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Research Article

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The influence factor of chemical phosphorus removal research

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ABSTRACT

Hydrolysis acidification/pre-denitrification biological aerated filter was adopted in a domestic wastewater treatment plant. The effluent was accorded with a standard in the Integrated Wastewater Discharge Standard(GB18918-2002), in which the effluent phosphorus was demanded below 0.5mg/L. Although the biological treatment can greatly reduce the total phosphorus content, it still can not meet the effluent quality and also need further treatment by chemical method. This paper mainly investigates the effects of adding chemicals for phosphorus removal and effects of chemicals on the head loss, digestive reaction and the color of effluent so as to guide the practical engineering application.

Keywords: Chemical phosphorus removal, Domestic wastewater, Coagulant

INTRODUCTION

Phosphorus is one of the factors of eutrophication, and sewage treatment must be phosphorus removal [1] in China. The Integrated Wastewater Discharge Standard (GB18918-2002) A standard clearly specified that total phosphorus emissions standards was below 0.5 mg/L.

Biological aerated filter was adopted in a city sewage treatment plant, which had 8 million m^3/d urban sewage water scales. Total phosphorus design for influent wastewater was 3.5 mg/L and the effluent was 0.5 mg/L [2]. Row water flowed through the coarse, medium and fine grid to amputate floating debris which were from downtown sewage, and then flowed to air swirl grit chamber to remove inorganic sand [3]. After flow the hydrolysis tank to strengthen pretreatment, the effluent flowed to the DN denitrifying bio-filter to complete denitrifying nitrogen effect, and then to the CN aeration bio-filter to complete nitration, finally went into UV disinfection tank and discharged into the sea [4]. Specific processes were shown in Figure.1.

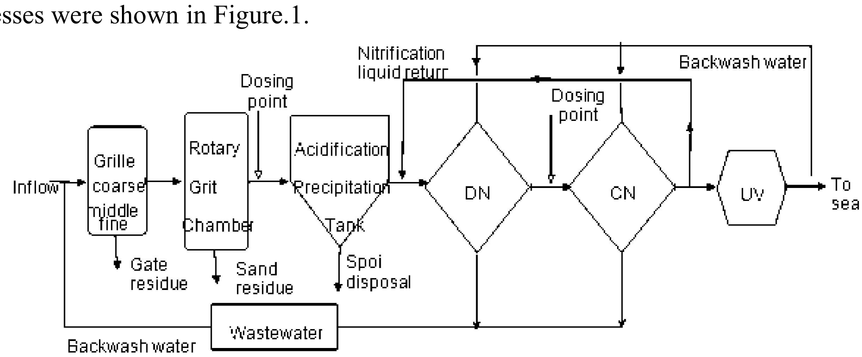


Figure.1 Flow chart of treatment process in domestic wastewater treatment plant

2. The effects of coagulant dosage point to choice on total phosphorus removal rate
The basic principle of chemical phosphorus [5] is through the inorganic reagents formed insoluble metal salt sediment, and then through phosphate deposits from sewage row mud will be removed [6, 7].

2.1 Dosing test before Hydrolysis sedimentation.
Coagulation using a static beaker tests, the PAFC Pharmacy (alumina content of 29.47%, iron oxide content of 2.78%) at different concentrations of 0*mg*/L, 20*mg*/L, 40*mg*/L, 60*mg*/L, 80*mg*/L, 100*mg*/L, 120*mg*/L and 140*mg*/L were added before the Hydrolysis acidification precipitation tank. Ferric chloride pharmacy (40% solution) to test for different concentrations, $FeCl_3$ concentrations were 0*mg*/L, 20*mg*/L, 40*mg*/L, 60*mg*/L, 80*mg*/L, 100*mg*/L, 120*mg*/L and 140*mg*/L. As shown in Figure.2 and Figure.3 is respectively the results of adding PAFC and $FeCl_3$ (40% solution) before Hydrolysis acidification tank.

Summarizing the daily measurement of TP removal of each processing unit, the conclusion is that the role of biological phosphorus by hydrolysis tank can remove 1.0*mg*/L phosphorus around. Therefore, if in the hydrolysis of phosphorus sedimentation tank dosing, this unit can not exceed the maximum effluent total phosphorus 1.5*mg*/L. Then adding the concentration of PAFC should be no less than 130*mg*/L; adding the concentration of 40% $FeCl_3$ solution should be no less than 110*mg*/L. It can be drawn from the economic analysis, when adding 1,500 *yuan*/ton PAFC cost 0.195 *yuan*/ton in hydrolysis sedimentation tank. And adding 1,800 *yuan*/ton 40% $FeCl_3$ cost 0.198 yuan. We can see the different between $FeCl_3$ and PAFC is only 0.003 *yuan*/ton, so the difference between the two is little.

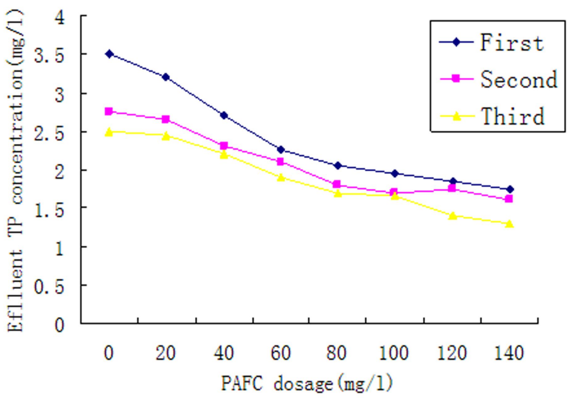


Figure.2 TP removal effect in hydrolysis tank with PAFC

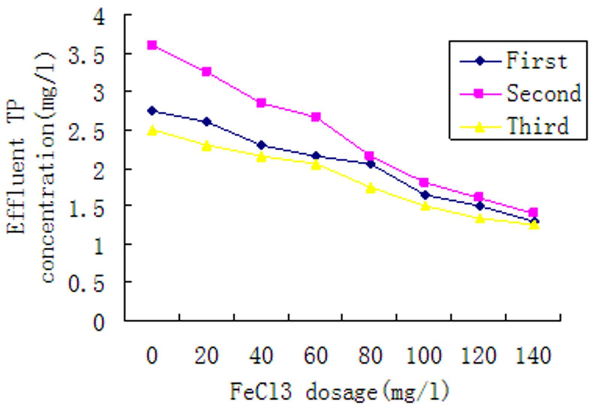


Figure.3 TP removal effect in hydrolysis tank with $FeCl_3$

2.2 Dosing test before CN.
To phosphorus removal by coagulation static beaker tests, the PAFC pharmacy (alumina content of 29.47%, iron oxide content of 2.78%) at different concentrations of 0mg / L, 5*mg*/L, 10*mg*/L, 20*mg*/L, 30*mg*/L, 40*mg*/L, 50*mg*/L and 60*mg*/L were added in DN of the sewage drains which is the front of CN. Adding 40% $FeCl_3$ at different concentrations, $FeCl_3$ concentrations were 0*mg*/L, 5*mg*/L, 10*mg*/L, 15*mg*/L, 20*mg*/L, 25*mg*/L, 30*mg*/L and 35*mg*/L. Fully stirring the mixture through precipitation after 2 hours, we can use the membrane with 0.45μm filter, and then take the filtrate to measure TP concentration to prevent flocculation sludge with unfiltered samples, in which affect

the accuracy of measurement.
Figure.4 and Figure.5 respectively shows that the test results of adding PAFC before CN pool and 40% $FeCl_3$.CN pool is the last process in the biological treatment, the effluent total phosphorus need to below 0.5*mg*/L. To achieve the standard, the concentration of adding PAFC is simply 40*mg*/L; the concentration of adding 40% $FeCl_3$ is only 30 *mg*/L. By economic analysis, we can cast pharmaceutical before CN pool, adding the dosage of 1,500 *yuan*/ton PAFC cost 0.06 *yuan*/ton; adding 1,800 *yuan*/ton 40% $FeCl_3$ cost 0.054 yuan. Compared with PAFC, adding $FeCl_3$ saves more than 0.006 yuan/ton.

By the economic analysis, we can see that adding drugs in CN pool costs lower than in hydrolysis pool. So the decision in engineering, we use $FeCl_3$ for chemical additive reagents adding before CN pool.

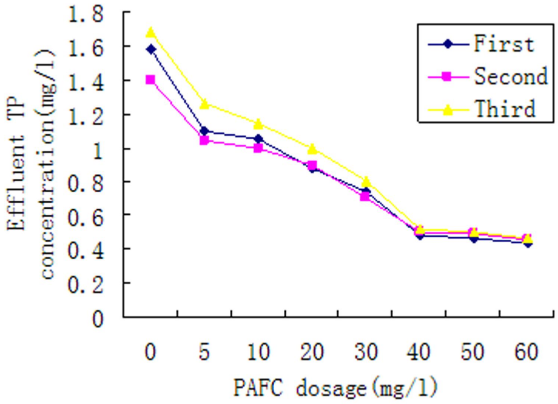


Figure.4 TP removal effect in CN tank with PAFC

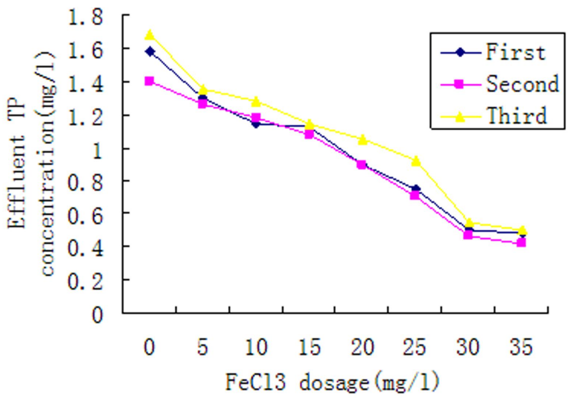


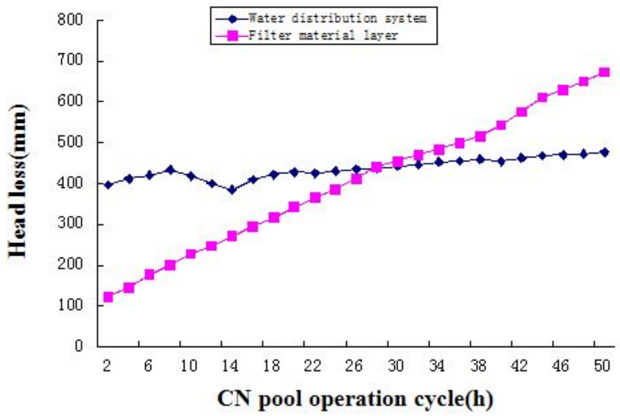
Figure.5 TP removal effect in CN tank with $FeCl_3$

3. Effect of adding chemicals on the treatment process [8, 9, 10]

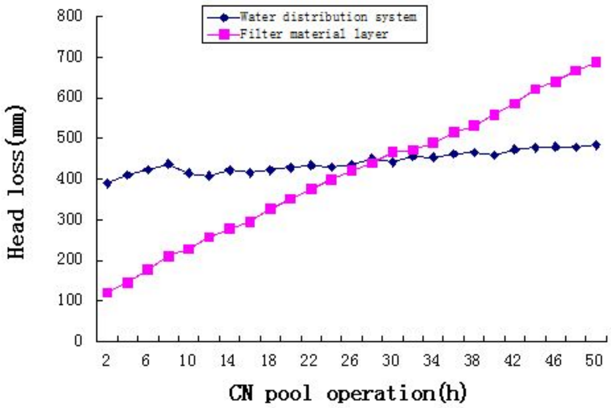
3.1 Doing effects in CN pool on the head loss

After dosing $FeCl_3$ in CN pool it will produce a certain amount of phosphorus sludge, and the existence of phosphorus sludge will increase SS sewage amount of CN pool, which also can produce certain influence on the head loss of CN pool in one cycle changes. In dosing 30 mg/L $FeCl_3$, other indicators and the water filter operation parameters under the condition of no too big change, it is analyzed the head loss of CN pool in one running cycle by test analysis, the changes of concrete is shown in Figure.6.

As we can see from the Fig.6, adding the $FeCl_3$ in CN pool the head loss of the whole operation cycle is higher than without adding $FeCl_3$, but the gap is not big. The different of water distribution system is very small, basic can be ignored. By comparison the gap is larger in filter material layer, around 10 mm.



A. Without dosing $FeCl_3$



B. Dosing $FeCl_3$

Figure.6 The head loss curve in one period in CN pool

3.2 Dosing ferric salt effects on nitrification

In Figure.7 we can see that ammonia nitrogen removal rate was measured several times in two days, after dosing $FeCl_3$ in CN pool. Compared with the system without dosing $FeCl_3$, ammonia nitrogen removal rate was a little change. Therefore, the influence of $FeCl_3$ can be neglected in the presence of other factors.

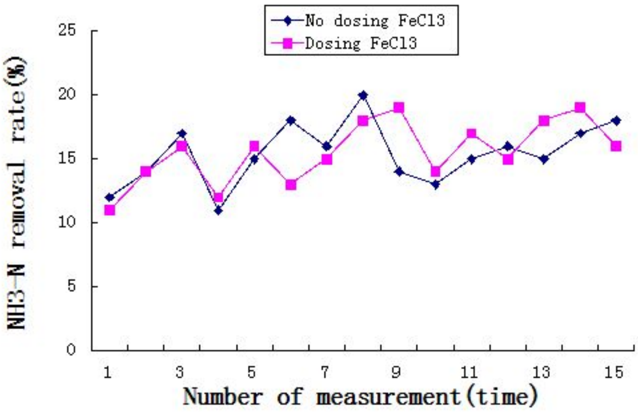


Fig.7 Dosing $FeCl_3$ effects on NH_3-N removal rate

3.3 Dosing ferric salt effects on effluent color

Due to adding $FeCl_3$ will have certain influence on water color, in order to prevent occur because of adding the $FeCl_3$ water chromaticity substandard phenomenon, the experiment measured the water chromaticity values after adding the $FeCl_3$. As we can see from the Tab.1, several water samples were measured for water chromaticity values of CN pool in a day.

Tab.2 Chromaticity with $FeCl_3$ dosage in the actual project

Number of measurement	Chroma
1	25
2	25
3	30
4	25
5	20
6	25
7	30
8	20
9	25
10	25

The urban sewage treatment plant pollutant discharge standard (GB18918-2002) level of A discharge standard stipulates that treated sewage chromaticity shall not exceed 30 degrees. Table in the determination of mean value does not exceed 30 degrees, so adding $FeCl_3$ of 30 mg/L is feasible.

CONCLUSION

(1) By the economic analysis, we can see that adding drugs in CN pool costs lower than in hydrolysis pool. So the decision in engineering, we use $FeCl_3$ for chemical additive reagents adding before CN pool.

(2) It was little influence on other water indicators, such as head loss, nitrification and effluent color after dosing $FeCl_3$ before CN pool. Thus, engineering practice of the study show that $FeCl_3$ has very good auxiliary to removal phosphorus.

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