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ANAEROBIC DIGESTION OF PULP

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ARTICLE DETAILS

ABSTRACT

Article History:

Received 26 June 2018 Accepted 2 July 2018 Available online 1 August 2018 Alkaline pulping produces a large amount of black liquor and volatile substances, such as methanol, dimethyl sulfide, terpene, ketone, etc. It can cause serious pollution of water and air. Anaerobic inhibition with lignin in cooking is nucleophilic reaction, thus inhibiting hair lignin base and help base groups, to reduce the color of black liquor, increase the pulps whiteness, reduce the produce of the volatile matter quality at the same time. Compared with non-oxygen and aerobic cooking black liquor, the residual alkali concentration of the former was increased by 33%, the PH was increased by 0.9, the chroma decreased by 22.3%, and the solids decreased by 23%. In the former, the ash content of the pulp was reduced by 67%, and the amount of alpha - cellulose increased by 5% and the brightness increased by 13%.

KEYWORDS

Alkaline pulping, black liquor, anaerobic cooking, nucleophilic reaction.

1. INTRODUCTION

Util 2015, the commercial biomass of biomass energy is about 18 million tons, in addition, president Xi Jinping proposed that the environment is the people's livelihood, the green mountains are beautiful, the blue sky is also happy, all these require us to make reform to the industry that has a serious problem of pollution and waste of resources [1,2].

The production of alkaline pulping in China occupies 90% of the chemical pulp production [3,4]. This will produce large amounts of alkaline pulping black liquor, liu proposed pulping wastewater occupy our country the third of the industrial wastewater emissions [5,6]. He ying proposed to solve the production of black liquor and exhaust gas at the root causes, which can reduce the cost and material consumption of enterprises and reduce the pressure of corporate pollution [7,8].

2. REACTION MECHANISM

Black liquor mechanism is: under the condition of high temperature, sodium hydroxide that does not dissolve in water polymer ether bond of lignin and benzene pyrolysis, and introduces the hydroxyl, making it easy to dissolve in water of small molecules, under aerobic conditions at the same time, the alcohol hydroxyl groups on the side chain was oxidized to carbonyl with color, in addition the methoxyl group on the lignin and OH -, nucleophilic reaction of S2 -, methanol, dimethyl sulfide, the introduction of new phenolic hydroxyl [6, 9, 10].

ROCH₃+Na₂S \rightarrow CH₃—S—CH₃↑+RONa (1) ROCH₃+NaOH \rightarrow CH₃OH↑+RONa (2)

Xiao guihua suggested that oxygen concentration is an important factor affecting methanol production, and the lower the oxygen concentration is, the less methanol is produced [6,11, 12]. To oxygen cooking process, can inhibit the nucleophilic reaction of lignin, thus inhibiting methanol, dimethyl sulfide and generate subsequent into quinone and adjacent phenol phenol oxidation of metal ion chelating agent hopson into complex reaction, dealing with pollution from the source. Industrial deoxygenation includes: atmospheric thermal deaeration, vacuum deaeration, desorption

and desorption of oxygen, iron desoxygenation, oxidative resins, etc. [11,13,14]. In this paper, the method of oxygen removal is to boil the liquid raw material into oxygen, and then to nitrogen to isolate the oxygen.

3. EXPERIMENT

3.1 Raw materials, reagents and instruments

The raw material is from the corn stalk skin of jilin city. The mill is crushed into granule and distilled water. The pressure cooker is boiling for 30min. Certain concentrations of NaOH, Na2S, HCl, KMnO2, BaCl2, CH3COOH, H2SO4, phe nolphthalein solution. Df-101s thermostatic heating magnetic stirrer, gsh-type autoclave, densitometer, constant temperature oven,crucible, analytical balance, pipette, circulating water multipurposevacuum pump.

3.2 Experimental methods

After cooking, and dehydration of straw particles into the cauldron, will use DF - 101 - s collection hot type constant temperature heating magnetic stirrer heating cooking for a period of time of reagent drainage into the kettle. Then tighten the end cap. After heating and holding for a period of time, add the liquid, After a period of heat preservation, remove the solid liquid mixture.

The black liquid parameters to be determined include black liquid density, solid content, residue, PH and chromaticity. The methods adopted are: (1) measured with a densitometer. Copy of the same amount of black liquor, and average (2) use pipette take three 1 ml in the conical flask black liquor were put into a beaker, and arrange in the quartz, washed with hydrochloric acid into the constant temperature oven, until the quality change, no longer take average of three (3) take 10 ml black liquor, join the 100 ml conical flask, add adequate BaCl2 solution, add distilled water diluted to scale, then let stand for a period of time, take the top 10 ml clear night with a pipette, with 0.1 mol/L HCl titration, measure the consumption volume of HCl (4) black liquor PH value is measured with a PH meter (5) take 1 ml black liquor, Dilute the water with distilled water

until it is indistinguishable from the optical water, recording the dilution multiple. The above experimental results are summarized, and the parameters of the industrial cooking black liquor are listed in table 1.

Table 1: The parameters of black liquor and black liquor

Pulping			Residual alkali		
method	Density g/L	Solid content g/L	g/L	PH	Chroma
Aerobic	1055	140	11.87	11.6	20600
	1042	107.84	16.02	13	16000
Anaerobic	1031	105.76	16.45	12.5	16000
	1047	109.72	15.01	12	16000

The paper pulp parameters that need to be determined include the pulp yield and the important parameters of the pulp quality. The methods adopted are: (1) to tear, cooking exp eriment of the proceeds of the pulp into petri dishes, put into the set temperature for 1 h in the 100-105 °C oven thermostat, measurement, calculation of pulp yield pulp, (2) take 1 g in the crucible heated, then put into the set temperature is 600 °C high temperature box, using analytical balance to measure quality, calculation of ash content (3) the torn pieces of paper pulp soaking with a certain concentration of NaOH, mercerizing, then under the condition of suction, solution with NaOH solution washing three times, then washing with distilled water, CH3COOH solution soak, then washing with distilled water, until the pulp to neutral (4) the pulp is vacuum suction, Contrast with the PANTONE color card by drying the oven and comparing the results with the computer standard color. The contrast results are shown in Figure 1. The above experimental results are summarized, and the parameters of industrial cooking paper are listed in table 2.



Figure 1: Comparison of aerobic cooking pulp and anaerobic cooking pulp with PANTONG color card

(A)Aerobic cooking(B)Liquid ratio is 1:4 anaerobic cooking(C)Liquid ratio is 1:4 anaerobic cooking(D)Liquid ratio is 1:4 anaerobic cooking

Notes a_1 , a_2 , a_3 , a_4 are pulp samples, b_1 , b_2 , b_3 , b_4 are PANTON color card sample, c_1 , c_2 , c_3 , c_4 are computer color specs.

Table 2: The parameters of anaerobic digester and aerobic digester

Pulping			Alpha-cellulose	
method	Pulp yield %	Ash %	content %	Brightness
Aerobic	50	3.5	80	144
	45.16	1.14	72	206
Anaerobic	46.01	1.26	85	193
	45.68	1.07	83	185

4. RESULTS AND DISCUSSION

By Table 1 we can calculate the average of each parameter of the black liquid, (1) under the anaerobic condition of black liquor density from 1055 g/L to 1044 g/L changed little, solid content from 140 g/L to 107 g/L, levels fell by 23%, down a lot, inhibit the phenol hydroxyl generation anaerobic conditions, reduce 22.3% lower lignin (2) the chromaticity of the soluble in water, for two reasons, one is water soluble lignin decreases, the second is inhibits the formation of phenolic hydroxyl anaerobic conditions, reduce the lignin oxidation into quinone and elevated and Fe3 + chelating (3) the residual alkali concentration 33%, PH 0.9, anaerobic conditions inhibit the nucleophilic reaction, reduce the consumption of OH - It is shown that there is less alkali needed to make pulps without oxygen, and it can reduce the amount of alkali used in cooking, so as to save cost.

Under anaerobic conditions for cooking, pulp yield fell by 4.84%, ash reduced by 67%, alpha cellulose content increased by 5%, 13% brighter.Low ash pulp, pulp quality is good, anaerobic cooking that can greatly improve the quality of the pulp. Alpha cellulose content is an important index to measure the pulp quality, the high content of alpha cellulose, performance is good, the pulp drainability and copying anaerobic cooking than general industrial high cooking the alpha cellulose pulp, anaerobic cooking pulp quality is good. Anaerobic cooking pulp whiteness, high balanced dissolved lignin in cooking phase, compared with the industrial steam the adsorption quantity on cellulose roughly equal, but because in the black liquor lignin base group is less, can largely improve the whiteness of pulp. Pulp yield is low because hemicellulose is more soluble.

5. CONCLUSION

Nucleophilic reaction of lignin and subsequent oxidation is a major cause of pulping process contamination, oxygen free cooking by oxygen can effectively restrain the two reaction, so as to reduce the production of waste gas, to a great extent at the same time also can reduce the black liquor chromaticity, improve the quality of pulp, pulp whiteness, drug use, thereby reducing the bleaching process reduces the pollution of bleaching. The development of anaerobic cooking is of great significance to the existing pulping industry.

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