20. RESEARCH ON THE EFFECTS OF COAGULATION WITH WASTE WATER

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In the study three different kinds of inorganic coagulants with different mounts of chemicals are used to conduct two groups of conventional coagulation experiment and enhanced coagulation experiment though six-jar stirring device, and set the aim pH, turbidity, TOC and the partical size of the floc. From the consequences it is known that as for the pH, PAC didn't do a great change to the waste water, while the obvious decline were caused by aluminum sulfate and ferric chloride. The three kinds of coagulants all make great change to the turbidity, with the best removal rate of PAC, then ferric chloride and the worst is aluminum sulfate during conventional coagulation experiment and the best removal rate of PAC, then aluminum sulfate and the worst is ferric chloride instead. All the coagulants showed similar effect on the removal of TOC with a trend of decline within conventional coagulation experiment and during enhanced coagulation experiment, PAC showed an increase about the removal rate of TOC, and ferric chloride declining with aluminum sulfate keeping the level. The general trend of particle size is that the size became bigger and the distribution expressed a worse concentration with the mounts of chemicals increasing.

Key Words : *coagulation,TOC, turbidity, PAC, aluminum sulfate, ferric chloride*

1. INTRODUCTION

Coagulation is a widely used technology which makes great sense in water treatment. Especially in water supply treatment, coagulation is one of most important technologies, and for the treatment after coagulation, it also plays a significant role. The core of coagulation is coagulants.

In about 1960, inorganic polymeric coagulant had high developed as a new kind of coagulant, and in recent years, inorganic polymeric have been widely used across the world for its wide range for use, non-toxic, cost-effictive, easy production and accessibility for treatment

In 20th century, the AWWA(American Water Works Association) gave a definition of enhanced coagulation, which means under the condition of turbidity removal standard, during the coagulation process of supply water treatment, excessive coagulants are used for better organic chemicals removal result.

2. EXPERIMENTS AND METHODS

The sample water for experiment use is from the intake of the supply water treatment factory, and the original water quality is showing as the **Table 1**,

Table 1 the quality of the sample

target	pH	Turbidity(NTU)	TOC(mg/L)
average	6.95	65.5	37.83

(1) Experiment chemicals and apparatus

We set three kinds of coagulants, PAC(the real content is measured by Al_2O_3, no less than 28%, the basicity 70%---75%, insolubes less than 0.5%), aluminum sulfate(analytically pure, molecular fomular $AL_2(SO_4)_3$•18H2O, molecular weight 666.42, content more than 99%) and ferric chloride(chemically pure, molecular weight 182.20, $FeCl_2$ content less than 1.0%, $FeCl_3$ content more than 97%), to make solutions with concentration of 50g/L to be used as high concentration coagulants.

(2) Experiment method

We conduct two groups of experiments the

conventional and the enhanced. In the conventional group we set six levels of amounts 5, 10, 20, 40, 80, 160 mg/L and in the enhanced group we set three levels 320, 640, 960mg/L. Through six-jar stirring device, first we set the speed of 300r/min with a period of 30s, and then 50r/min with the period of 15min. Finally work done 15min later, we take the water of upper phrase to check the turbidity, pH, TOC and with the flocculation we check the particle size.

3. RESULT AND DISCUSSION

(1) Conventional coagulation group

a) Turbidity

Turbidity is one of the key test of water quality which means the cloudiness or haziness of a fluid caused by individual particles (total suspended or dissolved solids) that are generally invisible to the naked eye, similar to smoke in air.

With the three kinds of coagulants we do experiment with 18 samples, taking the upper level water to test the turbidity, with the result showing in **Fig. 1.**

With the Fig. 1 we know that in conventional coagulation process PAC shows the best removal result, aluminum sulfate is the worst one and the medium being got by ferric chloride.

b)TOC

Total organic carbon (TOC) is the amount of carbon bound in an organic compound and is often used as a non-specific indicator of water quality or cleanliness of pharmaceutical manufacturing equipment.

With the same process of turbidty, Fig. 2 shows the result of the remaining TOC after conventional coagulation treatment.

Fig. 2 expresses the result of almost the same removal effect of TOC for all the coagulants, nearly half of the original quantity.

c)pH

The pH of upper level water is showed in **Fig. 3** which tells us whatever kind of coagulants will not do great contribution to the change of the pH apart from ferric chloride for the stronger hydrolysis action compared with the other two.

d)Floc

Floc size concentration for each coagulant is showing as below from **Fig. 4.1** to **4.3**, the green line stands for the percentage and the histogram stands for the channel.

The three Figurs show that the floc size concentration differs from the species. PAC makes the floc size bigger but the concentration dispersiver. Aluminum sulfate and ferric chloride both make the size smaller and concentration more centralized.

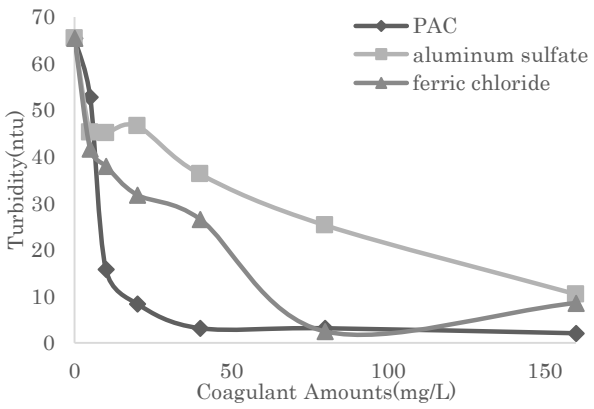

Fig. 1 turbidity result in conventional coagulation group

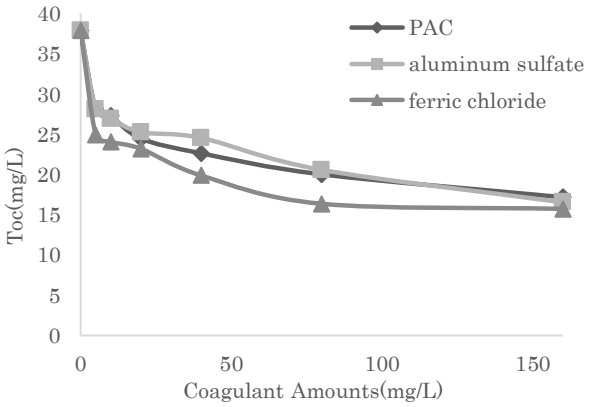

Fig. 2 TOC result in conventional coagulation group

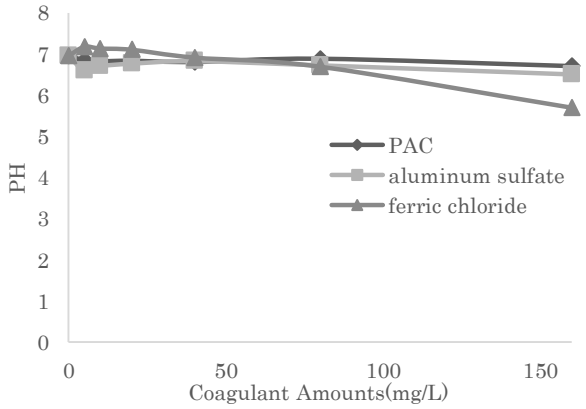

Fig. 3 pH result in conventional coagulation group

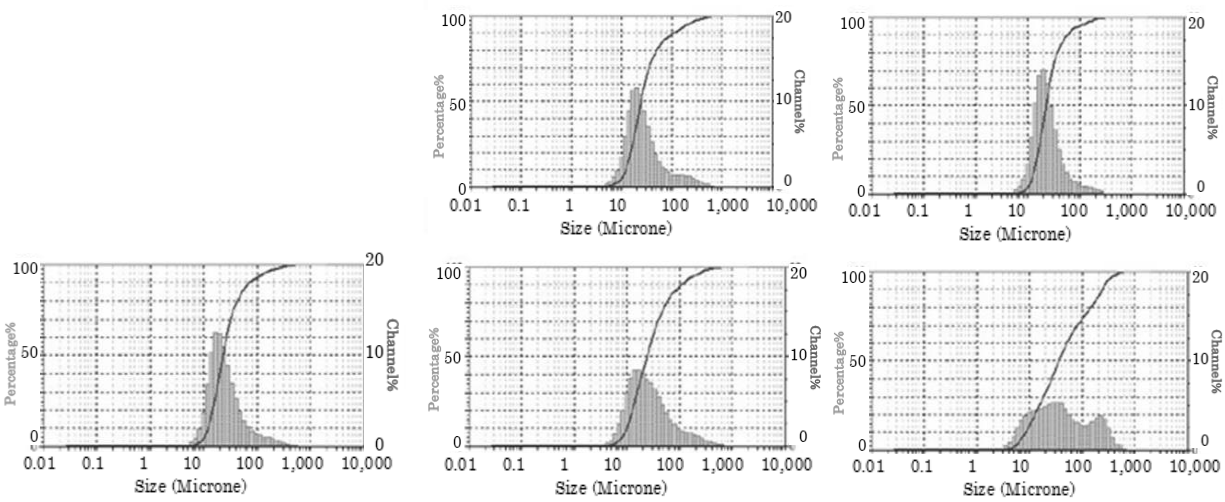

Fig. 4.1 the floc size with PAC

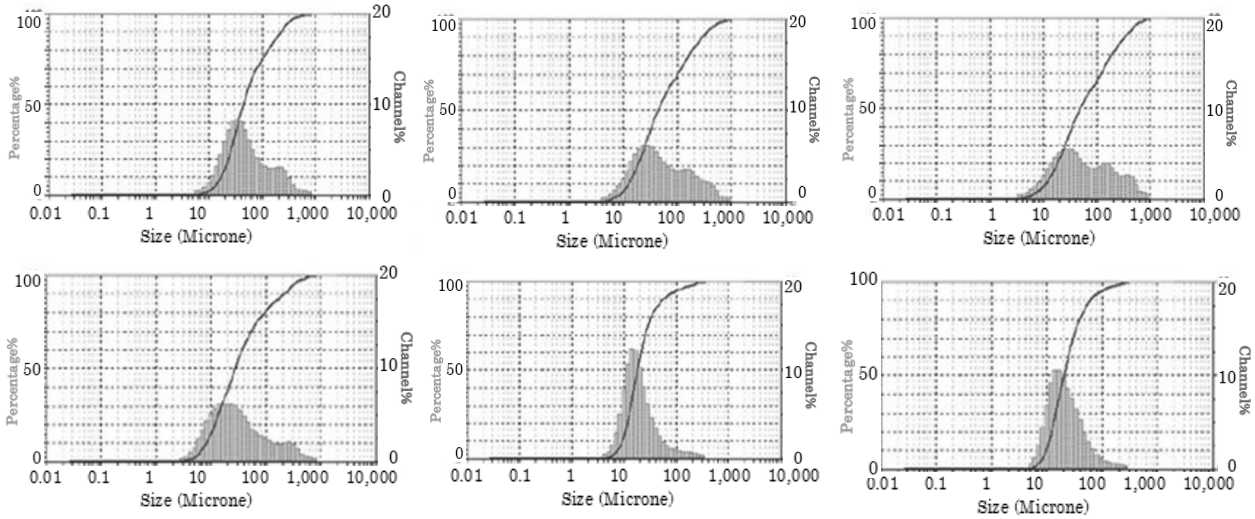

Fig. 4.2 the floc size with aluminum sulfate

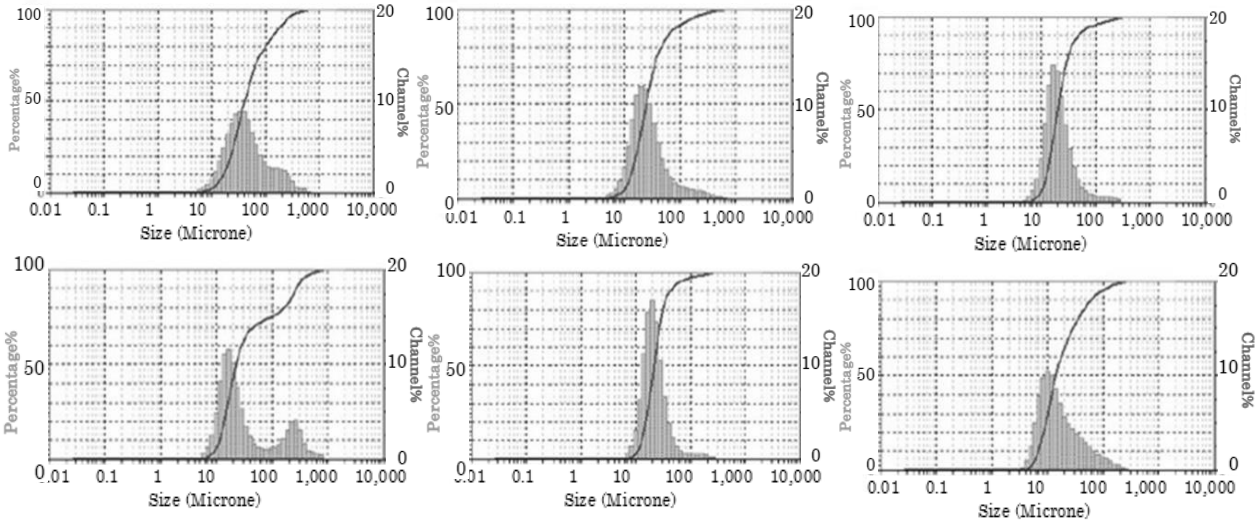

Fig. 4.3 the floc size with ferric chloride

(2) Enhanced coagulation group

a) Turbidity

as in **Fig. 5,** ferric chloride shows the different trend while the other two bring a little bit increase

b)TOC

TOC removal is nearly the same with the turbidty removal trend. ferric chloride will do complexation if the amount is too large as in **Fig. 6**

c)pH

In **Fig. 7** the result differs from the conventional group result. PAC keeps the same level while the other two both have an obvious decrease which shows the excess coagulants don't do any work for the coagulation at process at all.

d)Floc

The floc size concentration is showing in **Fig. 8**.Whatever coagulants won't do much change to the floc size, and concentration is also the same result.

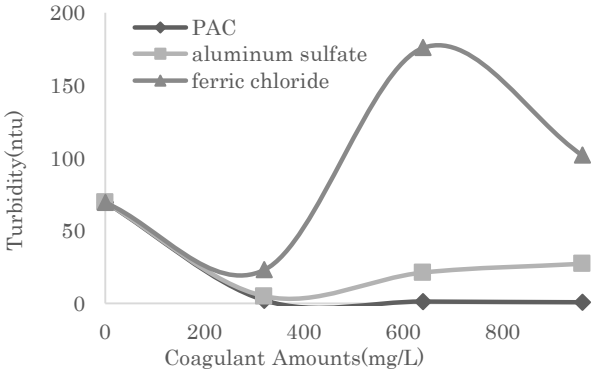

Fig. 5 Turbidity result in enchanced coagulation group

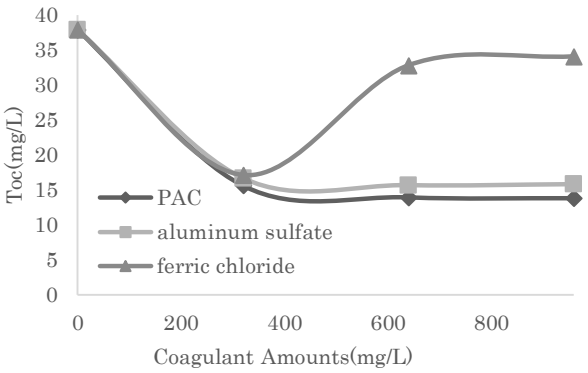

Fig. 6 TOC result in enchanced coagulation group

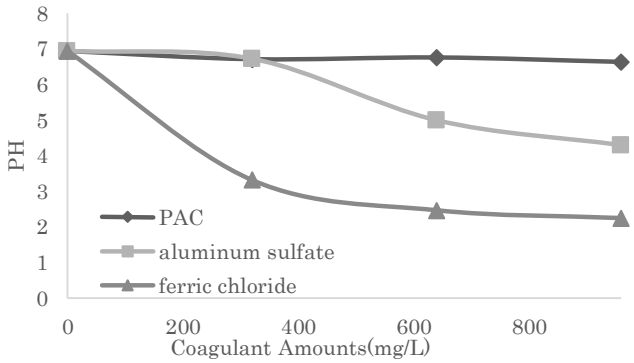

Fig. 7 pH result in enchanced coagulation group

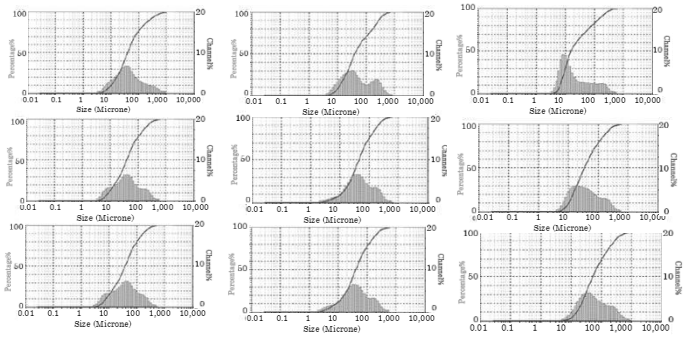

Fig. 8 Floc result in enchanced coagulation group

4. CONCLUSIONS

PAC is to be with the best effect of removal of turbidity while the other two work worse than PAC. For TOC all coagulants show the same level while during enchanced process ferric chloride does worse work than the other two. During the conventional process, PAC makes the floc size bigger but the concentration dispersiver, and during the enhanced process, all don't differ that much. Conventional coagulation almostly doesn't do change to the pH of the effluent while the enhanced coagulation especially low molecular weight inorganic coagulants make great change to the pH for the amout of the coagulant is excessive.For the ordinary waster water treatment, conventional coagulation do a great change to the water quality and for the cost-effective, it has a potential for the wide use. While there is no any necessity of using enchanced coagulation for it not only doesn't do any change to the water quality after the conventional process, it will make the water quality worse for the excessive amount.

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