Development of Surface Acting Agents using Naturally Occurring Phenols from CNSL, A Penetrating Aid in Kraft Pulping.

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ABSTRACT

Cashew Nut Shell Oil is a naturally occurring phenolic material. Commercially CNSL is vacuum distilled to separate cardanol. The structural features of CNSL are similar to that of many surface-active compounds, which are basically manufactured by using petrochemicals. The petrochemical based compounds are non-biodegradable and hence are not ecofriendly. Sulphonated CNSL can be conveniently used for important applications such as detergents, emulsifying, penetrating, wetting and soluibilising agents. CNSL is readily available in the West Coast Belt of India. As CNSL is obtained from natural resources it is more advantageous and eco-friendly. The compound is proved to be a good penetrating aid for pulping of hardwoods. It improves the pulp quality and yield by accelerating delignification process.

INTRODUCTION

Surfactants, also called surface-active agents are organic chemicals that change the properties of water by lowering the surface tension of water. In the paper industry there are number of areas where the surfactants have multifunctional uses. They are used as emulsifiers, solubilizers and detergents. Recycling of paper is no longer an environmental issue but a fact of life. Deinking of newspapers by the wash system in USA or Floatation system in western Europe involve surfactants like PEG esters, alcohol ethoxylates, alkyl phenol / ethoxylates modified Fatty acids and blends of specialty nonionic. Newsprint is moving towards what is called 'Super News'. This paper requires filler to help smooth the sheet, improve the brightness and control the way the ink reacts on the paper. Polyethylene oxide polymers serve as retention aids in conjugation with bentonites. In the paper industry the sizing technology has undergone radial transformation resulting in alkaline sizing. The gradual replacement of the alkylketone dimer (AKD) by Alkyl Succinic Anhydride (ASA) in the sizing market has resulted in a boost for nonionic surfactants, as ASA needs prior emulsification for use.

As there is a cellulose degradation (due to excess alkali) reaction competing with that of delignification, it is essential to ensure that alkali/AQ is transported to lignin site as fast as possible by using certain surface-active agent. This will ensure lower requirement of alkali and thus the alkali providing cellulose degradation reaction can be arrested. This should mean that use of surface active agent will not only consume lower amount of alkali but also provide pulp of improved yield (due to reduced cellulose degradation).

The desired surface-active agent, acting as penetrating aid in pulping should have following essential features:

i) It should be water soluble
ii) It should be resistant to alkali
iii) Preferably it should be structured out of phenolic moiety as that of lignin.

Sulphonated CNSL in the salt form is readily soluble in water and resistant to alkali, is well suited as a penetrating aid to increase the rate of delignification during pulping by Kraft process. Compound is obtained from natural source and also available at cheaper rate than the compounds commonly used for this purpose. The compound better competes with Anthraquinone. A combination of two also gives best result.

EXPERIMENTAL

The Mixed Hard Wood (MHW) are subjected to pulping in the laboratory by using autoclave digester. The cooking cycle and digester parameters adopted are as follows:

Following table shows various cooking experiments conducted and the results

Table No. 1 Cooking Cycle

Cooking cycle	Time hrs
80-120 °C	1
@ 120 °C	1
120-168 °C	1
@168 °C	1.25

Table No. 2 Cooking Variables

Chemicals charge A.A as Na_2O%	15-16.5
Sulfidity Percentage	15.5 to 18
Bath ratio	1:2.9
Max.Cooking temp °C	165-170
Cooking pressure (Kg/cm^2)	7-8

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Table No. 3 Pulping using Ammonium salt of sulphonated CNSL as penetrating aid

Particulars	Cook I	Cook II	Cook III	Cook IV
A. A %	15.5	15.5	15.5	15.5
Sulphidity %	18	18	18	18
AQ %	-	-	0.05	0.05
Penetrating aid %	-	1.0	-	1.0
Results				
R.A.A gpl	2.3	2.2	2.9	2.9
Total yield	46.0	44.3	41.8	43.2
Kappa No.	21	18	17	16

Table No. 4 Pulping using sodium salt of sulphonated CNSL as penetrating aid

Particulars	Cook I	Cook II	Cook III	Cook IV
A. A as Na_2O %	16.5	16.5	16.5	16.5
Sulfidity	16.5	16.5	16.5	16.5
Penetrating aid %	-	0.5	-	0.5
AQ %	-	0.05	0.05	-
Results				
R.A.A as Na_2O gpl	4.34	5.58	5.58	4.96
Total yield %	46.3%	48.2%	48.5%	48.6%
Kappa No.	21.6	16.4	17.8	18.0

Table No. 5 Optimization of penetrating aid

Particulars	Cook I	Cook II	Cook III	Cook IV	Cook V	Cook VI
A. A as Na_2O %	16.5	16.5	16.5	16.5	16.5	16.5
Sulfidity	16.5	16.5	16.5	16.5	16.5	16.5
Penetrating aid %	0.3	0.4	0.5	0.6	0.7	0.8
Results						
R.A.A as Na_2O gpl	1.2	3.1	3.8	2.9	2.9	6.0
Total yield %	47.0	48.2	48.32	46.6	47.14	48.0
Kappa No.	21	16	15	15	17	18

obtained .

Observations and discussion

1) Cook I is the blank in which pulping is done only with white liquor. Kappa No. obtained is 21 and the yield is 46%

2) Cook II Involves addition of penetrating aid with WL. It is observed that the Kappa No. is dropped from 21 to 18 and yield obtained is 44%.

The maintenance of pulp yield at the same level despite higher levels of delignification indicates that the Ammonium salt of sulphonated CNSL acts as penetrating aid and improves the rate of delignification simultaneously arresting cellulose degradation.

Comparing the effect of addition of AQ in cook III reveals that similar level of deliginification is attained, but the pulp yield with the penetrating aid is higher. This means that undoubtedly the rate of delignification is fastened by the addition of penetrating aid and selectively lignin removal is improved.

Further in cook IV penetrating aid as well as AQ is used & Kappa No is reduced to 16 and and yield obtained is about 43%.

Observation & Discussion

1. Table No. 4 shows that sodium salt is also good penetrating aid, which gives better yield and lower kappa number.

2. Penetrating aid gave same yield as that of AQ with almost same kappa number with AQ penetrating aid has given slightly lower yield but kappa number has dropped to 16 from 18, which indicates that delignification is better in presence of AQ.

3. Table No. 5 shows the optimization study of penetrating aid.

4. 0.5% addition of Penetrating aid given the best results with lowest kappa number and highest yield.

5. It is concluded that 0.5% is the active optimized concentration of penetrating aid, which will be kept constant for all further studies.

Remarks

Combination of penetrating aids and Anthraquinone prove to have better effects in the experiments. Lower sulphidity and increased active alkali gave most suitable results. In order to establish the net effect of penetration aid, further work is being continued in the laboratory to optimize dosage with and without AQ & to get better yield and lower kappa number.

CONCLUSION

Salts of sulphonated CNSL are proved to be good surface-active agents. These can be used to increase the rate of deliginification in place of Autraquinone which is 200 Rs/kg and cost of penetrating aid comes around roughly Rs.20-25/Kg Therefore higher pulp yields suggest that higher dose of penetrating aid against AQ is tolerable. It is expected that this cheap penetrating aid could substitute the costly AQ.

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