Commercial Utilization of Cold Blow and Extended Delignification Techniques in Batch Cooking

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INTRODUCTION

Conventional batch kraft cooking has many advantages in comparison with the continuous kraft process :

- High Availability
- Simple Design and Operation
- High Flexibility
- Low Sensitivity to Chip Quality Variations
- Low K-no. Variations
- Easily Expanded to High Production

On the other hand energy demand for continuous cooking has typically been about 40% lower than for the conventional batch process. This means that it has been necesrary to develop a moie energy efficient datch tcchnology.

At the same time new process technologies aiming at more selective delignification have been developed. The extended delignification technology offers the possibility to reach lower K-no.s, thereby reducing the chemical consumption as well as the effluent from the bleach plant.

These new technologies, cold blow and extended delignification, have been tested in full scale at the ASSI Karlsborg mill in Sweden.

Based upon successfull results, Karlsborg decided in 1984, to convert their 9350 cu.ft. batch digesters to the Sunds cold blow and extended delignification techniques. Start-up of the new system was in September, 1985.

THE COLD BLOW SYSTEM

The cold blow technique (Figure 1) comprises the following steps :

- Chip filling where the chips are evenly distributed and packed within the digester preferably by utilizing a steam packer.
- After the digester has been filled with chips it is steamed with low pressure steam. added at the top of the digester. Air is vented through the strainers until the chips are preheated to about 210°F.
- White liquor preheated in a heat exchanger to almost cooking temperature and hot black liquor from a pressurized accumulator are charged to the digester. After Liquor charging, the digester content will have a temperature of about 290°F as compared to 170–190° for a conventional batch system.
- The higher starting temperature will result in a shorter heating time and also reduce the steam consumption for heating. As mentioned, the heating can be preformed either directly or indirectly.

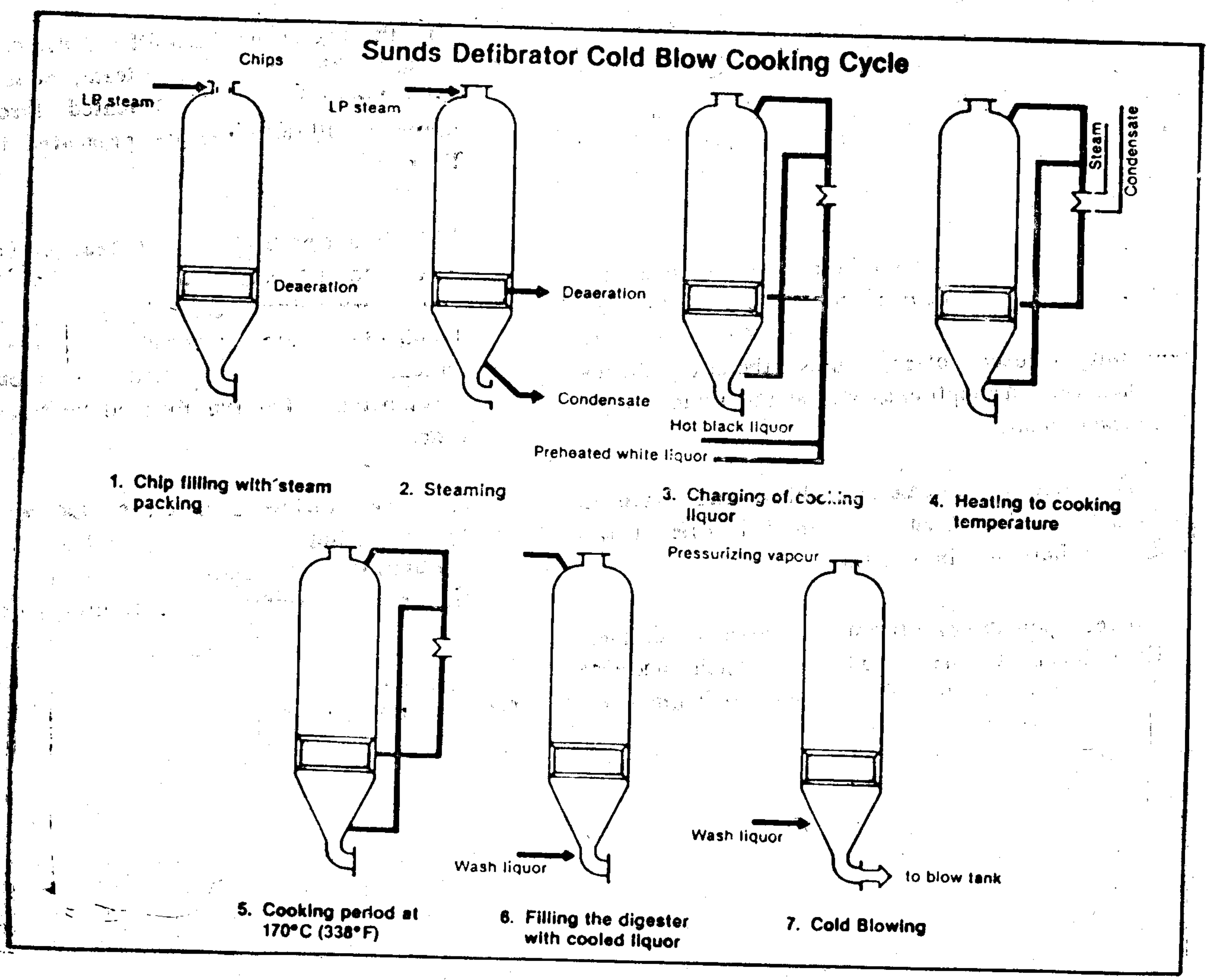
*Sunds Defibrator, Singapore

— The digester is then kept at cooking temperature and pressure until the target K-no. is reached.

— Cooking is interrupted by charging washer filtrate to the bottom of the digester, thus displacing the hot cooking liquor through strainers at the top of the digester. The hot liquor is collected in the accumulator. The digester content is cooled down to about 210°F. The hot black liquor in the accumulator is utilized for preheating of white liquor as well as for recharging black liquor as well as for recharging black liquor in the next cook.

— The actual blowing of the digester starts by opening the blow valve. Pressure in the digester is maintained by connecting the accumulator to the top of the digester. The cold blow is more rapid and efficient than a conventional hot blow due to the reduced flashing. The cold blow technique has proven to eliminate TRS emissions from the digester area since gases relieved from the blow tank are condensed in an indirect condenser. The noncondensable gases leaving the condenser can either be burned in the lime kiln or in a separate burner.

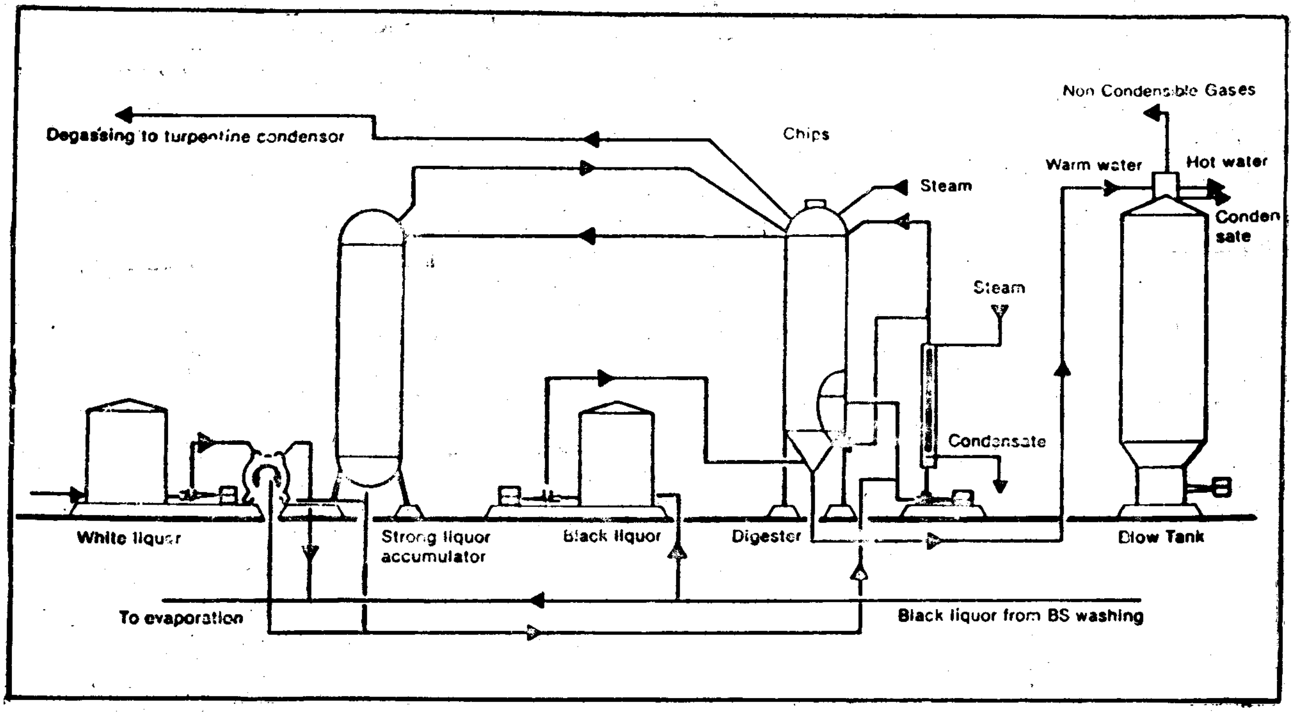
FIGURE-1



A principle flow sheet for the cold blow system is shown in Figure 2. No conventional blow heat recovery is required. The hot liquor accumulator, the white liquor heat exchanger, and the black liquor tank for cooling liquor are characteristic for the cold blow system. Further-more, less digester volume is required for a certain capacity due to the reduced time for heating and an overall shorter cooking cycle compared to a conventional batch system.

Table I compares energy consumption for direct and indirect heating with conventional hot blow as well as cold blow. Conventional hot blow with indirect heating results in lower energy consumption in

FIGURE–2



ENERGY CONSUMPTION (Million BTU/Ton)

	Hot Blow		Cold Blow	
	Direct Heating	Indirect Heating	Direct Heating	Indirect Heating
COOKING	4.5	3.9	2.5	2.3
EVAPORATION	4.5	3.5	4.0	3.6
TOTAL	9.0	7.4	6.5	5.9

cooking and evaporation than direct heating since the steam condensate can be recycled to the boiler house. Cold blow reduces steam consumption as the white liquor is preheated and the hot black liquor is recharged to the digester, resulting in a higher starting temperature.

EXTENDED DELIGNIFICATION

By combining two-stage cooking and cold blow as shown in Figur 3 it is possible to extend the delignification to a lower K-no. without viscosity and pulp strength losses. The initial cooking cycle phases of chip filling, steaming, liquor filling and heating are identical with the cold blow concept except the white liquor charge is split in two stages.

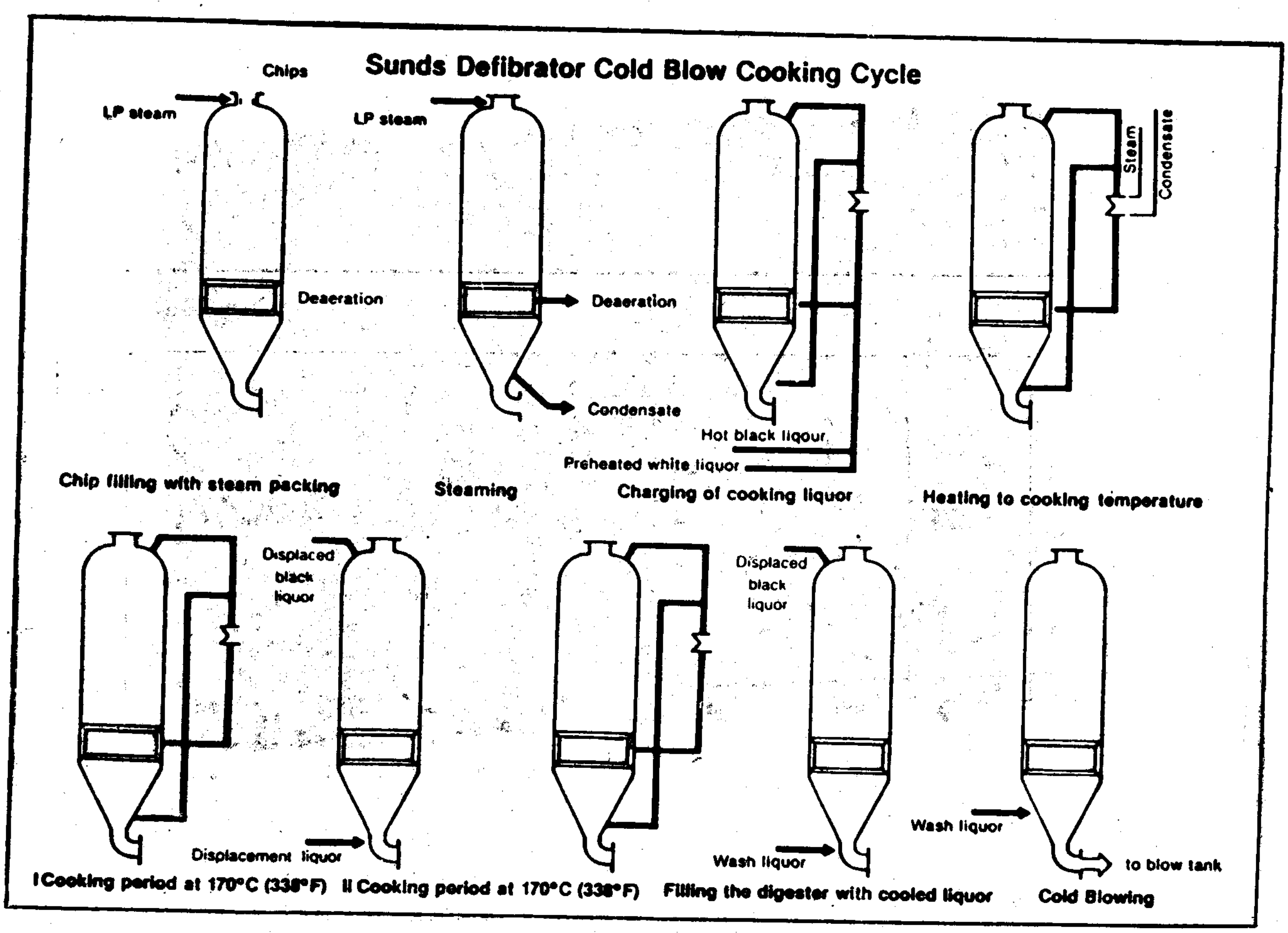
— In the first cooking phase the digester is kept at cooking temperature until a target H-factor is reached.

— The hot cooking liquor with high dry solid content is displaced by hot black liquor with a low content of solids. Additional white liquor is simultaneously charged for the second cooking phase. The displaced cooking liquor goes to a hot liquor accumulator. Displacement stops when a preset volume has been displaced.

— Then the second cooking phase continues until the target K-no. is reached.

— The final cooling and cold blowing are performed the same way as described before for the cold

FIGURE-3



blow system. The main difference in equipment between the two systems is that two black liquor accumulators are required for extended delignification while one is enough for cold blow.

Figure 4 shows the cooking cycle for 9350 cu.ft. digesters. The short heating time required for the cold blow technique will fully compensate for the extra displacement and cooking phases. The total cooking time for extended delignification will in fact be shortened by some 20 minutes resulting in 7% higher digester capacity.

The ASSI Karlsborg installation has no preheating because of the need to produce hot water for the bleach plant. Heating time is thus extended by 20 minutes, but the total cooking time is still shorter than the conventional system. In fact, results obtained from the start-up prove the cycle time is shorter than xpected since only 10-15 minutes are required to blow these large digesters.

The main reason the ASSI Karlsborg mill decided to install the extended delignification combined with cold blow was they wanted to reduce steam usage and simultaneously produce a pulp with better pulp strength-K, no. relationship. This enables Karlsborg to extend the delignification of their softwood to a K-no. of less than 17 and still maintain the same viscosity as with conventional cooks at a K-no. of 20-21. Mill data from Karlsborg is shown in Figure 5. At a certain K-no. the viscosity increase is about 10%.

The extended delignification lowers the bleach chemical consumption as well as bleach plant effluent.

The cooks at Karlsborg were performed manually during start-up to try out the sequence control but are now performed automatically. H-factors are calculated for the two cooking phases. Another important experience is the cold blown pulp drains more easily,

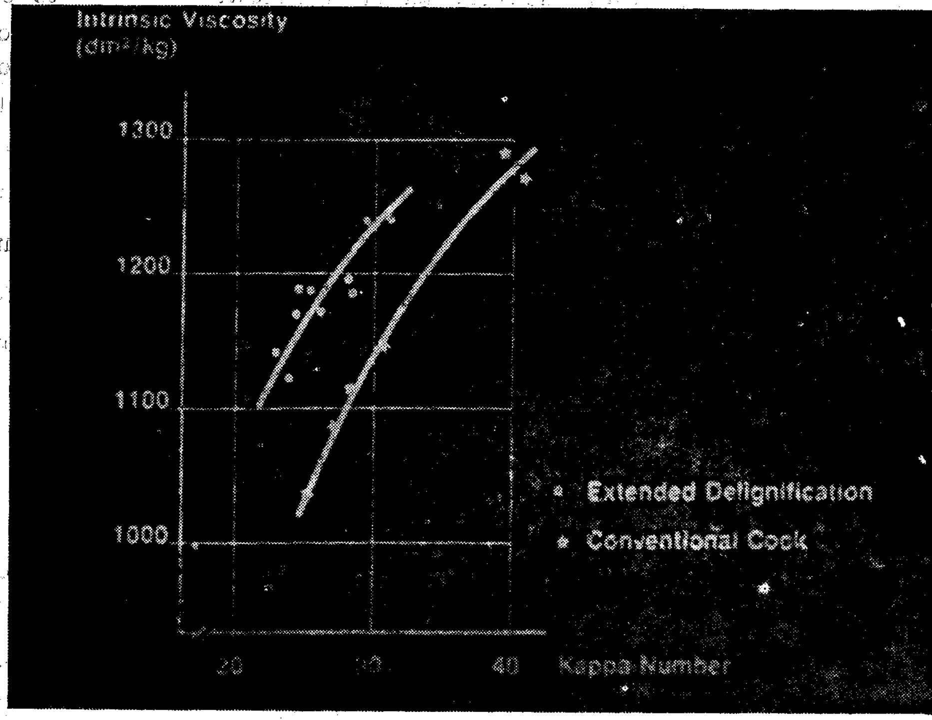
This has increased the BSW discharge consistency and improved the washing efficiency.

The Sunds Defibrator cold blow technique has recently also been demonstrated in a North American kraft mill with steam batch digesters. One of the exis-

FIGURE–4.

Cooking Cycle for 265 m³ Digesters

	Conventional cooking	Extended Delignification with cold blow
Chipfilling	40	40
Presteaming	25	25
Liquor charge	20	20
Heating	90	45
Pressure phase 1	40	15
Displacement		25
Pressure phase 2		30
Cooling		20
Blow	45	20
Spare time	15	15
Total Cooking Time	275 min	255 min
Digester Plant Capacity (considering 6 digesters)	810 ADT/D	860 ADT/D



ting 8000 cu ft. digesters has been converted to cold blow. Heat savings are better than expected, demonstrating a very even liquor displacement. Also, in this case, performance of the BSW has improved significantly.

CONCLUSIONS

The cold blow and extended delignification process offers the following advantages :

- Lower K–no on Brown Stock without loss in Viscosity.
- Elimination of TRS Emissions.
- Reduced Effluents from the Bleach Plant.
- Reduced Steam Consumption in the Digester Plant.
- Reduced Chemical Consumption in the Bleach Plant.
- Improved Brown Stock Washing Due to the Displacements in the Digesters.

The process can be operated with a gas phase in the top of the digester and is consequently applicable on both directly and indirectly heated digesters.

SUMMARY

The pulping industry has shown great interest in the Sunds Defibrator cold blow and extended delignification process. Most existing batch cooking plants can be retrofitted. A payback time of 1 1/2-3 years can be expected if taking only steam savings into consideration. Other positive impacts such as elimination of TRS emission improved pulp quality and washing also contribute to make this technique attractive.