PEROXIDE BLEACHING OF SGW FOR THE PRODUCTION OF COATED PRINTING PAPER FOR OFFSET AND ROTOGRAVURE

High-brightness sheets can be produced without optical brightener

BY K. BUSSMAN AND J. KAPPEL

THE FELDMÜHLE HAGEN-KABEL mill, Germany, currently produces 520 000 tonnes/year (t/y) of coated wood-free and wood-containing printing papers using three paper machines. Only the smallest machine previously used peroxide-bleached stone groundwood (SGW). The other two were supplied with dithionite bleached pulp. The capacity of the new bleach plant was designed to replace the existing medium-consistency peroxide bleach plant and, in addition, to supply one of the two larger paper machines.

The objective when planning the plant configuration was to produce high-brightness SGW (80 to 82% ISO) with a minimum of chemical costs, additional waste water load and carry-over to the paper machine. A complete two-stage peroxide bleaching system hardly pays with groundwood pulp, as shown in [1]. Recirculation of residual bleaching chemicals to the same bleach tower as suggested in [2] leads to a build-up of impurities, as shown in [3].

Thus, a two-stage system using high-consistency peroxide and dithionite was chosen, according to [4]. In order to limit the carry-over from the bleach plant to the paper machine, a washing stage was installed after the high-consistency peroxide stage similar to the plant described in [5].

Evaluation of the data in the literature and laboratory-scale bleaching tests led to the following concept:

- High-consistency peroxide stage;
- Washing stage;
- Dithionite stage.

SCHEDULE

- A task force was formed in mid-June 1988 to define throughput, technology and the basic concept.
- Three suppliers with widely differing concepts were shortlisted.
- In January 1989, the order was placed with the supplier that proposed the lowest expected chemical consumption, maximum brightness, specific energy consumption and best references available.
- Civil work started on June 1, 1989.
- Erection work began in August 1989 and was completed on schedule on January 7, 1990.
- Delayed approval by the authorities postponed start-up to April 1990.
- Bleached pulp could be supplied to one paper machine from May 10, 1990. The other paper machine followed shortly afterwards.
- The change-over to bleached pulp from the new plant only required the paper machine to be shut down for 45 minutes in order to complete electrical wiring and make some changes to the control system.

PLANT CONFIGURATION

SGW from pine (17%) and spruce (83%) with a freeness of 70 mL CSF is produced using continuous grinders. Two paper machines can be supplied with either bleached or unbleached pulp from this groundwood pulp (GWP) plant. According to the requirements of the paper machines, the turn-down production ratio needed is 4:1.

In the peroxide stage, the pulp suspension is thickened from 4 to 35% consistency using two double-wire presses. The fibre mat is then shredded and fed to the high-consistency mixer using screw conveyors. In the mixer, the fibre...
bundles are broken down into loose structures and the bleaching chemicals are mixed in.

After a retention time of 2.5 hours, the pulp is discharged from the tower without dilution using a slowly rotating scraper. After dilution in a screw conveyor, the pulp drops into the standpipe of a medium-consistency pump (SF pump) and is fed to the double-wire wash press equipped with a medium-consistency headbox. In this press, the pulp is thickened, re-diluted with warm fresh water and dewatered again. Dilution to 4 or 10% takes place in the subsequent screw conveyor.

There are two dithionite bleaching lines, operating at 4% and at 10% consistency. In the existing 4% line (not shown in Fig. 2), chemicals are added ahead of the post-refiner. The retention time in the bleach tower is 60 to 90 minutes. There is no post-refining in the 10% line, which can also be operated at 4%. Chemicals are dosed ahead of a pump and the retention time is 2 to 5 hours. Pulp chests with a capacity of 50 to 100 m³ are installed before and after the bleaching stages to equalize the flow of pulp.

Three water circuits were installed in order to optimize washing efficiency, Fig. 3. The water circuits of the P and Y stages are completely separate, thus resulting in minimum carry-over to the paper machine, low chemical charge and easy operation.

After the high-consistency bleach plant, the pulp is diluted with clear filtrate from the paper machine which was previously fed to the SGW plant. The double-wire wash press has two water circuits, one using the filtrate before and one with the filtrate after the washing section, Fig. 4.

The concentration of residual peroxide differs in these two filtrates. The greater part of the filtrates is used for dilution after the bleaching tower and the surplus, caused by the addition of wash water, can be recirculated ahead of the bleach plant in order to make use of the residual peroxide, or it can be bled to the effluent treatment plant to purge the COD load.

**OPERATING RESULTS**

**Peroxide stage:** Since the aim of the installation was to achieve high final brightness with a minimum of chemical costs, single-stage operation with peroxide was only run for three days during start-up. Most of the reliable data, Fig. 5 and Table 1, therefore, cover the range of 1.5 to 2.5% peroxide addition (based on bone-dry pulp).

During the first operating phase, the bleaching parameters, for NaOH, silicate, temperature, time and water circuits, were optimized. The final brightness was increased by 2 points during this phase. Usually, a peroxide addition of 1.8% results in a final brightness of 78% ISO. The data were collected during single-stage operation in the startup phase and three months after this.

**Dithionite stage:** The dithionite stage was operated most of the time at a bleaching consistency of 4%. Some comparisons

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**TABLE 1. BLEACHING PARAMETERS: PEROXIDE STAGE.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency in the bleach tower:</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>Retention time:</td>
<td>&gt;2.5 hrs</td>
</tr>
<tr>
<td>Temperature:</td>
<td>70 - 75°C</td>
</tr>
<tr>
<td>NaOH:</td>
<td>55 - 60% of H₂O₂ charge</td>
</tr>
<tr>
<td>Silicate:</td>
<td>100% of H₂O₂ charge</td>
</tr>
<tr>
<td>DTPA added to bleaching liquor:</td>
<td>0.5%</td>
</tr>
<tr>
<td>DTPA added to pulp suspension:</td>
<td>0.2%</td>
</tr>
<tr>
<td>Initial brightness:</td>
<td>64 to 67.5% ISO</td>
</tr>
</tbody>
</table>
with bleaching at 10% consistency showed a slight drop in final brightness of 0.4%. It is assumed that this is due to the fact that pulp deaeration has not yet been optimized. This optimization work is currently underway.

The average brightness increase in the dithionite stage is in the range of 2.5 to 4% ISO, Fig. 6 and Table II. In this two-stage system it is possible to bleach to brightnesses well above 82% ISO. The dithionite charge was transformed into a cost equivalent peroxide charge using the following equation:

$$\text{Equivalent chemical charge} = \text{peroxide charge} + 0.8 \times \text{dithionite charge}$$

The high final brightness values in Fig. 6 were achieved with particularly good wood quality.

The dosage of dithionite was limited to a maximum of 0.8% since higher charges did not show a significant increase in the brightness. The bleaching conditions applied most of the time using 1.8% peroxide plus 0.8% dithionite normally achieve 80 to 80.5% ISO brightness. A maximum of 82.5% ISO is obtained.

The brightness of the former medium-consistency stage shown in Fig. 6 was obtained with a bleaching consistency of only 8 to 10%.

Figures 7 and 8 show development of the final brightness and bleaching costs at a given final brightness for:
- The start-up phase (single-stage bleaching);
- Three months after start-up (single-stage bleaching);
- Six months after start-up (two-stage bleaching);
- Each of them compared with the former bleach plant.

### NEW EFFECTS

After installation of the high-consistency stage, the temperature in the groundwood mill was increased by 8 to 10°C by closing its water circuits. This had a positive effect since the water temperature rose to a beneficial range for SGW. At the same time, the COD concentration increased. Both the temperature and the COD concentration can be controlled by the purge stream. The slightly reduced strength prop-

### TABLE II. BLEACHING PARAMETERS: DITHIONITE STAGE.

| Consistency in the bleach tower: | 4% |
| Retention time: | 1.5 hrs |
| Temperature: | 50°C |
| pH: | 6 ± 0.3 |
| Acidification: | 0.5 - 1% bisulphite |
| Dithionite: | <0.8% |
| Initial brightness: | 76 to 78% (80%) ISO |
| Final brightness: | 79 to 82% (82.5%) ISO |

### TABLE III. CHANGE IN FIBRE PROPERTIES DURING BLEACHING.

<table>
<thead>
<tr>
<th>Property</th>
<th>Former Plant</th>
<th>New Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile:</td>
<td>reduction &lt;10%</td>
<td>reduction &lt;10%</td>
</tr>
<tr>
<td>Tear:</td>
<td>2 - 2.5% reduction</td>
<td>50% reduction</td>
</tr>
<tr>
<td>Opacity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shives:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy for post-refining</td>
<td>decreased</td>
<td></td>
</tr>
</tbody>
</table>

### FIG. 5. FINAL BRIGHTNESS VS. PEROXIDE CHARGE.

### FIG. 6. BRIGHTNESS INCREASE FOR TWO-STAGE BLEACHING.

### FIG. 7. FINAL BRIGHTNESS AT THE SAME COSTS FOR BLEACHING AGENTS.

### FIG. 8. COMPARISON OF BLEACHING CHEMICAL COSTS AT A GIVEN BRIGHTNESS.
Properties, Table III, can be compensated for by a somewhat lower freeness. Due to the installation of the washing stage, the temperature in the headbox dropped by 29°C, the temperature in the headbox dropped by only 3°C. The COD concentration of the SGW suspension in and in the headbox was reduced by 39%.

Thus, the retention agent charge could be cut from 800 mL/min to 480 mL/min. The drop in temperature showed no effect. Almost no optical brighteners are required due to the increased SGW brightness. Silicate showed no effect on the paper machine.

During the startup phase it was established that a high dosage of dithionite and/or short retention time decreased the effectiveness of the shading colors, which led to fluctuations in the color of the final paper. This was eliminated after restricting the dithionite dosage to a maximum of 0.8% and the retention time to a maximum of 1.5 hours. Another reason for the fluctuations in Cie-Lab co-ordinates arose from the increased brightness of the base sheet, which also required a change in shading color dosage.

The high outlet consistency of the double-wire presses allows excellent bleaching response in the peroxide stage compared with the former bleach plant, Figs. 6 to 8. The Bauer McNett fibre fraction remains unchanged during dewatering. The fibre content of the filtrate is only 0.75 g/L.

Fibre properties did not change in the high-consistency mixer.

High-washing efficiencies can be achieved with the double-wire wash press, resulting in a low bisulphite demand for acidification and high brightness increase in the dithionite stage. No decomposition of residual peroxide was measured in the washing stage.

**Optimization**

- Recirculation of the residual peroxide increases the initial brightness by 0.5 to 1% ISO.
- Optimization of the caustic charge resulted in a higher final brightness by 0.5 to 1% and less residual peroxide.
- The silicate charge could be reduced by more than 50% at the same final brightness.
- The brightness increases obtained in the peroxide and dithionite stages were optimized to achieve minimum chemical costs.
- The brightness gain in the dithionite stage increased with low bisulphite charges.
- Optimization of the washing stage after the peroxide tower and recirculation point of the filtrate.
- If possible, reduction of DTPA charge at the same brightness.
- Improved deaeration of the pulp suspension for the 10% dithionite bleaching stage.
- Increase in the design production by higher inlet consistencies and new wire qualities.

**Conclusion**

Six months of the new bleach plant operation showed the following advantages:

- Bleaching costs could be cut by 43%.
- High-brightness sheets can be produced without optical brightener.
- Seasonal variations in incoming brightness can easily be compensated in the bleach plant.
- Short-term changes in incoming brightness are evened out by the two-stage system.
- The deviation in final brightness is normally less than 0.5% after the peroxide stage and less than 0.3% after the dithionite stage.
- Yellowing of the pulp was not observed even after long retention times caused by unscheduled shutdowns of the paper machine.
- The shive content was reduced by 50%.
- Unscheduled bleach plant shutdowns were only caused by initial operating errors.

**References**


Résumé: Une installation de blanchiment a deux étages pour pâte mécanique a été en service à l’usine Hagen-Kabel de la Feldmühle AG. Cet exposé traite des données projetées et de salles effectivement atteintes. Il décrit les effets de cette installation nouvelle de blanchiment sur l’usine de pâte mécanique et la machine à papier, ainsi que les premières expériences en marche continue.

Abstract: There are four classes of commonly used internal sizing agents for recycled paperboard: AKD, ASA, dispersed rosin, and rosin soap. This paper describes how each is affected by the increasing amounts of calcium carbonate present in recycled furnish.


**Keywords:** COATED PAPERS, PRINTING PAPERS, BLEACH PLANTS, HYDROGEN PEROXIDE, DITHIONITES, GROUND WOOD, EQUIPMENT, OPERATIONS, SEQUENCES, OPTIMIZATION.