Modernization of Industrial Cotton Bleaching Facilities

*Continuous processing with high density fiber loading reduces water usage by 35% and energy consumption by 10%*

The profitability of individual companies bleaching loose stock textile fibers and other textile products is very much dependent on efficient manufacturing operations. This is a highly competitive industry segment where large companies applying economies of scale for high-volume orders often share the competitive landscape with small & mid-size companies vying for sales of specialized products. Traditionally labor intensive with outdated technologies, waste & inefficiency are common occurrences within manual bleaching operations.

Working to improve profitability and operating efficiency for its customers, Rousselet-CDB has introduced a new, continuous concept for cotton fiber bleaching processors. Keeping pace with the rapid development of new technologies, the automated Rousselet-CDB process is designed for efficient operation within a sustainability driven regulatory environment.

Specializing in high-density fiber loading and product transfer, the modernized Rousselet-CDB system is based on a series of material handling technologies integrating automation with specialized carriers, high-density feeding presses, autoclaves, and continuous centrifugal hydro-extractors.

www.rousselet-robatel.com
www.cdb-textile.com
High Density Fiber Loading & Material Carriers

Specially designed, high-durability carriers are used throughout the Rousselet-CDB cotton bleaching process. Also known as kiers, these carriers ensure efficient material handling by facilitating the transfer of cotton cake between the loading presses, autoclave, and cake breakers.

The specialized carriers, which produce cakes up to 2.30 meters tall, are automatically positioned within the fiber loading area and then slowly rotated to assure proper distribution of the fiber (initially compacted using water).

Following the initial compaction, the carrier is fixed in place to accept a specialized hydraulic press, which compacts the cotton into an extremely dense 345 kg/m³ cake.

For reference, in traditional low-density bleaching operations where the fiber is loaded only using water, cake density values typically range between 260 kg/m³ and 270 kg/m³. This low value is due to the “springy” behavioral characteristic of cotton fibers, which have a tendency to seek and recover their initial volume.

Since the primary cause for defects and other poor bleaching quality is normally a result of poor loading and insufficient cake compaction, maintaining this high density cake is an imperative to product quality. By definition, the Rousselet-CDB carrier ensures that the compressed volume of the cake is maintained.

This specialized cake carrier and high density loading system:
- Deliver a perfectly homogeneous cake with no splits or cracks, and therefore no preferential flow paths
- Minimize material handling, which provides greater efficiency in the bleaching process
- Improve profitability of the bleaching facility by reducing costs in the process and maintenance requirements

The Polyclave & Low Bath Ratio

Following hydraulic compaction, the cake carrier is automatically removed from the press area and transferred to the Rousselet-CDB “Polyclave,” which is a specially designed autoclave suitable for bleaching or dyeing a broad range of natural and synthetic fibers.

Working with these high-density cotton cakes means that the Polyclave:
- Through automation, is integrated with the upstream hydraulic press
Trolley system for material carrier movement and rotation

- Accepts the specifically designed carriers from the pressing operation
  - Contributing to efficiency in the bleaching process, the Polyclave is capable of accepting carrier cakes with heights up to **2.30 meters**, but does not require an intermediate plate to divide the cake.

- Incorporates the internal, high-performance pump required for bleaching these high density cakes
  - Variable speed pump mounted to the vessel to minimize hold-up of bleaching solution

Minimizing the bath ratio, which is a direct indicator of bleaching efficiency, is a combination of the cotton product (fiber and origin) and the flexibility of the processing equipment. Taking into account the large cake height in relation to its high-density, Rousselet-CDB can guarantee a very low bath ratio:

- **High Density Cotton Cake**: bath ratio is between **2 liters and 4 liters / kg** of dry cotton.
- **Low Density Cotton Cake**: bath ratio is between **6.5 liters and 9.0 liters / kg** of dry cotton.

Rousselet-CDB technologies impact the process and facility by maintaining very low rates of water consumption.

- **High Density Technology**: averaging between **25 and 30 liters** of water per kg of bleached cotton (as a function of fiber, origin, and selected treatment)
- **Low Density Technology**: averaging up to **60 liters** of water per kg of bleached cotton (as a function of fiber, origin, and selected treatment)

This very low water consumption generates savings through:

- **Reduced Energy Usage**
  - Less water for bleaching means less heating, less pumping
  - Lower use of ancillary products such as hydrogen peroxide, soda, softener, etc. because their consumption is directly linked to water use

- **Lower Waste Water Volumes**
  - Less water used in bleaching means less water for waste treatment

- **Downsizing Waste Treatment Plant**
  - Reduction in waste water volume for the same quantity of fiber

**Downstream Processing & SCPC Continuous Hydro-Extraction**

Existing textile bleaching companies have few options available to improve efficiencies of conventional operations. Where low-density cakes are manually transferred using plates and
chains between stations of the bleaching facility, limitations to improving productivity rates include:

- **Cake Height:**
  - Functionally, the process is limited by the capability of the batch hydro-extractor (the basket height is a function of the basket radius)

- **Workshop & Storage:**
  - Significant cake handling occurs through the workshop (cake from the carrier often divided into two as a minimum).
  - Large storage areas are required to hold cakes between process steps (low density produces a higher number of cakes to achieve the same level of cotton production)

In the new Rousselet-CDB concept, the production capacity of the high-density system plays a key role in optimizing facility design for material handling downstream of the autoclave. Efficiently managing this volume requires a Model SCPC continuous hydro-extractor.

Without any human intervention, the fibers are automatically conveyed from the breaker to the SCPC continuous hydro-extractor for dewatering and pneumatic transfer to the dryer for final moisture control in preparation for baling.

Advantages of the new concept with the SCPC continuous hydro-extractor:

- **Cake Breaking Efficiency:**
  - Less energy is required to break a wet cake than a cake after hydro-extraction.
  - Because the cake is broken before hydro-extraction, there is no direct relationship between the cake dimensions and the basket of the hydro-extractor.

- **Continuous Operation:**
  - Through mechanical and pneumatic conveyor systems, bleached fibers are continuously processed.
  - Automatic operation assures no manual intervention.

- **Fiber Transfer:**
  - Bleached fibers are pneumatically ejected from the hydro-extractor in a form that is fluffy and easy to dry (conventional systems feed cotton fibers in...
sheets to the dryer where it is difficult to get homogenous drying)

- **Dryer Efficiency:**
  - Constant, repeatable moisture levels are attained because fibers are spun in a thin layer on the centrifuge basket
  - Easy to handle bleached fibers reduce dryer energy consumption, facilitate setting of dryer conditions, and provide a more constant yield

### Savings Compared To Conventional Bleaching Technologies

In the table below we present the case of an organization in Brazil that has completed designs for a new cotton bleaching facility featuring the state of the art Rousselet-CDB bleaching system.

Forecasting a production rate of 7,500 tons/year, this company anticipates a comparative annual savings of **$1,027,740** or **24%** over their outdated, conventional bleaching facility.

#### MODERNIZED INDUSTRIAL COTTON BLEACHING

Comparative Savings of Continuous Processing with High-Density Fiber Loading

<table>
<thead>
<tr>
<th></th>
<th>CONVENTIONAL COST ($/TON)</th>
<th>ROUSSELET-CDB CONTINUOUS COST ($/TON)</th>
<th>COMPARATIVE SAVINGS ($/TON)</th>
<th>COMPARATIVE ANNUAL SAVINGS</th>
<th>ANNUAL ECONOMIC BENEFIT %</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTION (TONS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENERGY</td>
<td>$260.33</td>
<td>$235.55</td>
<td>$24.78</td>
<td>$185,850.00</td>
<td>10%</td>
</tr>
<tr>
<td>ANCILLARLY PRODUCTS</td>
<td>$161.03</td>
<td>$114.16</td>
<td>$46.87</td>
<td>$351,540.00</td>
<td>29%</td>
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<tr>
<td>WATER</td>
<td>$42.85</td>
<td>$27.85</td>
<td>$15.01</td>
<td>$112,560.00</td>
<td>35%</td>
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<tr>
<td>MANPOWER</td>
<td>$84.52</td>
<td>$34.50</td>
<td>$50.02</td>
<td>$375,165.00</td>
<td>59%</td>
</tr>
<tr>
<td>POST-TREATMENT</td>
<td>$5.17</td>
<td>$4.82</td>
<td>$0.35</td>
<td>$2,625.00</td>
<td>7%</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>$9.34</td>
<td>$9.34</td>
<td>$0.00</td>
<td>$0.00</td>
<td>0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$563.23</strong></td>
<td><strong>$426.20</strong></td>
<td><strong>$137.03</strong></td>
<td><strong>$1,027,740.00</strong></td>
<td><strong>24%</strong></td>
</tr>
</tbody>
</table>

### Results and Observations

The fundamental objective of the new Rousselet-CDB continuous bleaching system is to develop a high-density cake. Gaining efficiency improvements during all critical phases of the process, the integrated system from Rousselet-CDB including its automated carriers, high-density feeding presses, Polyclaves, and continuous SCPC hydro-extractors is the **ONLY** method for achieving meaningful savings in the industrial production of bleached cotton.