Accurate fiber analysis and classification helps FPC Papeles achieve optimal refining and recipe management

FPC Papeles produces high-quality testliner and fluting papers based on 100% recycled material. They use the highest-quality raw materials to achieve high resistance values in their finished product. By using ABB’s Fiber Tester Plus, the mill was able to get the accurate data needed to classify raw materials and optimize refining.

Classifying and blending raw materials for improved recipe management
The team at FORESTAL Y PAPELERA CONCEPCIÓN S.A (FPC Papeles) had a goal of using recycled material rich in long fibers for their production of high-performance paper. The mill, located near Concepción, Chile, started a project to identify the ideal mix of fibers from their four sources: domestic and imported double-lined kraft corrugated cuttings (DLK), Old Corrugated Carton (OCC) pulp, and Kraft Liner Board (KLB) pulp.

Leveraging ABB’s L&W Fiber Tester Plus, the mill analyzed the following fiber morphological characteristics:
• Fiber length (mm)
• Proportion of long fibers (%)
• Coarseness (µg/m)

These properties play a fundamental role on refining requirements as they are directly proportional variables, meaning the greater fiber length, the greater the proportion of long fibers and the greater the coarseness of the fibers.

A fiber with high coarseness needs a higher refining intensity to be collapsed and thus achieve much more resistant interfibrillar links in order to increase the paper strength.

“Using Fiber Tester Plus helped us find optimal fiber classification to determine refining intensities for each type of recycled material without damaging the fiber,” said Ogger Araneda, Lab Analyst at FPC-Papeles. “Thanks to our ability to accurately classify, the raw material yard was segregated with the aim of using the best quality raw materials for manufacturing our best paper quality ever.”

This allowed them to test the combination of different types of raw materials using the blend module with Fiber Tester Plus. This supported the mill’s goal of optimizing the load of the pulper and fiber properties in accordance with the corresponding manufacturing recipe.
Refining

The development of high-performance paper led the mill to seek optimal refining points for each type of recycled material with the objectives of:

- Not damaging the fiber
- Making fewer unwanted cuts in the fiber
- Generating good fibrillation
- Obtaining more resistant interfibrillar connections
- Increasing paper strength
- Saving energy
- Improving the paper machine productivity

Refining curves were created, which means defining and keeping the refiner’s operational parameters constant while only modifying the specific energy consumption (kWh/ton). The refiners were optimized in accordance with the requirements of the paper manufactured and the state of the refining discs.

The recipes were adjusted based on the ideal blend of imported materials, the loading of bales was optimized to feed the pulper for a specific grade, and the amount of DLK was increased by substituting OCC.

The two tables below indicate that with the use of the Blend module from the Fiber Tester Plus, it was possible to create references with the main fibers used in production and control the mixing.

### Recipe-1

<table>
<thead>
<tr>
<th>Reference Fiber</th>
<th>Expected %</th>
<th>Measured %</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCC</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>DKL</td>
<td>10</td>
<td>9.9</td>
</tr>
<tr>
<td>Imported DKL</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>KLB</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### Recipe-2

<table>
<thead>
<tr>
<th>Reference Fiber</th>
<th>Expected %</th>
<th>Measured %</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCC</td>
<td>70</td>
<td>73.4</td>
</tr>
<tr>
<td>DKL</td>
<td>30</td>
<td>26.4</td>
</tr>
<tr>
<td>Imported DKL</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>KLB</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The main morphological characteristics that Fiber Tester Plus delivers that were used for creating the refining curves are: Fiber Length, Fibril Area and Perimeter, and Courseness. The following tables show the effect of refining energy on each of these properties.

- **Fiber Length** decreases when applying greater refining intensity. This means the higher the specific energy, the greater the fiber cut.

- **Perimeter and area of fibrils (%)**: these two variables increase when applying more refining energy. This means, the higher the specific energy, the greater the fibrillation.

- **Courseness (μg/m)**: decreases when applying higher refining energy. This means, the higher the specific energy, the greater the fiber collapse.

“Thanks to the analysis carried out in the Fiber Tester Plus, very conclusive results were obtained to define a complete and integrated refining curve,” confirmed Araneda. “It was possible to know the real behavior of the fiber at different refining intensities, leading us to find the optimal refining points to meet the specifications of each grade produced.”

Additionally, the results were transferred to the operators who could use this to further optimize and continuously improve the production process.
Performance and lifecycle of refining discs

The mill wanted to see how they could improve the performance of the physical refiner asset. Performance tests on the refining discs were carried out at the beginning, half-life and end of their normal lifecycle.

The Fiber Tester Plus was also used to validate these results. It showed the area and perimeter of fibrils and the strength for CMT (Corrugating Medium Test) and tensile decreases with longer usage of the refining discs.

Thanks to these results, strategic decisions were made regarding the purchase and use of refining segments to meet the quality requirements of both the pulp and finished product. This included how to manage and optimize the disc performance.

In the two graphs below, we observe a refining curve at the middle of the lifecycle of the segments; when more than 60 kwh/ton of energy is applied, the fibrillation is maintained and then the CMT and Tensile declines.

![Graph 1](image1)

Fibrillation area and perimeter were monitored on how it develops according to the refining segment life cycle to find an optimum timing for replace it.

![Graph 2](image2)

CMT and Tensile starts to decrease at 60 kwh/ton.

The same was done monitoring the CMT and Tensile from the finished paper.
Conclusions
High Performance paper is characterized by having a high flat compression strength, which is measured through the CMT laboratory test.

The CMT value was leveraged against other data points including raw materials and their optimal refining points as well as the effects of chemicals and other adjustments made within the paper machine (jet-wire speed, fiber orientation, etc.) to determine the best specifications to produce high-quality paper.

"The Fiber Tester Plus has a fundamental role," concluded Araneda. "With the data and characteristics of the fiber that it provides us, we carry out an excellent classification of the raw materials and at the same time we find the optimal refining points for them. Then, complementing the morphology of the fiber with resistance values carried out on laboratory sheets, we were able to obtain very conclusive results."

The higher the specific refining energy (with segments at the beginning of their lifecycle) the greater the fibrillation and the CMT increases, this means they are directly proportional variables.

The higher the specific refining energy, the greater the collapse of the fiber (decreases coarseness), achieving better fibrillation and, at the same time, more resistant interfibrillar bonds, increasing the strength values in the paper such as the CMT.