Soda Pulping with addition of Anthraquinone

MADAN, R. N.*

SUMMARY

Eucalyptus and pine woods were cooked by soda process with addition of small quantities of anthraquinone, i.e. 0.15%. For comparison these woods were also cooked by soda and sulphate processes. From the results, it was concluded that soda-anthraquinone (Soda AQ) process gives yield and pulp quality similar to kraft level but better than soda level.

INTRODUCTION

It is well known that in alkaline process, the addition of sulphide ion accelerates the rate of delignification with less damage to cellulose and hemicellulose. In order to obtain a pulp of desired kappa number, severe conditions are required in soda cooking, than in kraft pulping. This results in inferior quality of pulp and in lower yield than obtained in the kraft process. Bach and Fiehn ([1,2]) reported that by addition of small quantity of anthraquinone mono sulphonate (AMS) to soda and kraft cooks of pine, pulp in improve yield, with less rejects without any adverse effect on strength was obtained and the rate of delignification was accelerated. AMS not only stablizes polysaccharides towards alkaline degradation but also interacts with lignin causing its rapid and extensive removal. AMS possesses unique properties superior to other pulping additives than being investigated so-far. However due to high cost of AMS, it could not be used on industrial scale. Recently Holton ([3,4]) found that Anthraquinone (AQ) and its derivatives with Alkyl substituents (e.g. 2-methyl anthraquinone) are superior additives than its sulphonate derivatives. In these investigations it was reported that small amount of AQ accelerates the soda pulping process and it could effectively compete with the sulphate process in terms of pulp quality. These effects were observed in pulping of both softwoods and hardwoods. The soda AQ process has received the attention to date ([1,5]) as it represents the ultimate solution to kraft odour problem. Addition of AQ during sodium hydroxide cooking scandinavian spruce led to a marked increase in the delignification rate and a slower dissolution of carbohydrates ([6]). Holton ([7]) also studied the effect of AQ in the kraft pulping of sothern pine chips for use in liner board on laboratory as well on mill scale. Farrington et al ([8]) cooked Eucalyptus and pine woods with sodium hydroxide and small quantities of quinonoid additives. The process was carried out successfully on a commercial scale. Due to low cost and better performance of AQ it may get a wide spread interest in additive pulping. In forging countries this application is at present limited to mills already practicing soda pulping and these kraft mills under sufficient environmental pressure to switch over to soda.

From the above work, the author was prompted to carry out preliminary investigations, in order to see the effect of AQ on pulping of indigenous raw materials like Eucalyptus and pine woods with sodium hydroxide.

EXPERIMENTAL

200 g. (O.D.) chips of Eucalyptus hybrid were digested by sulphate ($NaOH : Na_2S=3 : 1$) soda and soda anthraquinone (AQ=0.15%) on the basis of oven dry raw material in a three litre stationary stainless digester using chips to liquor ratio 1 : 4. The quantity of chemicals for all cookings was 16% as Na_2O and the time of cooking was 2.5 hrs. including 1 hr. to raise the temperature of contents to maximum temperature (162°C). Pine wood was cooked under identical conditions except the period of cooking was 3.5 hrs. (including 2 hrs. to raise the temperature to maximum) and the maximum temperature was 170°C.

After the digestion the pulps were washed, screened on laboratory screen and then, yields, screen rejects and kappa number of the unbleached pulps were determined. The results are recorded in Table—1. The unbleached pulps were beaten in Lampen mill to about 250 ml (C.S.F.) and standard sheets of 60 gms were made. The sheets were conditioned at 65% RH and 25 ± 1°C and tested for strength properties. The results are recorded in Table—II.

*Cellulose & Paper Branch, Forest Research Institute, Dehra Dun

TABLE—I

YIELD AND KAPPA NUMBER OF EUCALYPTUS AND PINE COOKED BY DIFFERENT PROCESSES

Sl. No.	Raw Material	Process	Unbleached pulp yield %	Rejects %	Kappa number
1.	Eucalyptus	Soda	45.5	2.4	30.6
2.	Eucalyptus	Soda-AQ	47.7	1.4	24.2
3.	Eucalyptus	Sulphate	47.3	0.6	24.7
4.	Pine	Soda	46.2	2.8	65.6
5.	Pine	Soda-AQ	47.6	1.8	58.6
6.	Pine	Sulphate	49.3	1.0	53.2

TABLE-II

PULP PROPERTIES FOR SODA, SODA-AQ AND SULPHATE PROCESSES

Sl. No.	Pulp Type	Burst factor	Tear factor	Breaking length, Km	Bulk, Cm^3/g
1.	Eucalyptus soda	33.3	85	5.21	1.63
2.	Eucalyptus soda-AQ	38.1	92	6.30	1.53
3.	Eucalyptus sulphate	49.1	105	6.46	1.50
4.	Pine soda	65.1	108	9.60	1.78
5.	Pine soda-AQ	75.0	116	11.30	1.69
6.	Pine sulphate	81.2	125	12.70	1.64

RESULTS AND DISCUSSIONS

In Table—1, the effect of small quantities of anthraquinone on soda cooking of Eucalyptus and pine woods has been shown. By soda-AQ pulping of Eucalyptus slightly high pulp yield at lower kappa number was obtained as compared with soda process, but the yield and kappa number is comparable with sulphate pulping. Similarly, results were obtained in case of pine wood. Pine pulp have high kappa number than Eucalyptus pulp which may be due to higher lignin content in softwoods. The screen rejects are less in case of Eucalyptus pulp than pine pulps. This shows AQ is effective in delignification. In Table—II, the pulp quality data is given. The conventional strength properties of Eucalyptus pulps obtained by soda AQ pulping are higher than these obtained by soda process and are comparable with sulphate process. Similar trend have been obtained in case of pine pulps. There is no significant difference in bulk of pulp obtained by kraft and soda-AQ process, although it is somewhat higher in soda pulp. This short paper is being presented, although this requires pilot plant trial and use of AQ derivatives.

REFERENCES

1. Bash, B. and Fiehn, G., Zellstoff Papier **21**, No. 3 (1972)
2. Bach, B and Fiehn, G., East German Pat 8, 549 (June 20, 1973).
3. Holton, H. H., Proceeding 63rd Annual Meeting CPPA Technical Section, Montreal (1977).
4. Holton, H. H.,—U.S. Pat 4012, 280 (March 15, 1977).
5. Ghosh, K. L., Venktesh, V., Chin, W.J. and Gratz, J. S, Tappi, 60. No. 11, 127 (1977)
6. Hasta, J. and Samuelson, O., Svensk Papperstidning, **81**, No. 9, 285 (1978).
7. Holton—, H. H. and Bhapman, F.L., Tappi, 60 No. 11, 121 (1977).
8. Farrington, A., Nelson, P. F. and Vanderhock, N., Appita, **21**, No. 2, 119 (1977).