

STUDIES ON SINGLE STAGE BLEACHING PART-II. Bleaching of Soda-Sulphur Rice-Straw Pulp with Sodium Hypochlorite

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(Received November 8, 1987, revised February 4, 1989)

Soda-sulphur rice-straw pulp is new one. So studies on its bleaching by sodium hypochlorite are also new findings. Writing and printing paper may be made of it, and better grade newsprint can be easily prepared from laboratory evaluated unbleached soda-sulphur pulps.

Key words: Hypochlorite bleaching, Soda Sulphur, Rice Straw pulp.

INTRODUCTION

There is no report in chemical abstracts and literature on making of soda-sulphur pulp [1] of rice-straw. In soda-sulphur pulping, elemental sulphur is added to the cooking liquor (NaOH solution) in the rotary digester made of stainless steel. As a result stronger pulps, [1,2] with higher yields in relatively short cooking time not only in case of rice-straw, but also in other cellulose raw materials are obtained.

Single-stage bleaching with sodium hypochlorite [3] is an old bleaching process. But the outcome of the present studies on sodium hypochlorite bleached soda-sulphur pulp of rice-straw is a new finding. In this bleaching process properly prepared sodium hypochlorite liquor [4] is added to the pulp under optimum bleaching conditions until the pulp attains desired degree of whiteness without degradation of pulp beyond a certain limit. The hypochlorite treatment is best carried out at a pH level where active bleaching agent is predominantly hypochlorite but not hypochlorous acid. For this use of a buffer hypochlorite is made for prevention of low pH medium during commercial hypochlorite bleaching.

EXPERIMENTAL

Preparation of the unbleached pulp: The soda-sulphur pulp was obtained by using the following optimum conditions set up by M.S. Karim [1].

Table 1. Optimum conditions for soda-sulphur cooking of rice-straw.

NaOH (%)	Sulphur (%)	Temperature °C	Time in hours	Material-liquor ratio	Pressure kg/cm ²
10	1.0	150	2.5	1:7	5.0

Table 2. Yield, permanganate number, brightness, ash-content and fibre-length and diameter of the unbleached pulp.

Yield (%)	Permanganate number [5]	Brightness % [6]	Ash %	Fibre-length (mm) [7]	Fibre-diametres (mm) [7]
57.94	9.00	50.10	11.06	1.26	0.007

Laboratory evaluation of unbleached pulp: One kilogram (O.d) of the unbleached pulp was used for beating in the pilot plant Hollander beater at a consisting of 1.57% for different time i.e. 00,10,20,30,40,50 and 60 minutes and sample of pulp-slurry corresponding to each beating time was collected. Standard pulp-sheets were made in a sheet former known as rapid kothen sheet forming machine [8]. Similar several sheets were made from each of the collected samples and all were tested for tensile [9], tear [10] and bursting strength [11] according to Tappi standard procedures. The results are plotted in Fig.1. The freeness [12] of the unbleached pulp was also determined and is shown in the same figure.

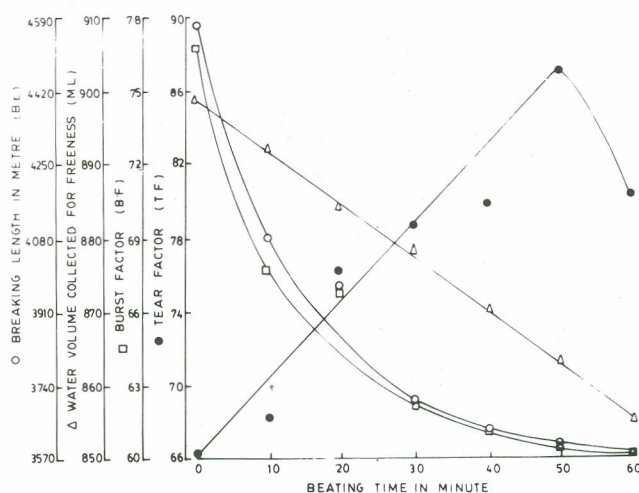


Fig. 1 Paper making properties from unbleached soda sulphur pulp of rice straw.

Establishment of optimum conditions for bleaching: Each time 50g oven dry unbleached soda-sulphur pulp was taken in a round bottom flask and the samples were treated with different percentages of total chlorine demand (T.C.D.) with variation in temperature, time and consistency. The pulp-sample-slurry was heated directly with the gas flame. The results are given in the Table 3,4,5 and 6.

RESULTS

Table 3. Effect of chlorine demand on the bleached pulp-yield and the physical properties of the bleached pulp-sheets.

(a) Amount of pulp bleached in g.o.d. basis	50.0
(b) Temperature °C	95-100
(c) Time of bleaching in minutes	30.0
(d) pH of sodium hypochlorite solution	10.0
(e) pH of the bleaching medium	10.0
(f) % Consistency	3.0

Expt. No.	Percentage of T.D.C.	Bleached yield (%)	Breaking length	Tear factor	Burst factor	Brightness (%)
1	80	53.71	3614	56.00	70.00	60.4
2	90	53.43	3354	66.12	68.56	65.2
3	100	53.18	3237	64.34	65.78	66.8

Table 4. Effect of temperature on the bleached pulp-yield and the physical properties of the bleached pulp-sheets.

(a) Amount of pulp bleached in g.o.d. basis	50.0
(b) Chlorine used as NaOCl (% total demand)	90.0
(c) Bleaching time in minutes	30.0
(d) pH of sodium hypochlorite	10.0
(e) pH of bleaching medium	10.0
(f) % Consistency	3.0

Expt. No.	Temperature °C	Bleached Yield (%)	Breaking length in metre	Tear factor	Burst factor	Brightness (%)
4	25 - 30	56.99	4224	59.39	66.87	56.0
5	55 - 60	56.00	4059	63.16	68.76	59.9
6	95 - 100	53.74	3600	66.50	60.55	65.0

Table 5. Effect of time on the bleached pulp-yield and the physical properties of the bleached pulp-sheets.

(a) amount of pulp-bleached in g.o.d. basis	50.0
(b) Chlorine as NaOCl (% of total demand)	90.0
(c) Temperature °C	95-100
(d) pH of Sodium hypochlorite solution	10.0
(e) pH of the bleaching medium	10.0
(f) % Consistency	3.0

Expt. No.	Time in minutes	Bleached Yield (%)	Breaking length in metre	Tear factor	Burst factor	Brightness (%)
7	30	53.48	3340	66.12	60.07	64.8
8	60	53.02	3518	68.31	67.39	70.0
9	90	52.19	3302	70.43	57.81	71.7

Bleaching in bulk quantities for beating: Such bleaching was done in an autoclave. Each time 500 g.o.d. basis unbleached pulp was used for bleaching with the optimum conditions for bleaching as mentioned in Table 7.

Table 6. Effect for consistency on the bleached pulp-yield and the physical properties of the bleached pulp-sheets.

(a) Amount of pulp bleached in g.o.d. basis	50.0
(b) Chlorine as NaOCl (% of total demand)	90.0
(c) Temperature °C	95-100
(d) Time in minutes	60.00
(e) pH of sodium hypochlorite solution	10.00
(f) pH of the bleaching medium	10.00

Expt. No.	Time in minutes	Bleached yield (%)	Breaking length in metre	Tear factor	Burst factor	Brightness (%)
10	2'0	52.81	3504	68.00	66.87	68.5
11	3'0	53.02	3523	68.04	67.19	70.0
12	4'0	53.12	3533	67.85	66.76	69.0

Table 7. Optimum conditions for single stage bleaching of soda-sulphur rice-straw pulp with sodium hypochlorite.

Total Chloride demand (T.C.D.)	Temperature °C	Time in minutes	Consistency (%)	Pressure in mmHg
90	95 - 100	60	3.0	760

Table 8. Yield, brightness, ash-content, fibre-length and fibre-diameter of sodium hypochlorite bleached soda-sulphur rice-straw pulp.

Yield (%)	Brightness %	Ash %	Fibre-Length (mm)	Fibre-diameter (mm)
53.02	70.0	9.74	1.04	0.0065

Paper-making properties of the sodium hypochlorite bleached soda-sulphur rice-straw pulp: The thus bleached pulp was beaten for different times 00-60 minutes in the pilot plant Hollander beater. The handsheets were made from the different pulp-samples collected at 0 minute and 10 minutes intervals thereafter and the sheets were tested for tensile, tear factor and bursting strength. The freeness was also calculated and the results are plotted in Fig. 2.

RESULTS AND DISCUSSION

The paper making properties (breaking length, tear factor burst factor) given by sodium hypochlorite bleached soda-sulphur rice-straw pulp are satisfactory for preparation of writing and printing paper. The brightness value (70) is lower than 3 stage CEH soda pulp [13] of rice-straw and even lower than sodium hypochlorite bleached soda jute and sulphate [14] jute pulp. Yet the value is within the international specification for paper-making.

The discrepancy in physical properties of the pulp-sheets made from pulp bleached in the flask and those of the pulp-sheets made from the pulps bleached inside the autoclave may be due to variation in the amount of pulp 50g in the flask to 500g in the autoclave. In addition, the discrepancy may be due

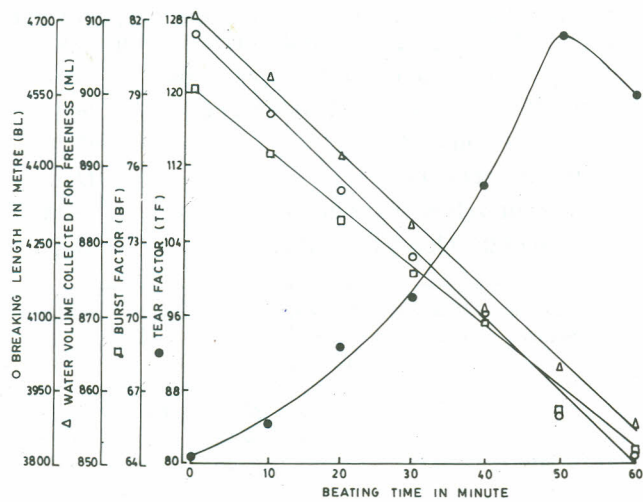


Fig. 2 Paper making properties of sodium hypochlorite bleached soda sulphur rice-straw pulp

to direct application of heat to the pulp inside the flask by Bunsen burner whereas the pulps inside autoclave was given indirect heat.

CONCLUSION

Sodium hypochlorite bleached soda-sulphur rice-straw pulp may be a good source for writing and printing paper.

Laboratory evaluated unbleached pulp may be used for good quality newsprint and unevaluated unbleached one for packing and wrapping paper.

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