectively, the corresponding coagulant dosage are 35 mg/L, 30 mg/L, 30 mg/L separately. In conclusion, from the perspective of the removal efficiency of turbidity, when the sludge external reflux ratio is 10%, the removal effect is the worst, and 30% is the best.

2) Under different sludge external reflux ratio, the influence of the dosing amount of coagulant on TP, as shown in figure 4.

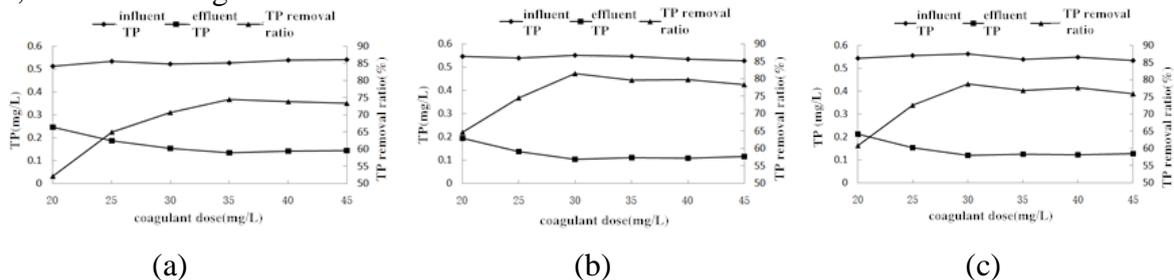
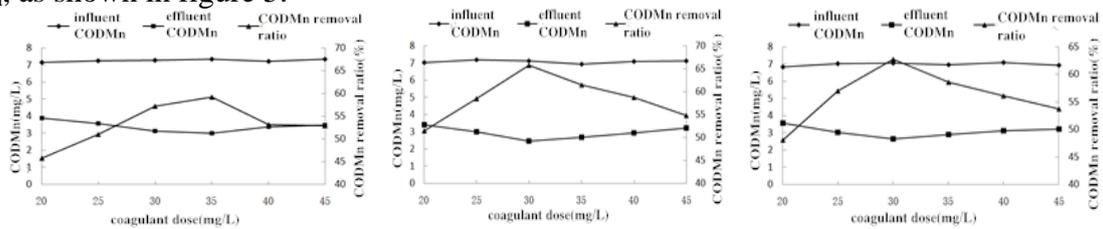


Fig.4 TP removal in different dosage By Sludge Recycle Ratio of 10%, 30%, 50%

The figure 4 shows that within the experimental range of coagulant dosage, the effluent TP of micro vortex clarifier is relatively stable. Different sludge reflux ratio have an effect on the treatment effect of TP. When the reflux ratio is 10%, 30%, 50% respectively, the effluent TP of micro vortex clarifier are 0.134mg/L, 0.102mg/L, 0.119mg/L, the biggest removal ratio can reach 74.57%, 81.52% and 78.83% respectively, the corresponding coagulant dosage are 35mg/L, 30mg/L, 30mg/L separately.

When the sludge external reflux ratio is 30%, the removal effect of TP is the best.

3) Under different sludge external reflux ratio, the influence of the dosing amount of coagulant on COD_{Mn} , as shown in figure 5.



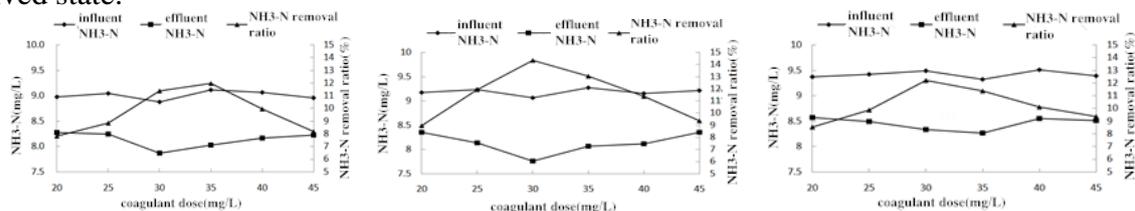
(a) (b) (c)

Fig.5 COD_{Mn} removal in different dosage By Sludge Recycle Ratio of 10%, 30%, 50%

The figure 5 shows that with the increase of coagulant dosage, under different reflux ratio, effluent COD_{Mn} are decreased at first and then increased. Different sludge reflux ratio have an effect on the treatment effect of COD_{Mn} . When the reflux ratio is 10%, 30%, 50% respectively, the effluent COD_{Mn} of micro vortex clarifier are 2.99mg/L, 2.44mg/L, 2.63mg/L, the biggest removal ratio can reach 59.21%, 65.73% and 62.75% respectively, the corresponding coagulant dosage are 35 mg/L, 30 mg/L, 30 mg/L separately.

4) Under different sludge external reflux ratio, the influence of the dosing amount of coagulant on NH_3-N , as shown in figure 6.

The figure 6 shows that with the increase of coagulant dosage, under different reflux ratio, effluent NH_3-N are decreased at first and then increased. Different sludge reflux ratio have an effect on the treatment effect of NH_3-N . When the reflux ratio is 10%, 30%, 50% respectively, the effluent NH_3-N of micro vortex clarifier are 8.02mg/L, 7.76mg/L, 8.33mg/L, the biggest removal ratio can reach 11.96%, 14.35% and 12.22% respectively, the corresponding coagulant dosage are 35 mg/L, 30 mg/L, 30 mg/L separately. As you can see, under three different sludge external reflux ratio, the removal effects of NH_3-N is not very ideal, this is because the micro vortex clarification process is poor in removing dissolved pollutant, and NH_3-N in raw water is mostly exist in the form of dissolved state.



(a)

(b)

(c)

Fig.6 NH_3-N removal in different dosage By Sludge Recycle Ratio of 10%, 30%, 50%

To sum up, different external reflux ratio have an good effects on treating the raw water of Kong-mu Lake. Among them, when the external reflux ratio is 30%, and coagulant dosage is 30 mg/L, the removal effect of turbidity, TP, COD_{Mn} , NH_3-N is the best; When the external reflux ratio is 50%, and coagulant dosage is 35 mg/L, the removal effect is better; When the external reflux ratio is 10%, and coagulant dosage is 35 mg/L, the removal effect is the worst.

4 Conclusion

When inlet flow of micro vortex clarifier is $10m^3/h$, the flocculating time is 6.8min, dosing amount of coagulant PAC gradually increased from 20 mg/L to 45 mg/L and external sludge reflux ratio is

30%, the treatment effect is the best. On the condition of the optimum dosage is 30 mg/L, the lowest effluent water turbidity, TP, COD_{Mn}, NH₃ - N are 0.376 NTU, 0.102 mg/L, 2.44 mg/L, 7.76 mg/L respectively.

Acknowledgments

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