Alternatives to Cryogenic Milling with Medium Melting Point and/or Natural Origin Products

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Milling is the unitarian operation that enables to reduce particle size of dry solids or dispersed in a liquid vehicle.

In the milling of dry solids, the physical process is based in the impact of the particles against a moving element of the mill. We can distinguish four types of basic equipment for this kind of milling technology:

- Ball mill: it is a cylinder located in horizontal position that turns on its axis. Inside the cylinder the balls impact against the solid reducing its particle size (Figure 1).
- Impact mill: there are several milling elements (pins, beaters, hammers) that spin at high-speed allowing particle size reduction. The choice between the different elements depends on the nature of the product, its initial particle size, and the required final particle size (Figure 2).

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FIGURE 1. MBL-775 ball mill by Lleal

» Impact mills usually are the most common in all kinds of industries because they are very versatile and compact. Their design and operation mode allows the circulation of air through their interior enabling the removing of part of the heat generated during milling process, but not all of it

- Micronizer-classifier mill: it has an impact mill system that allows to reduce particle size but also the internal circulation of air enables to retain the material until it reaches the target size (Figure 3).
- Jet-mill: product circulates at high-speed through the interior of the equipment due to the high flow of air that induces the collision between particles and their fragmentation.

Impact mills usually are the most common in all kinds of industries because they are very versatile and compact. Their design and operation mode allows the circulation of air through their interior enabling the removing of part of the heat generated during milling process, but not all of it. In waxes or natural origin products this remaining heat could provoke the melting or degradation of materials in the milling elements. The solution with this kind of problems is the dosing of liquid nitrogen on the material to process to reduce its temperature. The use of nitrogen implies an added cost to the process and a safety risk to the operator due to the handling of nitrogen both in liquid and gas form.

In our test laboratory we had checked that for some products it is possible to replace cryogenic milling with an impact mill for a room temperature milling with a micronizer-classifier mill (Figure 4). This is possible because this micronizer-classifier needs a very high circulation of air to work properly. This circulating air removes the generated heat in a more efficient way that in the traditional impact mills. Here, we show two successful substitutions of cryogenic impact milling for a micronizer-classifier mill.

FIGURE 2. K-315 komodin mill with hammer disc

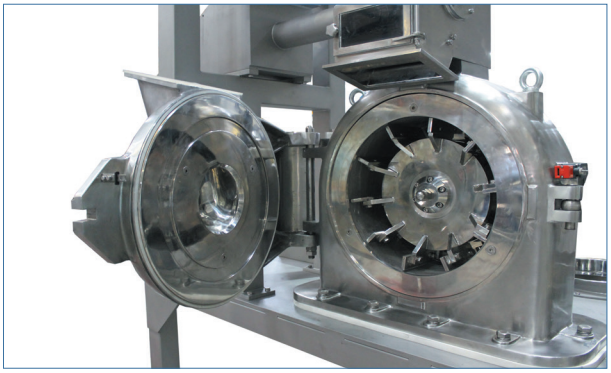


FIGURE 3. MMS-1500 micronizer-classifier mill by Lleal

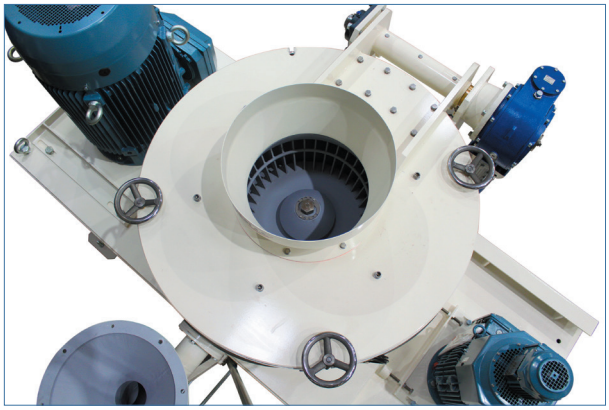
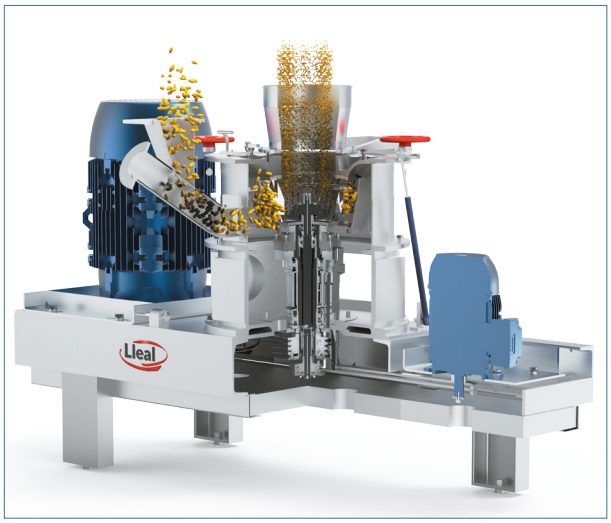


FIGURE 4. Inside view with product of a MMS micronizer-classifier mill



CARNAUBA WAX

Carnauba wax is a natural wax with a melting point between 78-85 °C that, in our case, is formed by flakes with a particle size bigger than 2 mm. Our costumer needs an average size about 150 microns. This average size is not too small, and we tried to achieve it with an impact pin mill. This kind of configuration do not have any interior retention system and we hope that the low residence time allows the milling process in a room temperature equipment. Unfortunately, at only 20 seconds of milling we observe the leaking of melting wax through the mill discharge hopper.

Wax is processed in our micronizer-classifier mill MMS reaching a reduction of particle with an average size of 75 um and the following particle size distribution (Figure 5).

The material is processed without problems and without any phase transition.

TIGER NUT

Tiger nut is an edible tuber that in our case has a 25 % fat content and 5 % water content. The material is processed with a pin mill but at 30 seconds of milling we observe a sharp increase of electrical intensity and above the maximum intensity of the mill engine. We stopped the process, and we observe that the fat in the tiger nut has melted and pasted the pin mill. Reducing the size particle in this equipment requires the use of liquid nitrogen. Again, we process the material in our micronizer-classifier MMS to obtain a material with the same quality that the standard sample with any variation in organoleptic parameters of tiger nut.

Micronizer-classifier MMS is emerging as an alternative to the use of liquid nitrogen with medium melting point or/ and natural origin product.

FIGURA 5.

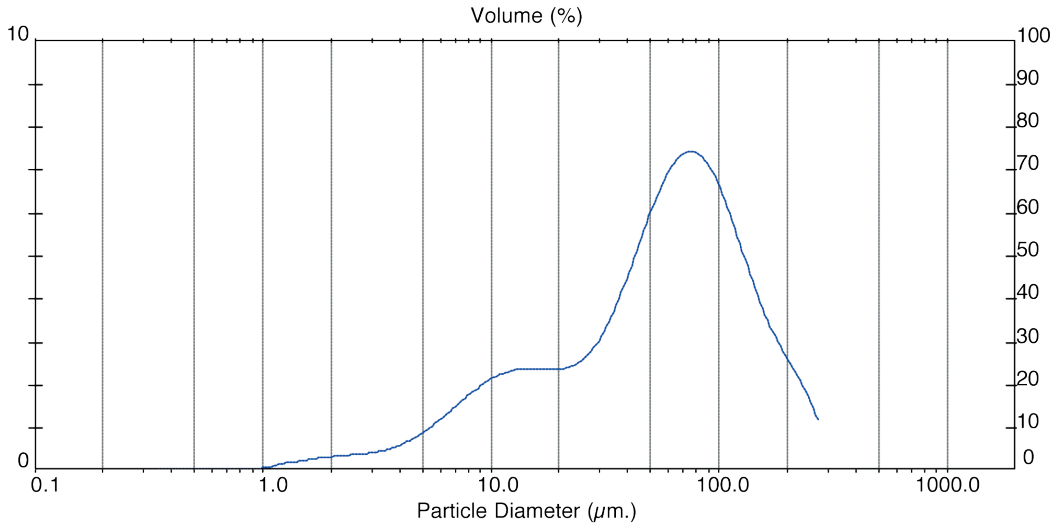


FIGURA 6. Tiger nut before milling

FIGURA 7. Tiger nut milled with a MMS micronizer