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RESEARCH ARTICLE

EVALUATION OF DEINKING PERFORMANCE OF ACTIVE CALCIUM SILICATE FILLED PAPER

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ABSTRACT

The deinking effect of printing paper filled with $CaSiO_3$ and $CaSiO_3$/French chalk was investigated. As a result, it shows that the two kinds of paper samples have better deinking effect, and the whiteness of the former is slightly higher than that of the latter. However, the strength index of the former is slightly lower than that of the latter. The adhesive removal effect of the paper sample filled with $CaSiO_3$ is better than that of the paper filled with $CaSiO_3$/ French chalk powder.

INTRODUCTION

More and more attention has been paid to the reuse of waste paper with the enhancement of people's awareness of environmental protection and the increasing shortage of papermaking fiber raw materials. Waste paper reuse has the advantages of saving primary fiber, reducing energy consumption and reducing the environmental pollution. It is an effective way to solve the problems faced by the pulp and paper industry, such as resource shortage, energy shortage, and environmental pollution. The deinking process of waste paper is the main factor restricting the reuse of waste paper, which is of great significance in saving raw materials, reducing pollution, protecting forest resources, reducing cost and energy consumption. Datang International High Alumina Coal Research and Development Center has developed active calcium silicate high filling papermaking technology based on the project of extracting alumina from high alumina fly ash. The reuse of activated calcium silicate filling paper is a problem that must be faced in the future with the popularization and application of this technology. However, at present, its deinking effect is not clear. This paper focuses on the evaluation of the deinking effect of active calcium silicate filling paper printing. This paper intends to provide a reference for the reuse of this kind of paper.

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Experiment

Raw Materials

Printing Pattern: The patterns are taken from Datang International High Aluminium Coal Research and Development Center. Active calcium silicate is filled with four-color overprint double adhesive paper with ash content of 40%, and active calcium silicate and French chalk powder are filled at 1:1 with an ash content of 35% (525 ℃). After tearing the above two kinds of printing paper into 25mm × 25mm size, we mix evenly, and balance moisture, and set aside.

Chemical: Deinking agents, sodium hydroxide, sodium silicate, hydrogen peroxide, and EDTA are all pure reagents for chemical analysis. And then prepare a certain concentration of a solution as required.

Experimental method: The two kinds of the paper samples except fillers (active calcium silicate addition) are different, fiber raw materials and printing process conditions are the same. Consequently, flotation deinking was carried out under the same conditions and the effects of deinking effect and deinking pulp quality were investigated.

Pulping: The printing waste paper was crushed in the FORMAX 450H high consistency pulper produced by AMC Company in the United States. The conditions are as follows: pulp consistency is 10%, temperature is 40-45 ℃, time is 10 min, NaOH is 1.2%, H_2O_2 is 1.4%, Na2SiO3 is 1.8%, EDTA is 0.3%, and deinking agent is 0.8% Flotation.

Flotation: Carried out in HG-18 flotation cell. The slurry concentration is 1%, the temperature is 40-45°C, the time is 10min, the air volume is 10L/min, and the slurry circulation frequency is 50Hz. Collect deinking scum to measure the yield.

Paddle and Hand-made Film Production: The pulper breaks the pulp or flotation deinked pulp with Buchner funnel to make the pulp sheet to evaluate the original ink concentration of the waste paper and the ink concentration in the pulp after deinking respectively to calculate the deinking efficiency; meanwhile, the pulp is measured separately The sticky matter content in the deinked pulp of machine crushing and flotation is used to evaluate the sticky matter removal effect.

The deinked pulp is hand-printed on a PTI paper sheet former made in Austria. The quantitative control is about60g/m^2, the papermaking concentration is about 0.35%, the pressing pressure is 3kgf/cm^2, and it is vacuum dried at 96°C under constant temperature and humidity conditions. Under test the physical and optical properties of the paper.

Detection of Residual Ink Concentration of Pulp Sheet, Paper Physical and Optical Properties: Pulp: determine the effective residual ink concentration (ERIC) value; hand copy: detect optical properties, such as whiteness, lightness (L) and chroma (a* value and b* value), tensile strength, tear strength, Physical properties such as folding resistance and bursting strength.

RESULTS AND DISCUSSION

Deinking effect: As we can see from Table 1, shows the test results of optical properties of two kinds of printing paper samples during deinking process.

Table 1. Comparison of whiteness and chromaticity changes of two kinds of printing paper samples after crushing and flotation deinking

Project			1#	2#	Note
Pulping whiteness/%ISO	Front		53.50	40.19	The pulps after pulping or flotation deinking are copied into slices for determination
	Reverse		61.52	61.06	
	Average		57.51	50.62	
Whiteness of flotation deinked pulp/%ISO	Front		69.71	68.16	
	Reverse		85.32	79.56	
	Average		77.52	73.86	
Lightness% and chromaticity inde	Front	L	84.88	82.84	Determination of pulp tablets of flotation deinked pulp
		a*	2.33	3.55	
		b*	-3.42	-6.09	
	Reverse	L	88.68	87.03	
		a*	3.39	3.57	
		b*	-9.62	-8.23	
Paper whiteness/%ISO			92.57	89.69	Flotation deinking pulp handmade sheet
Lightness% and chromaticity inde	L	%	90.26	89.77	Flotation deinking pulp handmade sheet
	a*		3.12	3.43	
	b*		-12.01	-11.01	

The whiteness of the 1# pulp sample is higher than that of the 2# pulp sample, and the whiteness of the negative side is higher than that of the positive sample from the whiteness of the pulp sheet after pulping and flotation. It may be due to the high whiteness of the filler, resulting in the high whiteness of the reverse side.

Table 2 Determination results of residual inks in the deinking process of two kinds of printing paper samples

Project		1#	2#	Note
Residual ink after pulping/ppm	Front	480.38	807.51	
	Reverse	459.15	373.88	
	Average	469.76	590.70	
Residual ink after flotation/ppm	Front	105.82	151.51	Determination after crushing pulp and flotation deinking pulp into slices
	Reverse	56.65	80.42	
	Average	81.24	115.96	
Ink removal	Average	82.71	80.37	
Residual ink in hand sheet of deinked pulp after flotation/ppm		29.87	36.80	Deinked pulp handmade sheet

Table 3. Determination results of stickies in the deinking process of two kinds of paper samples

Project		1#	2#	Note
Pre-deinking adhesive	/kg	725	450	Pulmac sieve and image analyzer
	mm^2/kg	42.2	31.9	
Adhesive after deinking	/kg	75	50	
	mm^2/kg	1.1	2.3	
Adhesive removal rate	%	97.39	92.79	Calculated according to mm ²/ kg

Table 4. Physical strength results of deinked pulp handmade sheet obtained from two kinds of paper patterns

Strength index	Unit	1#	2#
Folding endurance	freq	9	11
Burst index	kPa·m^2/g	2.35	2.33
Tensile index	N·m/g	36.1	38.8
Tear index	mN·m^2/g	8.30	8.31

Table 5. Flotation yield, fiber length and dissociation of two kinds of paper deinking process

Project	1#	2#	Note
Flotation yield	82.93	82.86	Calculated by measuring the flotation deinking residue.
Pulp ash/%	13.02	12.04	The handmade sheet burned at 525 and constant weight.
Fiber length after pulping	0.972	0.958	Flotation deinked pulp (determined by fiber length analyzer)
Fiber length after flotation	0.888	0.899	
Degree of dissociation after pulping	285	300	Filtration performance of flotation deinked pulp (dissociation meter)
Degree of dissociation after flotation	265	275	

The whiteness measurement results of the two deinked pulps also show the same rule as above, because the whiteness of the filler is higher than that of the fiber. In addition, there is a direct relationship between the content of the broken pulp and the flotation pulp. Because the ash content of the 1# handmade film (13.02%) is about one percentage point higher than that of the 2# handwritten film (12.04%). In addition, the whiteness of the handmade sheet of the flotation deinked pulp is higher than that of the pulp sheet, which is mainly due to the further removal of ink due to the washing effect of the papermaking process. From the chromaticity index, the pulp sheet and handwritten sheet are slightly reddish and blue after deinking, which may be related to the hue of the ink used in the four-color overprinting of the original sample.

It can be seen from Table 2 that the determination results of residual inks in the deinking process of two kinds of paper samples. The ink removal rate is 82.71% and 80.37% respectively after the 1# and 2# sample is broken up and floated, and the ink removal effect is good. The residual ink content of the handmade sheet is reduced to 29.87ppm and 36.80ppm.

Adhesive removal effect: As we can see from Table 3, it shows the determination results of stickies in two kinds of paper deinking process. The number and area of glue of 1# pulp sample before flotation were higher than that of 2# pulp sample before flotation. After flotation, the number of glues of 1# pulp sample and 2# pulp sample decreased by 89.66% and 88.89% respectively, and the area of glue decreased by 97.39% and 92.79% respectively. The adhesive removal effect of 1# pulp sample is slightly better than that of 2# pulp sample in the process of deinking, which may be related to the adsorption of adhesive and filler. In addition, it is related to the loss in the process of flotation and washing. The two original paper samples are very clean and the adhesive content is very low, which can be considered to have no impact on production. Besides, the impact of the difference in the removal rate of the two stickies is negligible.

Physical property: It can be known from Table 4 that the test results of the physical properties of two kinds of paper samples after deinking. These strength indexes are directly related to the adhesion of the fiber and the strength of the fiber itself, in which filling can improve the whiteness of the paper. However, it will reduce the strength of the paper. It can be seen from Table 4 that there is little difference in the strength of the hand-made sheets of the two kinds of paper samples after deinking, and the folding endurance, tensile index and tear index of the 1# sample are slightly lower than those of the 2# sample, but the burst resistance is basically the same, which may be related to the higher ash content of the sample. Because CaSiO3 and French chalkum powder are inorganic, filling will inevitably affect the combination of pulp fibers, thus reducing the paper strength. However, if we grasp the balance between dosage and strength loss, we can obtain better benefits.

Other indicators: As we can see from Table 5, it shows the results of flotation yield, fiber length and degree of dissociation in the deinking process of two kinds of paper samples. As a result, the flotation yields of the two kinds of pulp are basically the same, and the ash content of the handmade sheet of the 1# pulp sample is higher than that of the 2# pulp sample.

Conclusion

The 1# and 2# printing paper samples filled with CaSiO3 and CaSiO3/French chalkum powder have good deinking effect. In addition, the whiteness of the 1# deinked pulp is slightly higher than that of the 2# deinked pulp, while the strength index of the former is slightly lower than that of the latter. It has something to do with the high ash content of the former handmade sheet. In addition, the adhesive removal effect of the 1# paper sample is slightly better than that of the 2# pulp sample in the process of deinking, which may be related to the adsorption combination of the adhesive and the filler and the loss in the flotation and washing process. The two original paper samples themselves are very clean and the adhesive content is very low. Consequently, it can be considered that it will not affect the production, and the impact caused by the difference in the adhesive removal rate of the two paper samples in the deinking process is negligible.

REFERENCES

Zhan Huaiyu. 2010. Supply and utilization of non-wood fiber raw materials and waste paper raw materials for papermaking in China [J]. China Paper. 29 (8): 56-64.

Zhang Yunzhan. 2009. Q &An on modern waste paper pulping technology [M]. Beijing: chemical Industry Press.

Yang Heng, Zhang Sufeng. 2012. Influencing factors of waste Paper Deinking and Biological Enzymatic Deinking [J].

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