

Research on the Recycle Economy Industry Based on Chemical Pollution Problems

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Environmental problems become very conspicuous and complex and the social economy transforms to recycle economy from linear economy with the high development of social economy. In the 21st century, one of the primary mission that human facing is how to solve problems on ecological crisis, and realize the sustainable development of ecological environment and human society. This paper gets the methods to solve these problems through studying chemical pollution problems in recycling production of paper, including handling problems of reddish blue in waste paper, recycling utilization problems of short fibre pulp in white water, processing and recycling problems of deinking waste water and so on. These methods solved environmental problems in real life.

1. Introduction

Recycle economy means in the development of economy, follow the law of ecology, and integrate cleaner production, integrated use of natural resources, ecological design and sustainable consumption as one, to realize wastes minimization, recycling and harmless, harmonious cycle of materials in the economy system and natural ecological system, and maintain natural ecological balance (Sauvé et al., 2016). As one pattern of Closing Material Cycle, recycle economy is a kind of innovation after human reflected the unsustainable traditional development mode; at this point, there is no concept of "wastes", all wastes are "misplaced resources". By means of arterial industry and venous industry of output and input (Ghisellini et al., 2016), recycle economy composes economy activities into a material recycle process of "resources-products-consumption-renewable resources" and a cycling use mode of "less exploitation, efficient utilization and low emission" (Lieder et al., 2017). Development of recycle economy is the inevitable choice for China implementing the sustainable development, and it is also the deepening and concretization of strategy of sustainable development (Lieder and Rashid, 2016).

Flocculation sedimentation is the principal treatment technology of regenerated paper wastewater; therefore, key point of this experiment is to confirm the optimal technological condition of the flocculation sedimentation (Asif et al., 2016). Because flocculants' mechanism of action is more complex (Ghisellini et al., 2016), and influence factors are more. Most flocculants have one optimum condition value, when the condition is higher or lower than this value, the colloidal particles may be stable again. In order to achieve the maximum flocculation effect, it is necessary to find the optimum condition (Smol et al., 2015).

Factors affect the effects of flocculation sedimentation include: dosage, mixing time and speed, pH value, temperature of flocculants. PH value and temperature affect the effects of flocculants, which are mainly reflected in influences on ζ electric potential of colloidal particles and characters of flocculants (Georgescu-Roegen, 2014). In fact, flocculation effects of flocculants have great differences at different temperatures and pH values. This experiment makes use of the contrast method to select flocculants, confirm the dosage, pH value and the optimum temperature, so as to realize the optimum flocculation effect, extract short fiber pulp in white water, reduce turbidity and CODCr concentration of deinking waste water.

Papermaking waste treatment can effectively make use of resources, protect ecological environment, thus, it has been paid more and more attention by people. In paper mill, the waste paper recycling and utilization will produce plenty of white water and deinking waste water. How to purify white water and deinking waste water, and continue to use them for production? It raises concerns of the great majority of scientific and technical

personnel. Among water treatment technologies and methods, flocculation method is one of the most economical, convenient and effective method. Therefore, the use of discussion of relationship between types of flocculants and flocculation effects in treatment of wastewater from regenerated paper mill has practical significances on small and medium-sized recycled paper enterprises. When treating white water and deinking waste water of recycled paper, the economical and applicable, better treatment effect program has certain reference values and practical extended significances for the same type of enterprises.

2. Experimental Method

Respectively prepare 2000mg/L $AlCl_3$, $FeSO_4$, $Al_2(SO_4)_3$, PAC (polyaluminum chloride) water solution, prepare the rest 10 types of organic flocculants into 500mg/L solution.

Table 1: The basic process parameters of coagulation beaker test at home and abroad

Test unit	Process parameters				
	Fast stir speed(r/min)	Fast stir time(min)	Slow stirring speed(r/min)	Slow stirring time(min)	Settling time(min)
Industrial Water and Management	80-100	>0.5	40-60	15-20	15-30
Tong ji University	200	2	30	8	15
Tsinghua University	100	1-3	20-40	10	20-40
South China University of Technology	120	2	30	2	15

This experiment refers to the above literatures and finds out the specific experimental method through comprehensive comparison: get 200mL white water, add a certain amount of flocculants, and mix (150r/min) it quickly for 2min, then slowly mix (40r/min) for 5min, standing for 30min, measure absorbance, turbidity of the supernatant liquid, dry at 160°C until the constant weight is reached after the supernatant liquid is removed, and measure mass of the extracted paper pulp.

3. Experimental Results and Discussion

3.1 Experimental results

The turbidity standard curve is created as shown in the Figure 1 below according to measure the turbidity of standard series of solutions' absorbance: 0, 4, 10, 20, 40, 80, 100.

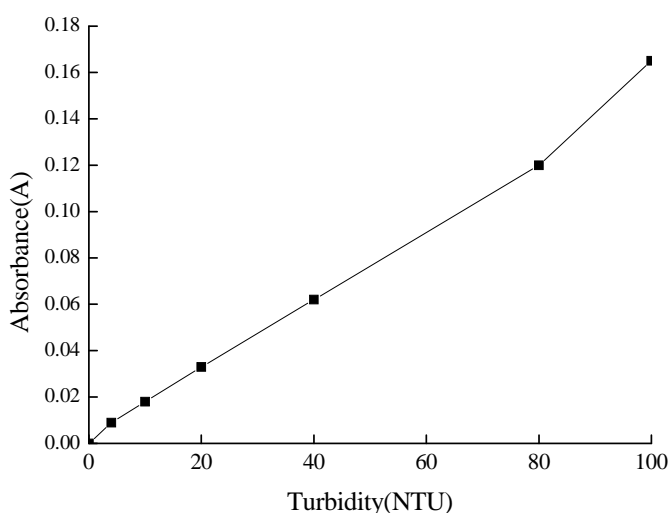


Figure 1: Turbidity standard curve

Respectively get white water and conduct jar experiments, dry bottom of jars until the constant weight is reached, 200m1, then add AlCl_3 , FeSO_4 , $\text{Al}_2(\text{SO}_4)_3$ solution with a certain concentration, standing for 30min, then remove the supernatant liquid and measure the turbidity; dry at 160°C after the supernatant liquid is removed, and measure mass of the extracted paper pulp, see Figure 2 for the experimental results.

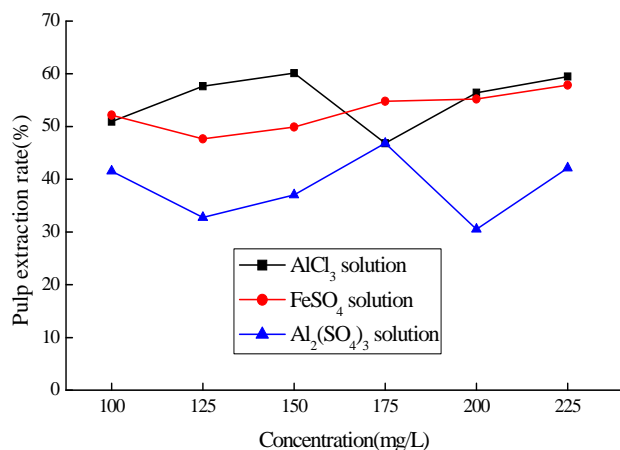


Figure 2: Effect of Flocculant Concentration on Extraction Rate of Pulp in Whitewater

The experimental results show that among several types of inorganic molecule flocculants, flocculation effect of AlCl_3 is relatively better, when the concentration is 150mg/L, extraction ratio of paper pulp in white water reaches 60.69%, and flocculation effects of $\text{Al}_2(\text{SO}_4)_3$ and FeSO_4 are relatively worse. In general, flocculation effects of inorganic flocculants are unsatisfied, better flocculation effects require higher concentration.

It can be seen from Figure 3 and 4 that concentrations of different cationic flocculants have different influences on flocculation effects.

Respectively get 200ml white water, then add different flocculants with the optimum concentration, adjust the temperatures to: 20, 30, 40, 50, 60°C , conduct the jar experiment, remove the supernatant liquid and measure the turbidity after standing for 30min, the experimental results are shown in Figure 5 and Figure 6.

The experimental results show that: influence degrees of temperature of the water solution have different flocculation effects on different flocculants. As for flocculants used in the experiment, the flocculation effect is good under the room temperature; consider from the economic benefit, the flocculation sedimentation can be conducted under room temperature.

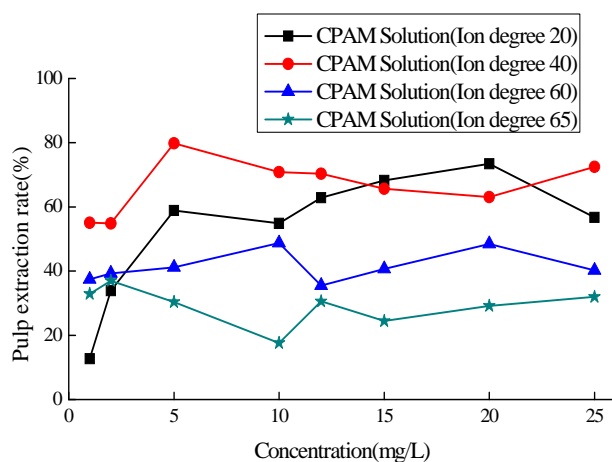


Figure 3: Effect of four cationic PAM flocculant concentrations on pulp extraction rate in white water

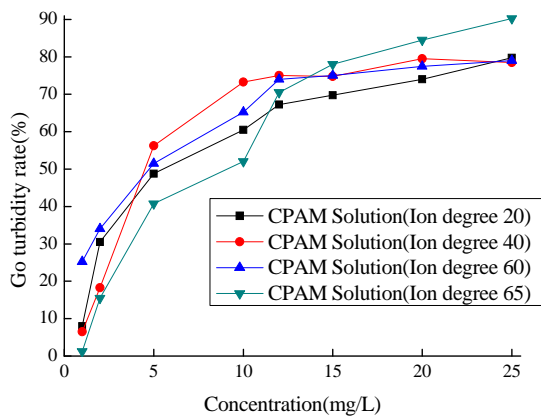


Figure 4: Effects of four cationic PAM flocculant concentrations on turbidity in white water

3.2 Discussion

(1) Within certain limits of dosage of flocculants, flocculation effects increase with the dosage of flocculants increase. However, when dosage of flocculants reaches a certain value, the peak value appears, then increase dosage, and the flocculation effects decrease.

(2) Electric charge generated from the influences of cationic degree on the flocculating effect is an important factor that affects its bridging action. Electric charge density of flocculants affects absorption of polymers on particles surface, and adhesive strength with particles surface. Polymers with higher cationic charge density have more attractive points with fine particles surface, and particles are easier to be flocculated; however, if cationic charge density is the excessively higher, it will have adverse effects on flocculation effect of white water.

(3) Experimental results of influences of different types of polypropylene phthalimides on flocculation effects show that cationoids are superior to anionics and non-ionics, because the colloid in white water is negatively charged, and better neutralization can be generated from cationic flocculants and negatively charged with colloidal particles instantaneously, and the colloid can be destabilized, and large floccules are further generated and precipitated rapidly, so as to achieve better flocculation effects.

(4) The effects of pH value on flocculation effect are different with the effects of pH value on organic polymer flocculants, however, in general, when the pH value is lower, the removal of turbidity is better, and the treatment effect of white water is better.

(5) The experimental results of effects of temperature on the flocculation show that: temperature of water solution has some effects on the flocculation effects, and different flocculants have different effects. For most flocculants, flocculation effects are better under room temperature; consider from economic benefits, treatment of white water under room temperature is more appropriate.

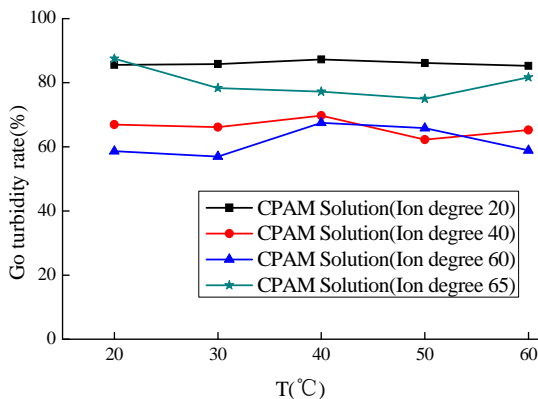


Figure 5: Effect of temperature on turbidity of white water when cationic flocculant is used

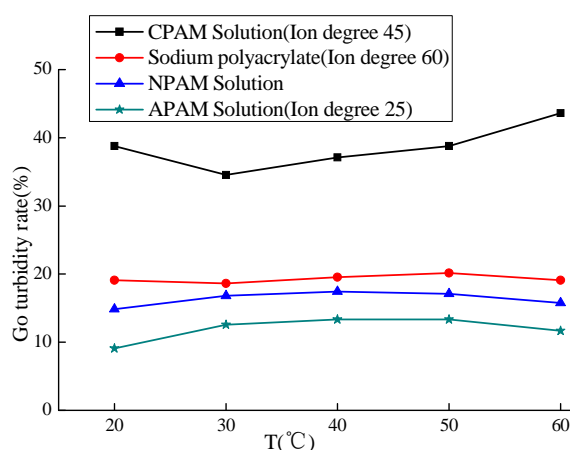


Figure 6: Effect of Temperature on Water Turbidity in Different Types of Flocculants

4. Conclusion

By means of the research on chemical problems of recycled paper industry, which are chemical degradation problems of reddish blue in waste paper, recycling utilization problems of short fibre pulp in white water of recycled paper production, and handling problems of deinking waste water in recycled paper production, the following conclusions are gotten:

- (1) Under lighting conditions, decolouration and degradation effect of sodium hypochlorite, chlorine dioxide and hydrogen peroxide on reddish blue is better, and it is much better than the degradation effect of exclusive use of oxidizing agents, which shows that it is the process of lighting stimulates the oxidization.
- (2) Among several reagents in the experiment, the degradation effect of sodium hypochlorite on reddish blue solutions is the best. When exclusively using acid-alkali method to degrade the reddish solution, the degradation effect is the worst.
- (3) Within certain limits of dosage of flocculants, flocculation effects increase with the dosage of flocculants increase. However, when dosage of flocculants reaches a certain value, the peak value appears, then increase dosage, and the flocculation effects decrease.
- (4) Effects of fractional ionization on the flocculation: is when handling deinking waste water, flocculants with higher fractional ionization are required.
- (5) In general, comparisons of effects of inorganic flocculants and organic flocculants show that, the flocculation effect of inorganic flocculants is worse, better flocculation effects require higher concentration. Relatively speaking, the flocculation effect of organic flocculants is better than that of inorganic flocculants.
- (6) The effects of pH value on the flocculation effect are different with the effects of pH value on organic polymer flocculants, however, in general, when the pH value is lower, the removal of turbidity is better, and the treatment effect of white water is better.
- (7) The experimental results of effects of temperature on the flocculation show that: temperature of water solution has some effects on the flocculation effects, and different flocculants have different effects. For flocculants selected in the experiment, flocculation effects are better under room temperature. Consider from economic benefits, flocculation sedimentation under room temperature shall be conducted.

This paper is based on the practical situations of recycled paper industry, especially some chemical problems that recycled paper enterprises in small and medium-sized villages and towns encountered, mainly including handling problems of reddish blue in waste paper, recycling utilization problems of short fibre pulp in white water, and handling problems of deinking waste water in recycled paper production. Our research is not only focused on how to effectively solve these problems, but also lower costs as much as possible. For this purpose, we compared different methods and conducted experiments by making us of different flocculants and drawn the above conclusions. It is expected that the conclusion can provide theoretical and beneficial references for recycled paper enterprises in small and medium-sized villages and towns to deal with such problems. The structure-function relationship between structure of flocculants and flocculation effects is the emphasis that requiring further discussion, which has great theoretical guiding significance for the development of economic and efficient new flocculants. Meanwhile, for other environmental problems in

recycled paper industry, how to solve problems from the chemical perspective is also an important issue needs to be concerned.

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