EXTRACT
The Claudius Peters Homogenizer: Cost cutting plaster production technology

GypsumTechnik

Gypsum technologies that impact your organisation – not the environment

Technology you can trust

Claudius Peters Projects GmbH
Schanzenstraße 40
21614 Buxtehude, Germany

Phone +49 (0) 4161 706 361
Fax +49 (0) 4161 706 7361
email projects@claudiuspeters.com
With a focus on operational cost, today’s calcining systems are measured by factors such as energy consumption, reliability and availability, all factors where the Claudius Peters calcining systems have proven their excellent performance. Taking the next steps, the Claudius Peters Homogenizer extends a gypsum calcining system, providing improved production quality and reductions in production cost.

The Claudius Peters Homogenizer: Cost cutting plaster production technology

In general, flash calcining systems are known to produce stucco qualities with relatively short setting times, but in an efficient and reliable process. The Claudius Peters mill calcining system allows production of a stucco quality ideal for the gypsum wallboard manufacturing process. For synthetic gypsum sources, typically fine raw materials with a high degree of free moisture, the grinding elements of a roller mill system are not required in the calcining process, which resulted in the development of the Claudius Peters Horizontal Impact Calciner. This system allows direct flash calcining of synthetic gypsum in a proven calcining system (see Global Gypsum Magazine February 2007, 'Horizontal Impact Mill, a new way of synthetic gypsum processing').

Depending on the final product requirements, plaster systems may require production characteristics with higher strength and extended setting time. These characteristics can be achieved with a set of calcining methods available, such as high burned gypsum flash calciners, kettle systems and indirectly as well as directly heated rotary kilns.

To provide a method of higher production efficiency and quality, Claudius Peters has added an additional process step to the standard calcining system. The target of this development is to homogenise the product quality, improve the water demand, stabilise the product and to reduce the operational cost. In a standard Claudius Peters Calcining system the product (stucco) is generated by direct flash calcining in the Claudius Peters Mill. The stucco is separated from the process gas stream in a System Dust Collector and typically immediately cooled.
from calcining temperature down to further processing temperature (see Figure 2). Due to the short processing time in this calcining method the stucco generated is qualified as quick setting stucco, which is ideal for the gypsum wallboard manufacturing. The stucco particles show fine internal cracks based on the thermal stresses during the flash calcining process. Also amounts of over-calcined gypsum in the form of soluble anhydrite (AIII) are generated (see Table 3). In a standard gypsum wallboard application these factors provide the required stucco quality. Storing this stucco quality for extended time leads to ageing, which can be seen in parameters such as reaction of AIII with humidity to form gypsum hemi-hydrate as well as extended setting times. Claudius Peters uses this effect of ageing in the Homogenizer which is located directly in the product flow downstream of the system dust collector (see Figure 4, below).

<table>
<thead>
<tr>
<th>Typical production values</th>
<th>Gypsum before Homogenizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum Dihydrate CaSO4 * 2 H2O</td>
<td>1 - 5 %</td>
</tr>
<tr>
<td>Gypsum Hemi Hydrate CaSO4 * 1/2 H2O</td>
<td>remainder %</td>
</tr>
<tr>
<td>Gypsum Soluble Anhydrite (AII) CaSO4</td>
<td>10 - 35 %</td>
</tr>
<tr>
<td>Gypsum Anhydrite (AII) CaSO4</td>
<td>0 - 5 %</td>
</tr>
<tr>
<td>Other contents</td>
<td>0 - 5 %</td>
</tr>
</tbody>
</table>

Figure 3: Example phase analyses of stucco.

While feeding the Homogenizer from the top with the production from the calcining system, the same amount of material is discharged form the bottom.

Due to the internal circulation, the stucco is evenly homogenised, providing a constant product quality. The fluidisation takes place with flue gas of the gypsum calcining system. This provides a gas with further calcining energy, allowing calcining of any amounts of residual gypsum dihydrate in the stucco. This gas is also loaded with high amounts of water vapour. This vapour will react with the soluble anhydrite content, generating the highest amounts of the gypsum hemi-hydrate in the final product. This reforming process allows artificial ageing of the stucco, not only optimising the phase-analysis, but also optimising particle conditions. Effects of this artificial ageing are shown in Figure 6, above.

Applying this method to a synthetic gypsum calcining process with a Claudius Peters Horizontal Impact Calciner, the results show a product quality from a flue gas desulphurisation gypsum (FGD) which shows

Above: Figure 6: Effects of artificial ageing comparing effects of total treatment time, from top to bottom:
A: Reforming of AIII by increasing the combined water content in the Claudius Peters Homogenizer over treatment time.
B: Extension of setting time due to the ageing process.
C: Reduction of material total surface area measured as BET figure, which is a result of the particle reformation.
D: Improving water demand of the calcined stucco

Left: Figure 4: The Claudius Peters gypsum calcining process with Claudius Peters Homogenizer.

The Claudius Peters Homogenizer allows the extension of thermal processing time. It receives the stucco at calcining temperature and keeps it in a fluidised state in the vertical processing vessel (see Figure 5, right). The Homogenizer has an aerated flat bottom which allows even fluidisation of the charged material. Internal circulation is generated by its central riser pipe which conveys stucco upwards by introducing higher fluidisation gas loads in the centre part of the vessel. The Homogenizer is operated in a continuous mode.

Left: Figure 5: Operation of the Claudius Peters Homogenizer.
parameters which are applicable for gypsum wallboard manufacturing. However, further operations with a phosphogypsum source show stucco qualities which are not usable for further production. Slurry of this material dewatered and generates no strength. The crystals of this phosphogypsum show a very long needle-like shape which results in this high water demand. With the installation of turbo mixers in the Homogenizer, this crystal shape can be destroyed and smooth stucco slurry with acceptable water demand can be generated. Figure 7, above, shows improvements after this step, while Figure 8 shows the improvement in the product. While the BET surface area has been slightly reduced, showing the total surface area including surface area of cracks and holes, the Blaine value, a measurement which represents the outside surface area, has been increased significantly. The particles containing thermal cracks have been ground by the energy of the turbo mixers, generating additional available surface area, destroying the needle-like crystal shapes (Figure 9). This material allows the production of finished products such as gypsum blocks and gypsum wallboard.

The implementation of the Claudius Peters Homogenizer into the calcining system does not only allow the homogenisation and improvement of stucco quality, but also reduces the thermal energy consumption. The Homogenizer allows the reduction of residual gypsum-dihydrate in the calcined gypsum. Using this post-calcining effect in the Homogenizer allows the main calcining circuit to operate at decreased calcining temperature, which in consequence reduces the waste heat leaving the system stack.

Since the water demand of the stucco is reduced, further savings can be found in the gypsum wallboard manufacturing process. If as an example the reduction is only 0.05kg/kg water in a mixer, this would reduce the amount of excess water by approximately 10%, leading to savings in water consumption but also to significant fuel consumption reduction at the wallboard dryer.

### Conclusions

All together, the applications of the Claudius Peters Homogenizer can be found in plaster systems, allowing the production of high strength homogeneous and artificially aged plaster qualities, as well as in the traditional stucco production for gypsum wallboard and other finished materials productions, where homogenous product and low production cost are the key factors. The application of the Homogenizer in a Claudius Peters calcining system has been shown, but also other calcining systems will benefit from this downstream stucco treatment step. This is another step by Claudius Peters to bring new and operating installations into a cost and quality competitive production process.

<table>
<thead>
<tr>
<th></th>
<th>FGD Gypsum calcined, after Homogenizer</th>
<th>Phosphogypsum calcined, after Homogenizer</th>
<th>Phosphogypsum calcined, after Homogenizer, with Turbo Mixer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blaine value</td>
<td>4500cm²/g</td>
<td>3600cm²/g</td>
<td>8000cm²/g</td>
</tr>
<tr>
<td>BET surface area</td>
<td>10m²/g</td>
<td>8m²/g</td>
<td>7m²/g</td>
</tr>
<tr>
<td>Water gypsum ratio</td>
<td>&lt; 0.7</td>
<td>&lt; 1.3</td>
<td>&lt; 0.8</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>&gt; 14 N/mm²</td>
<td>&gt; 2 N/mm²</td>
<td>&gt; 10 N/mm²</td>
</tr>
<tr>
<td>Flexural strength</td>
<td>&gt; 4 N/mm²</td>
<td>&gt; 1 N/mm²</td>
<td>&gt; 4 N/mm²</td>
</tr>
</tbody>
</table>