Effective utilisatation of cooking chemicals by use of additive

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SUMMARY

Soda, Soda—Anthraquinone, Kraft and Kraft pulps at lower sulphidity with anthraquinone were prepared to study the effect of anthraquinone using *Eucalyptus grandis* It was observed that Soda-AQ pulps were slightly better than the controlled Soda pulps but were inferior to Kraft–AQ pulps. In Kraft–AQ pulping the sulphidity could be reduced from 25% to 10% with saving of 1.5% active alkali, improvement in the yield and physical strength properties of hand sheets. The Kappa number of both the pulps were, however, similar 25 ± 1).

Soda and Soda—Anthraquinone pulping of wheat straw was also carried out. It was observed that with the addition of 0.15% AQ, to obtain same Kappa number (25 ± 1), 1.75% less active alkali is needed. The screened yield of pulp was higher by about 1.8%.

With the announcement[1] in the meeting of Canadian Pulp and Paper Association that the anthraquinone (AQ) is superior additive compound for polysaccharide stabilisation and delignification acceleration than the sodium salt of the anthrrquinone-2-sulphonic acid as suggested by Bach and Feihn[2] the Pulp and Paper scientists and technologists took deep interests to study the various aspects of AQ addition in alkaline pulping and in a very short period, more than fifty papers appeared in various scientific journals. It has been well established that use of AQ could reduce the consumption of chemicals and energy and improve yield and quality of the pulp.

A study was undertaken on effect of AQ addition during pulping on *Eucalyptus grandis* and wheat straw. The results are reported in this paper.

EXPERIMENTAL :

All the Pulping experiments were carried out in a stolsvets autoclave (bomb) digester, which consists of six stainless steel bombs, each of 2.5 litre capacity rotating in a polyglycol bath. After cooking, the pulps were washed with hot water, disintegrated and screened over flat laboratory screen using screen plate having 0.35 m.m. size slots. Screened pulp yield, screened rejects and Kappa nnmber were determined in each case. The pulps thus obtained were beaten in P.F.I. mill at different revolutions. Standard sheets of about 60 g.s.m. were made in sheet making machine, conditioned at 27 ± 1°C and 65 ± 2 R.H. and tested for various strength properties. The conditions of pulping, pulp yield, Kappa number and physical properties of handsheets interpolated at 300 ml. C.S.F. are recorded in Table I and II.

RESULTS AND DISCUSSIONS :

EFFECT OF AQ ADDITION IN SODA PULPING :

Results recorded in Table I for *Eucalyptus grandis* reveals that the extent of delignification, based on Kappa number, is more in soda-AQ pulp than in soda with a slight improvement in pulp yield. Increased delignification in soda-AQ pulp could be due to the more pronounced cleavage of β-aryl ether linkage in phenolic unit[3,4] of wood lignin However, a significant gain in pulp yield could be obtained at same Kappa number with decreasing the active alkali charge. In the case of wheat straw (Table II) a gain of 1.8% pulp at nearly same

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TABLE—I PULPING CONDITIONS AND PHYSICO-CHEMICAL PROPERTIES OF SODA AND KRAFT PULPS (WITH AND WITHOUT AQ) FROM Eucalyptus grandis

Sl. No.	PARTICULARS	Cook Number					
		1	2	3	4	5	6
1.	Active alkali as Na_2O*, %	16	16	14	14	12.5	12.5
2.	Sulphidity, %	0	0	25	25	25	10
3.	Anthraquinone addition*, %	—	0.15	—	0.15	0.15	0.15
4.	H factor	1115	1115	810	810	810	810
5.	Total yield*, %	52.2	52.3	54.6	55.2	58.9	53.7
6.	Screened yield*, %	51.6	52.0	53 4	54.8	55.4	53.6
7.	Screened rejects*, %	0.6	0.3	1.1	0.4	3.5	0.1
8.	Kappa number	33.0	22.8	26.3	18.4	36.8	25.1
9.	P.F.I. revolutions to bring down the Freeness 300 C.S.F. (ml)	7100	7100	7000	4500	5400	5350
10.	Burst index**	4 6	5.7	6.7	7.1	7.4	7.2
11.	Tensile index**	69	71	82.2	83.7	87.50	88.0
12.	Tear index**	8.9	8.9	9.9	9.5	8.7	10.0

* Percentage based on o.d. chips.
** Properties interpolated at 300 C.S.F. (ml).

TABLE—II PULPING CONDITIONS AND PHYSICO-CHEMICAL PROPERTIES OF SODA AND KRAFT WITH AND WITHOUT AQ FROM WHEAT STRAW

Sl. No.	PARTICULARS	Cook Number	
		1	2
1.	Active alkali as Na_2O*, %	11.75	10
2.	Anthraquinone addition*, %	—	0.15
3.	H factor	1665	1665
4.	Total yield*, %	52.6	53.7
5.	Screened yield*, %	50.6	52.4
6.	Screened reject*, %	2.0	1·3
7.	Kappa number	24.6	25.9
8.	Burst index**	4.2	4.4
9.	Tensile index**	56.5	61.5
10.	Tear Index**	5.8	5.5

*Percentage based on o.d. straw.
**Properties interpolated at 250 C.S.F. (ml)

Kappa number (25±1) with 1.75% less active alkali was obtained. The physical strength properties of the soda-AQ pulps of *Eucalyptus grandis* and wheat straw were found to be slightly superior particularly a gain of 22.8% Burst index in *Eucalyptus grandis* and 10.6% Tensile index in wheat straw, except the Tear index which remain unaffected.

COMPARISON OF SODA-AQ AND KRAFT PULP FROM *Eucalyptus grandis*

Soda-AQ pulp when compared with kraft pulp (sulphidity 25%) obtained at 2% less alkali and lower 'H' factor, it was observed that the pulp yield of kraft pulp was about 2·3% higher than soda-AQ. The physical strength properties of kraft pulp were superior at same lignin content (Kappa number 25±1.3). Lignin of 46.6% and 18.6%. In Burst index, 19.13% and 15.8%in Tensile, and 12.2% and 12.2% in Tear index was achieved in kraft pulp over soda and soda-AQ pulps, respectively.

EFFECT OF AQ IN KRAFT PULPING

The extent of delignification and physical strength properties of control kraft pulp when compared with kraft-AQ pulp, it was observed that the extent of delignification was further enhanced with the

addition of AQ in kraft pulping liquor. Though the hydrosulphide ion also causes cleavage of β aryl & other linkage in phenolic unit[5], but it seems that in the presence of small amount of AQ the cleavage of these bonds enhance, thereby, giving more delignified pulp. Improvement of about 1.4% in screened pulp yield was obtaind. Burst index, Tensile index and Tear index remained almost unaffected.

Therefore, it was felt worth while to reduce the active alkali for obtaining a pulp of same Kappa number. It was also considered that if sulphidity of pulping liquor could be reduced further advantage could be achieved.

EFFECT OF SULPHIDITY ON KRAFT-AQ PULPING

It can be observed from *Table I* that addition of AQ at same sulphidity reduced the Kappa Number from 26 3 to 18.4. Series of pulping experiments were conducted earlier to study the effect of sulphidity on AQ addition[6]. When the active alkali in kraft pulping was reduced to 12.5% as Na_2O and sulphidity was kept at 25%, pulps of higher Kappa number obtained By reducing the sulphidity marked improvement in delignification was observed.

Pulps with similar properties (14% active alkali and 25% sulphidity in cooking liquor) could be prepared by reducing active alkali to 12.5% and the sulphidity to 10% with the addition of 0.15% AQ in the cooking liquor.

To obtaion kraft pulps of 25±1 Kappa number, the active alkali in the cooking liquor was reduced and sulphidity of 10% was maintained. By using 12.5% active alkali pulp of desired Kappa number was obtained. The yield of pulp was similar to kraft pulp using 14% active alkali, 25% sulphidity. The strength properties of hand-sheets were slightly superior. One of the striking differences in the pulp obtained from 14% active alkali and 12.5% active alkali was that the latter required less energy to bring the freeness of pulp to a given freeness.

CONCLUSIONS

1. Addition of AQ (0.15%) in the cooking liquor improved delignification in soda and kraft pulping.
2. The strength properties of handsheets of soda-AQ pulp was better than soda pulp. Kraft pulp of *E. grandis* of same Kappa number, however, had better properties than soda or soda-AQ pulp.
3. In kraft pulping, when AQ was added to cooking liquor, the active alkali could be reduced by 1.5%. This reduction of active alkali could be done inspite of reducing the sulphidity from 25% to 10%.
4. The additional advantage of using AQ in kraft cooking liquor was that the pulps obtained were easy beating.

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