# Effective use and recovery of chemicals in cold soda pulping with partially closed system

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SUMMARY

Reuse and recycling of pulping spent liquor, fiberizing liquor and washings in cold soda pulping of *Eucalyptus tereticornis* were determined with partially closed system where 23%, of the volume of the fiberizing liquor alongwith previous spent liquor was recycled. There was a build up of solids in the range of 3.4 to 7.9% in six cycles. The pulp yield variation was not significant. The average chemical consumption was about 5% NaOH on wood. The Pulp properties were not changed significantly. Further the final cycle spent liquor properties indicated that this cold spent liquor could be processed alongwith chemical spent liquor. The system provides advantages particularly in reusing the residual sodium hydroxide and also prevents excess stream pollution due to drainage of cold soda spent liquor.

The cold soda process produces high yield pulp suitable for cheaper grade papers from many hardwood species. With the variation of the treatment, it is possible to obtain pulp that can be substituted for softwood mechanical pulp[1], the extremely high pollution loads which is generated by this CMP process will be one of limiting factor as it involves the environmental problems. In addition to dissolved organic, the CPM spent liquor usually carried 50% of residual caustic[2]. Baird et.al[3] have studied extensively the effect of reuse and recycling of spent liquors in cold soda pulping.

The recycling of spent liquor will provide a solution for effective reuse of residual caustic in spent liquor and reduction in pollution load. Further recycling of spent liquor will help in the build up of organic matters which will be desirable for chemical recovery.

The present investigation has been directed towards effect of counter current system involving reuses and recycling of spent liquor in cold soda pulp of **Eucalyptus tereticornis** species, on pulp properties, pollution load and chemical recovery of spent liquor.

## CHEMICAL TREATMENT OF E.TERETICORNIS

**Eucalyptus tereticornis** chips were impregnated in sodium hydroxide solution keeping to liqour ratio of 1:4 at room temperature for over night. The concentration of NaOH applied was 35 gpl.

Fig. 1 shows the partial closed cold soda pulping. After the first treatment spent liquor was subsequently used in next cycle along with 610 ml of fiberizing liquor after the two stage refining. Treated chips were refined in two stages. The final volume obtained after two stage of refining was 16 litres and refined pulp was washed with 23.5 litres.

After refining the pulp was collected and screened in laboratory flat screen of 0.25 ml slit width. Yield and brightness of unbleached pulps were determined. The results are recorded in Table (2).

The spent liquors, fiberizing liquors and washings obtained in each cycle were analysed for pollutional parameters and chemical composition as per standard methods given in[4].

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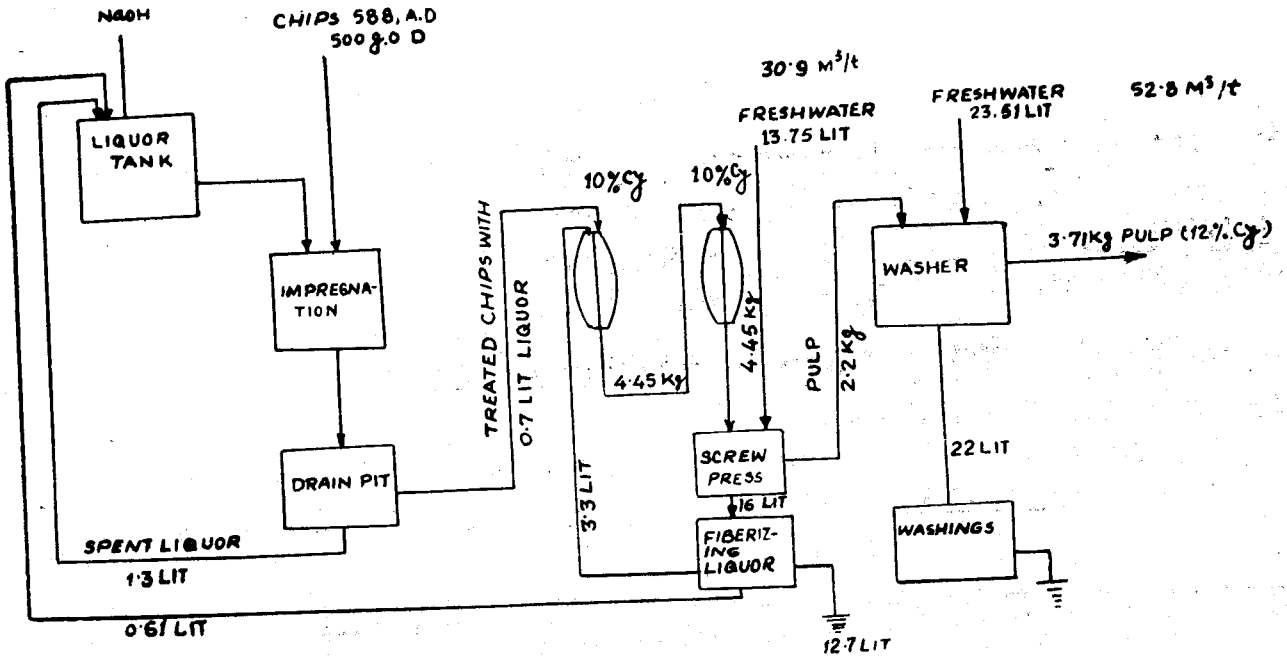


FIG.1. FLOW DIAGRAM FOR PARTIALLY CLOSED COLD SODA PULPING

TABLE—1 DISTRIBUTION OF ALKALI IN VARIOUS LIQUORS IN PARTIALLY CLOSED SYSTEM

| Cycle No. | Residual NaOH, g/l | | | % of applied NaOH consumed | % NaOH consumed on o.d. wood basis |
|---|---|---|---|---|---|
| | Spent liquor | Fiberizing liquor | Washings | | |
| 1. | 19.67 | 1.13 | 0.31 | 31.3 | 4.4 |
| 2. | 18.60 | 0.72 | 0.15 | 0 15 | 6.4 |
| 3. | 19.57 | 0.93 | 0.16 | 38.7 | 5.4 |
| 4. | 19.30 | 0.93 | 0.10 | 41.9 | 5.9 |
| 5. | 18.13 | 0.82 | 0.82 | 46 6 | 6.5 |
| 6. | 18.70 | 1.08 | 0.10 | 38.5 | 5.4 |

TABLE—2 EFFECT OF RECYCLING OF SPENT LIQUORS ON YIELD, BRIGHTNESS AND STRENGTH CHARACTERISTICS OF COLD SODA PULPS IN PARTIALLY CLOSED SYSTEM

| Cycle number | Total yield | Unbleached pulp brightness | Strength properties of pulps at 100 ml CSF | | | |
|---|---|---|---|---|---|---|
| | | | Apparent density | Burst index | Tensile index | Tear index |
| | % | % | g/cm³ | kPa.m²/g | Nm/g | mNm²/g |
| 1. | 84.44 | 25.4 | 0.48 | 0.25 | 19.0 | 1.95 |
| 2. | 85.69 | 23.6 | 0.48 | 0.30 | 19 0 | 1.75 |
| 3. | 85.50 | 25.3 | 0 49 | 0.25 | 18.0 | 1.95 |
| 4. | 84.92 | 25.6 | 0.49 | 0.30 | 19.0 | 1.70 |
| 5. | 85.12 | 26.0 | 0.47 | 0.25 | 18.5 | 1.75 |
| 6. | 84.82 | 25.7 | 0.48 | 0.30 | 18.5 | 1.90 |

TABLE—3 COMPOSITION OF LIQUORS IN PARTIAL CLOSED SYSTEM

| Cycle No. | Spent liquor | | | | | | Fiberizing liquor | | | | | | Washings | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T.S. | TSS | pH | Color | COD | Inorganics as NaOH | T.S. | TSS | pH | Color | COD | Inorganics as NaOH | T.S. | TSS | Color | COD | Inorganics as NaOH |
| | % | g/l | | g/l | g/l | % | % | g/l | | g/l | g/l | % | % | g/l | g/l | g/l | % |
| 1. | 3.40 | 3.48 | — | — | 19.6 | 63.1 | 0.35 | 0.3 | 11.5 | 7.1 | 1.74 | 61.4 | 0.15 | 0.44 | 0.57 | 0.4 | 36.7 |
| 2. | 5.53 | 6.60 | — | 114 | 35.2 | 57.7 | 0.42 | 0.3 | 11.5 | 9.8 | 2.03 | 43.1 | 0.17 | 0.34 | 0.64 | 0.5 | 48.2 |
| 3. | 6.51 | 8.59 | 11.0 | 243 | 38.7 | 53.7 | 0.48 | 0.5 | 11.5 | 13.6 | 2.52 | 51.6 | 0.16 | 0.26 | 0.89 | 0.5 | 44.8 |
| 4. | 7.19 | 10.10 | 11.0 | 264 | 44.3 | 51.4 | 0.57 | 0.5 | 11.6 | 21.8 | 2.83 | 46.8 | 0.22 | 0.58 | 1.00 | 0.4 | 41.1 |
| 5. | 7.77 | 10.10 | 11.1 | 270 | 48.6 | 49.0 | 0.58 | 0.6 | 11.7 | 18.6 | 3.22 | 44.7 | 0.21 | 0.88 | 1.43 | 0.4 | — |
| 6. | 7.89 | 7.63 | 11.1 | 309 | 50.8 | 49.2 | 0.56 | 0.5 | 11.6 | 18.9 | 3.22 | — | 0.17 | 0.44 | 1.86 | 0.5 | — |

All the unbleached pulps were evaluated for strength properties at $100 \pm 10$ ml CSF according to 150 Standard given in[4].

The evaporation and burning properties of cold spent liquors, were studied as per the procedures given in[4]. The results are given in Table (5).

## RESULTS AND DISCUSSIONS

Residual alkali distribution in various liquors has been shown in Table 1. It is evident that concentration of residual alkali was not much changed in subsequent cycle. The residual alkali distribution was observed 56% in spent liquor, 36% in fiberizing liquor and 8% in washing. This shows that 90% of residual alkali has been carried out by spent and fiberizing liquor. There was no trend in alkali consumption. The effect of reuse and recycling on pulp properties is given in Table 2. It is evident that pulp yield has not much changed at 6th cycle. The brightness of pulp have little variation. Strength properties of pulps did not change by recycling. Yield increased from original 8.44 to 85.7 and brightness dropped from 25.4 to 23.6.

From Table 3 it can be seen that the amount of total solid content present in spent liquor increase gradually with each cycle. The total solids content in spent liquor had build up to over 7.9%. The composition of fiberizing liquor coming from refiner is also given. The values show small gradual increase. In all cases, the maximum usable volume for make up of the next impregnating liquor (or 23% of fiberizing liquor) was combined with the spent liquor.

From Table 4 it can be observed that pollution load (COD) varies from 142 kg/t to 284 t from 1st to 5th cycle Colour load was considerably lower due to addition of fresh water in the system during processing. It is further evident from Fig. 1 that water consumption was as high as 83.7 $m^3$/t pulp.

From Table 5 results indicate that the cold soda spent liquor had low viscosity. However, it showed very poor swelling volume ratio which might be due to higher amounts of inorganic portion. This spent liquor which will be about 20$M^3$ from each cycle for 70 t/d. production could be processed alongwith chemical spent liquor.

TABLE—4 POLLUTION LOADS OF VARIOUS POLLUTIONAL PARAMETERS IN PARTIAL CLOSED SYSTEM

| £ Cycle No. | Spent liquor | | | | Fiberizing liquor | | | | Washings | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Suspended solids | Organics | COD | Colour | Suspended solids | Organics | COD | Colour | Suspended solids | Organics | COD | Colour |
| 1. | 9.8 | 96.2 | 54.9 | — | 9.5 | 58.1 | 66.1 | 268 | 22.9 | 47.4 | 20.6 | 30 |
| 2. | 18.2 | 64.9 | 96.8 | 314.8 | 10.5 | 100.4 | 75.8 | 367 | 17.5 | 45.7 | 25.0 | 33 |
| 3. | 25.2 | 91.5 | 113.0 | 710.5 | 18.7 | 86.3 | 94.2 | 508 | 13.3 | 45.4 | 25.0 | 46 |
| 4. | 28.7 | 104.6 | 127.3 | 759.6 | 18.9 | 113.1 | 106.6 | 322 | 30.1 | 67.1 | 20.9 | 52 |
| 5. | 29.4 | 120.1 | 141.9 | 786.8 | 24.1 | 119.4 | 120.9 | 699 | 45.5 | — | 20.8 | 74 |

* Expressed as kg/t of O.D. Pulp.

TABLE—5 PROPERTIES OF COLD SODA SPENT LIQUOR FROM PARTIALLY CLOSED SYSTEM

| Solids % | RESIDUAL NaOH | Inorganics as NaOH | Breekefield viscosity, cps at 80°C at % solids | | | | Swelling volume ratio ml/g |
|---|---|---|---|---|---|---|---|
| | g/l | | 35 | 45 | 50 | 55 | |
| 7.89 | 18.70 | 49.2 | 6.3 | 9 | 16 | 30 | 4.0 |

## CONCLUSIONS

1. The solids build up, in partially closed system where only spent liquor and part of fiberizing liquor is used, is slow.

2. The pollution loads are on higher side as the washings and part of fiberizing liquor from last cycle have to be drained.

3. Spent liquor from last cycle having nearly 8% solids could be processed alongwith chemical spent liquor.

4. The recycling of spent liquor did not have any influence on pulp properties.

5. The partially closed recycling system will be more effective when washing stage uses limited quantities of water.


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