WHITEPAPER:
ENERGY SAVINGS IN MILLING PROCESSES
The choice for a specific grinding technique is key to the quality of the end product and the output of the production process. The milling process requires a significant amount of energy which makes it worthwhile to monitor. In general, the grinding of raw materials is accounted for 20% of the energy consumption in the feed industry. This means that there is often room for cost saving.

» **No concessions**

Making concessions will jeopardise the quality of the end product, from both a technical and a nutritional point of view. A technical reason for having a sound milling process is to create a solid basis for downstream processes such as mixing, expanding, pelleting and extrusion.

The essential parameters of a milling process are the obtained structure and the particle size. Also, the milling process should have a sufficient capacity (t/h) and a low energy consumption (kWh/t). In addition, there are many other important aspects, such as maintenance (wear), explosion protection, noise level and dust emissions.

Quality screens

For a reliable, efficient milling process it is important to use quality screens. It is recommended to take mill manufacturer specifications into account. This ensures that the screens meet the requirements as regards:

- open area
- material thickness
- type of material
- type of perforation (Conidur or standard).
» **Two variants**

In the feed industry hammer mills are commonplace. Ottevanger Milling Engineers supplies two variants: mills with small diameters for 3.000 rpm and mills with large diameters for 1.500 rpm. Both variants have the same degree of reduction and the same hammer tip speed. The first category of hammer mills are compact but have a lower capacity. The larger mills (for 1.500 rpm) not only have a higher capacity, but they also produce less noise and heat in the milling chamber.

» **Squash effect**

Hammer mills with adjustable breaker plates allows you to achieve a ‘squash effect’ by making the milling chamber asymmetrical. The particles then ‘bounce’ between the hammers and the breaker plates, which means they undergo a double impact and the desired structure is achieved faster. This means that less power is required to achieve a certain capacity, which results in significant energy savings. Of course, it is also possible to use the squash effect to increase capacity using the same power. Moreover, energy consumption can also be reduced by using hammer mills that are fitted with high-efficiency motors (EF3).

» **1.500 RPM**

The 1.500 rpm mills are the types 1200-750, 1200-1000 and 1200-1250, with an installed power of 132 - 400 kW. These larger machines have capacities up to 38, 50 and 60 tonnes/hr on corn. Both hammer mill designs are capable of dual rotation. This allows the motor to go either clockwise or counter clockwise, making best possible use of the hammers and breaker plates. Energy consumption for corn milling (with a 3mm screen perforation) is around 4.5 kWh/t. The 1200BA Hammer mill series has a fully automated screen changing system.

» **3.000 RPM**

The 3.000 rpm machines are available in various types with an installed power varying between 30 and 250 kW. The smallest models being the Perfect 30, 650-375 and 650-550 with 30 - 55 kW motors are fitted with a 3mm screen. These hammer mills can reach capacities up to 7 and 12 tonnes/hr on corn. The largest 3.000 rpm machines types 670-750 and 670-1150, can reach capacities up to 25 and 35 tonnes/hr respectively. The hammer mills 650 and 670 both have the possibility for easy screen replacement without stopping the production process.
Feed device

For an efficient milling process the hammer mill should be fitted with an optimally operating feed device. A good feeding device should have the following properties:

- It should ensure an even distribution of the product fed to the hammer mill.
- It should ensure a variable load-dependent product fed to the hammer mill.
- It should filter out impurities (ferrous particles and stones).

A smooth, consistent product feed avoids an irregular load on the motor and uneven, excessive wear of the hammers and the screens.

Aspiration

In order to keep dust emissions from hammer mills to a minimum while keeping the performance to a maximum, a negative pressure must be created in the milling chamber by using an aspiration system. This (virtually) prevents the dust from escaping the mill. Aspiration also helps to cool the product, which improves product quality. The dust filter in the aspiration system can be fitted directly onto the bunker below the hammer mill but this is not the most efficient solution. After all, the dust emitted during the pulse cleaning cannot precipitate freely because of the upward air flow. A better solution is to extract the dust to a separate dust filter, where dust can be easily separated from the air flow. This kind of indirect aspiration realizes a higher performance of the filter.

Pre-screening

From an energy saving point of view milling processes can be optimised by pre-screening the product before milling. The fines are separated from the coarse, bypassing the hammer mill. This way only the coarse material is being ground, reducing the work load of the hammer mill. There are also benefits to be gained from optimising the particle size of milled grain in combination with the pellet compressibility. Another trend is to use a hammer mill in combination with a rollermill/structurizer.
Screen replacement versus frequency control

If a feed manufacturer produces a large variety of recipes it means that the hammer mill needs to be flexible. This has to do with the different requirements that are set regarding the structure of the products to be milled. This can be handled by varying the tip speeds or changing the screens. The use of an automatic screen changing system cuts change-over times and avoids the need for human interventions. An alternative is a frequency-controlled hammer mill. The frequency control makes it possible to vary the speed and set a unique combination of tip speed and screen perforation. Resulting in a different structure with the same perforation without changing the screens.

<table>
<thead>
<tr>
<th>Frequency control on the hammer mill</th>
<th>Automatic screen replacement on the hammer mill</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>No screen replacement required</td>
<td>Several perforations possible</td>
</tr>
<tr>
<td>Motor can continue to run</td>
<td>Motor can continue to run</td>
</tr>
<tr>
<td>No change-over times</td>
<td>No long change-over times</td>
</tr>
<tr>
<td>Less susceptible to problems</td>
<td>Maximum capacity possible</td>
</tr>
<tr>
<td>No additional dust formation</td>
<td></td>
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<tr>
<td>No additional wear</td>
<td></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Converter required</td>
<td>Dust formation</td>
</tr>
<tr>
<td>Screen perforations are limited</td>
<td>Greater installation space (height) required</td>
</tr>
</tbody>
</table>

Diagram 1 - A frequency-controlled hammer mill can be an attractive alternative to a hammer mill with automatic screen replacement.
» Design   » Engineering   » Manufacturing   » Erection and commissioning   
» Feed mills   » Pet food plants   » Aqua feed plants   » Cereal processing plants   
» Soybean processing plants   » Premix and concentrate plants   
» Silos   » Bulk storage and handling systems   » Electric control and automation

Ottevanger Milling Engineers B.V.

Location: Moerkapelle
Moerkapelse Zijde 32
2751 DL MOERKAPELLE
The Netherlands
Tel. +31 (0)79 593 22 21

Location: Aalten
Dinxperlosestraatweg 62
7122 AH AALTEN
The Netherlands
Tel. +31 (0)543 472 688

www.ottevanger.com
info@ottevanger.com