The Sunds Defibrator Non-Wood Fiber Technology

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INTRODUCTION

Non-wood fibers such as bagasse, straws and reeds are well suited for the production of bleached chemical pulps. In many part of the world they are the predominant fiber resource, producing good quality pulps for printing and writing papers.

During the last decade, both the market and the environmental organisations have put a pressure on the pulp industry to intensify the development activities towards reduced emissions and effluent volumes from the pulp mills, and especially from the bleach plants. Environmental regulations in many countries have put limits to the amount of organic compounds in the bleach plant effluents.

This paper will describe the different process steps in the Sunds Defibrator fiberline for non-wood fibers, and the impact on these steps on efficient pulp production, both with regards to pulp quality and environmental concern.

THE FIBERLINE

The Sunds Defibrator fiberline for production of bleached chemical pulps based on non-wood fibers is shown in **Figure.1** The following process steps are included:

- The continuous tube digester system
- Brown stock washing including wash presses and screening
- Oxygen delignification

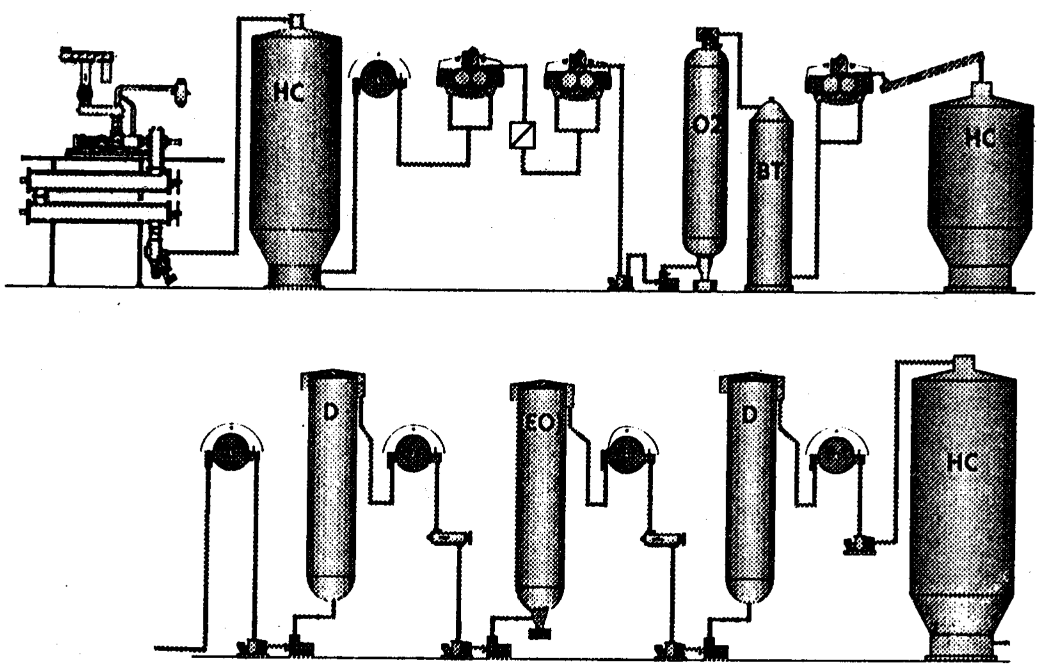


Fig 1. Sunds Defibrator Fiberline for non-wood fibers

Mechano Paper Machines Ltd, Calcutta, India
Sunds Defibrator AB, Sundsvall, Sweden

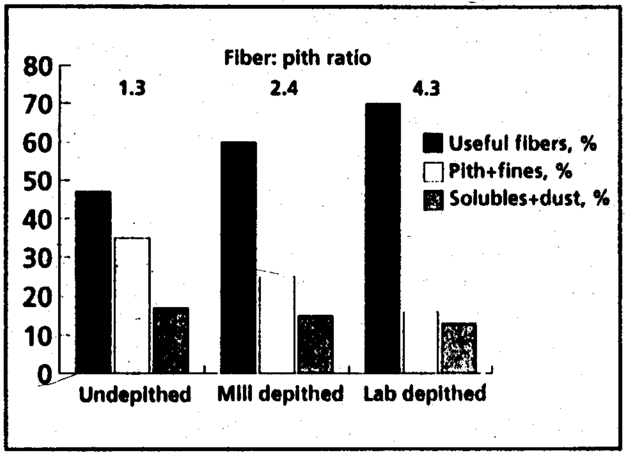


Fig 2. Depithing of bagasse.

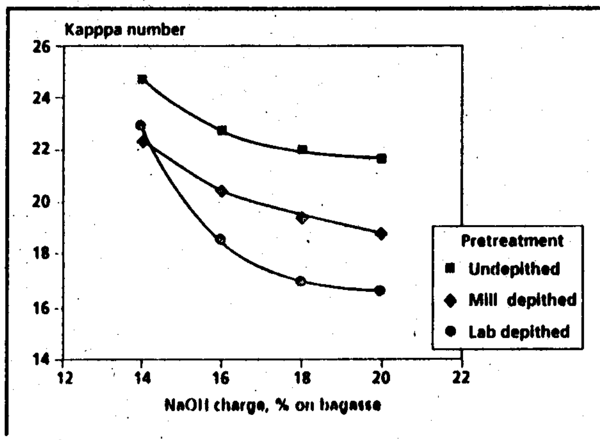


Fig 3. Soda cooking of bagasse.

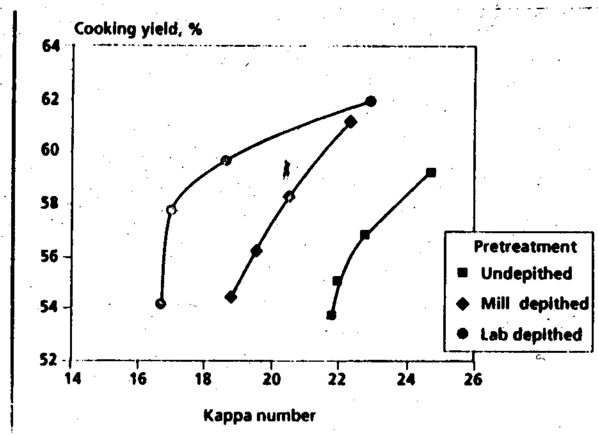


Fig 4. Soda cooking of bagasse.

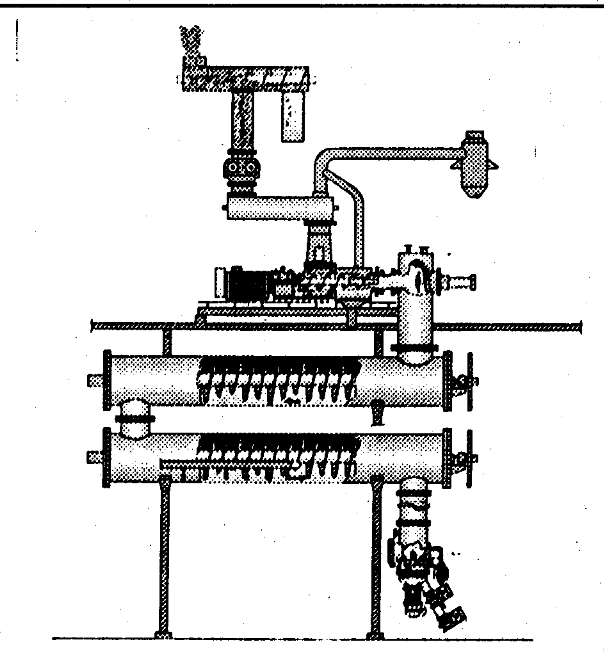


Fig 5. Continuous digester for non-wood cooking.

Three stage ECF bleaching, D(EO)D, with upflow towers and wash filters.

DEPITHING/PRETREATMENT

An efficient pretreatment of the raw material is essential for a successful operation of a non-wood fiber plant. Impurities such as pith (in the case of bagasse) must be removed in the best possible way as it will negatively affect chemical requirement, drainability and product quality. Three samples of bagasse of the same origin were soda cooked in the laboratory: Undepithed, depithed at the mill and the first sample depithed at our laboratory. The pith contents are shown in **figure 2.** The great influence that the pith content has on chemical consumption and yield in the cooking is clearly shown in **figures 3 and 4.**

TUBE DIGESTER COOKING

The continuous tube digester system is shown in **figure 5.** The raw material is fed into the screw feeder by means of screw conveyors. In the screw feeder the raw material is compressed before entering the digester tubes. After the cooking phase the pulp is discharged in a cold blow system. The major advantages of this process are:

- Thorough chemical impregnation ensuring uniform, high quality pulp.
- Cold blowing improving pulp strength
- Optimum heat economy
- Low investment costs.

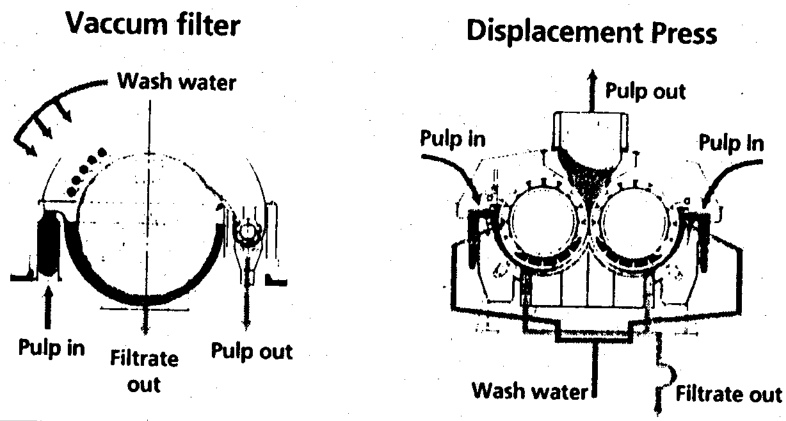


Fig 6. Principal of two different washer.

During the last 40 years, Sunds Defibrator has delivered more than 50 digesters of this type for non-wood fibers, mainly for bagasse.

WASHING

Washing of the pulp is another very important process step in order to reduce the consumption of bleaching chemicals and the discharge of organic material in the effluents.

The wash loss has historically been expressed as sodium sulfate which is an improtant parameter when looking at the recovery of inorganic chemicals. The wash loss of organic material, measured as COD (Chemical Oxygen Demand), is however more improtant from environmental impact point of view. It will affect the chemical consumption in the bleach plant, and it will contribute to the formation of chlorinated organics during bleaching.

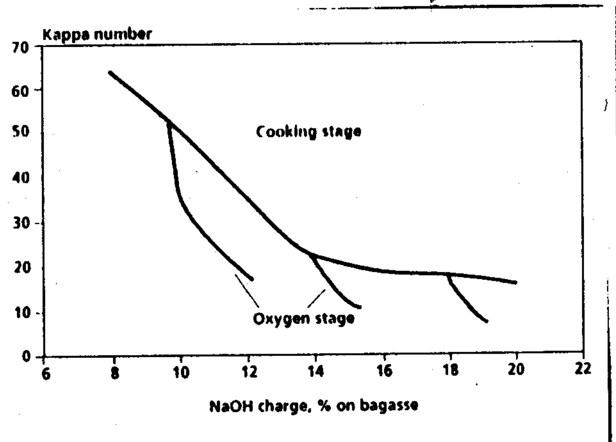
A low level of COD in the pulp after brown stock washing will also affect the pulp quality in a positive way, and can only be achieved with an efficient brown stock washing.

Our two types of washer are described in **figure 6,** the vaccum filter and the displacement press. Actual pulp consistencies and washing efficiencies for vaccum filters and displacement presses are presented in **figure 7.** The displacement press is a more efficient pulp washer than the vaccum filters.

The dissolved organics in the pulp entering the bleach plant will increase the consumption of

Washing Efficiency (%)	Pulp cons. Inlet (%)	Pulp cons. Outlet (%)	COD
Vacuum filter	1.0-1.5	10-14	65
Displacement press	3-5	30-32	85

Fig 7. Pulp consistency and washing efficiency for filters and presses.



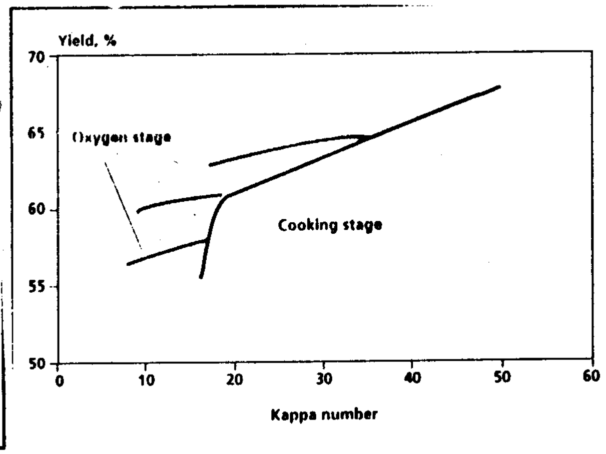


Fig 8 and 9. Results from oxygen delignification of bagasse pulp.

bleaching chemicals. As a general rule, a carry over of 10kg COD/ton of pulp will increase the consumption of active chlorine by about 6 kg/ton of pulp. A good washing performance is therefore essential.

OXYGEN DELIGNIFICATION

A further reduction of the kappa number before bleaching is possible by introducing an oxygen delignification stage. This is today an accepted standard technology in the wood-based pulp industry. This technology makes it possible to further reduce the kappa number by up to 50% before entering the bleach plant. Such a reduction in kappa number will also result in a corresponding reduction of the bleach plant effluent load by about 50% measured as COD, BOD, colour and chlorinated compounds (AOX).

An oxygen delignifieation stage is a much more effective way to reduce the kappa number compared to an extention of the cooking stage. **Figures 8 and 9** shows results for oxygen delignification of bagasse pulp. The amount of chemicals required to reach a certain kappa number is cosiderably decreased and the yield is much more preserved when cooking is combined with oxygen delignification in an optimal way compared to extended cooking.

A medium consistency oxygen delignification stage for non-wood fibers is shown in **figure 10.**

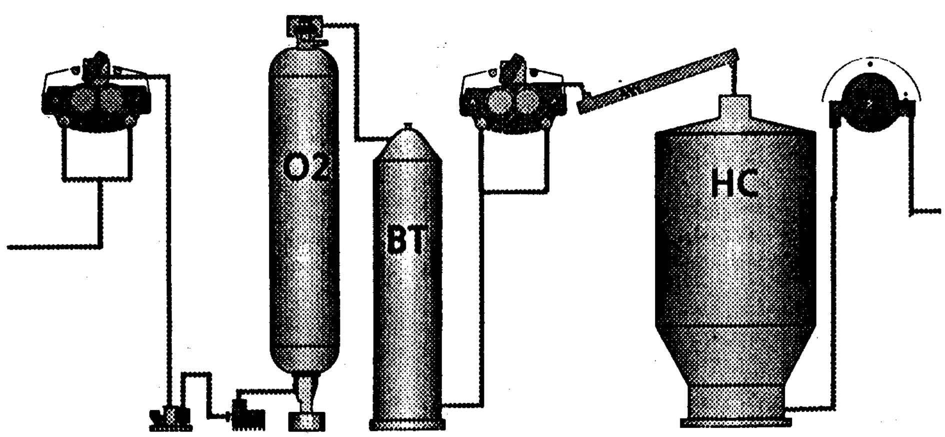


Fig 10. A medium consistency oxygen stage.

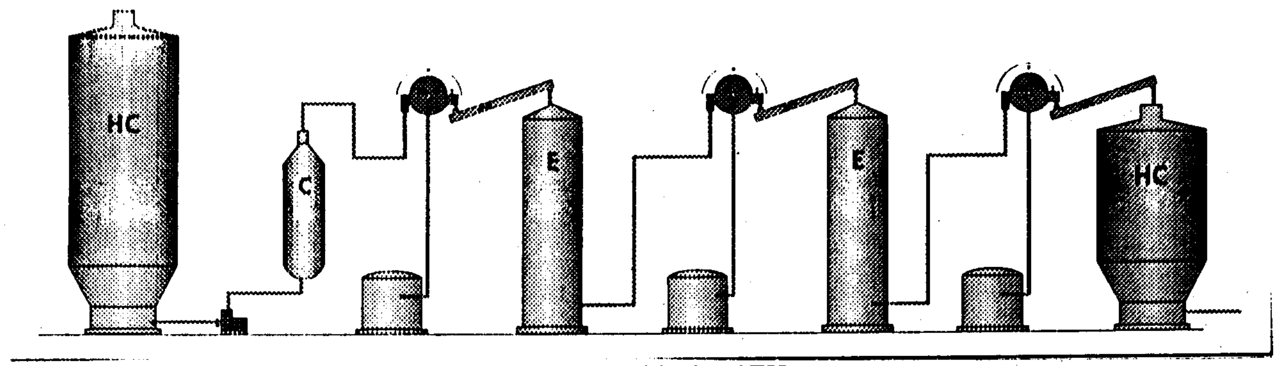


Fig 11. Bleach plant with the CEH sequence.

Typical operating conditions are 12% pulp consistency, 95-100°C temperature and 60 minutes retention time.

BLEACHING

Chemical pulps based on non-wood fibers are today normally bleached with chlorine and hypochlorite in the sequence CEH **(figure 11)** causing a severe load of chlorinated organics in the effluents. Furthermore the cellulose degradation in the hypochlorite stage is considerable, resulting in lower pulp quality even at moderate brightness levels.

The effect of introducing oxygen delignification and chlorine dioxide is presented in **figure 12.** By introducing an oxygen stage, the consumption of bleaching chemicals to reach brightness levels over 80% ISO is reduced by more than 50%. By introducing chlorine dioxide as main bleaching chemical it is possible to reach very high brightness levels with preserved pulp quality and low environmental load. As shown in the table, the strength potential (measured as pulp viscosity) is increased and the formation of chlorinated organic matter (AOX) is considerably reduced when changing from CEH to O(D+C)(EO)D bleaching.

However another interesting alternative to chlorine/chlorine dioxide or ECF bleaching is a TCF bleaching sequence based only on oxygen and

Bleaching Sequence	Kappa No.	Charge ActiveCl kg/odt	Bright- ness %ISO	Intrinsic viscosity dm^3/kg	COD kg/odt	AOX kg/odt
CEH	19	52	83	750	62	5.2
OCEH	11	25	86	800	38	2.8
(D+C)(EO)D	19	60	88	1000	74	1.8
O(D+C)(EO)D	11	32	89	900	40	0.7

90% ClO2 substitution in (D+C)

Fig 12. Bleaching data for bagasse pulp.

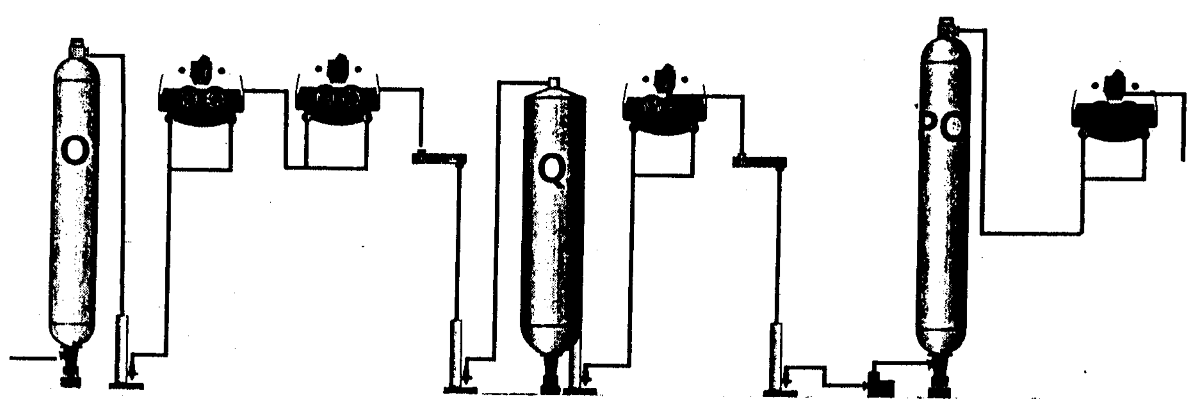


Fig 13. Sequence OQ(PO).

Temperature	100-105°C
Time	120 min
Oxygen	4-6 kg/odt
Pressure (Reactor Top)	0.3-0.4 MPa

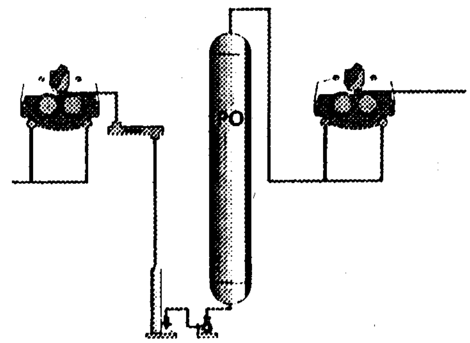


Fig 14. Typical operating data for a PO-stage

peroxide. **Figure 13** shows a simplified flowsheet for the sequence OQ(PO).

After oxygen delignification the pulp is treated in a chelating stage (Q-stage) where metal ions like manganese and iron (which will disturb the peroxide bleaching reaction) are removed. Finally the pulp is bleached in a high temperature peroxide stage, (PO)-stage. Typical operating conditions for a (PO)-stage are shown in **figure 14.** With a OQ(PO) sequences bagasse pulp can easily be bleached to brightness 85-86% ISO as shown in **figure 15.**

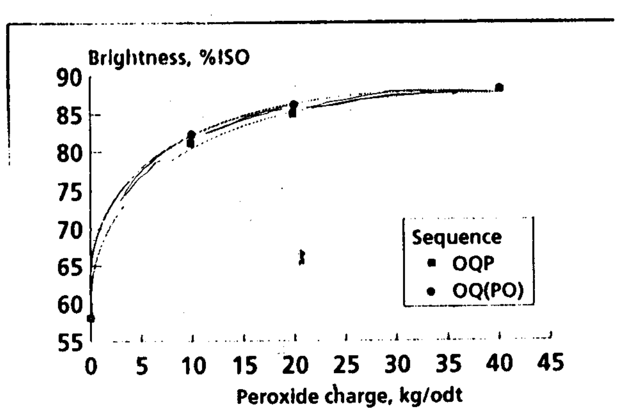


Fig 15. TCF bleaching of bagasse pulp.

CONCLUSIONS

A careful attention to the whole fiberline, from the depithing operation to the bleach plant, is essential in order to produce an environmental friendly and cost effective high quality pulp.

An efficient pretreatment/depithing operation is essential as it will significantly improve chemical requirements, drainability and product quality.

An efficient cooking and oxygen delignification will result in a low kappa number prior to bleaching with preserved yield and fiber quality.

A good washing will ensure a low carry over of dissolved organics (COD) into the bleach plant, and thereby decrease the consumption of bleaching chemical and the discharge of organic matter.

The use of chlorine dioxide as bleaching chemical will reduce the formation of chlorinated organic compounds and increase the pulp quality.

TCF bleaching based only on oxygen and peroxide is also an interesting alternative as brightness levels up to 85-86% ISO can easily be reached for example in the sequence OQ(PO).