

# Economical Cryogenic Grinding with liquid Nitrogen or Carbon Dioxide



# Cryogenic Grinding: Performance-Enhancing, Protective and Economical

Plastic, elastic and heat-sensitive materials can often not be ground finely or do not perform satisfactorily. With cryogenic size reduction Linde offers a process which allows many different materials to be pulverized economically. The cold of the gas ensures that the material is ground in a brittle condition. Reduced energy costs and increased production rates make the process very attractive.

Depending on the particular application, liquid nitrogen, which allows a wide range of grinding temperatures, or carbon dioxide, which is mainly used in the spice industry, is used for cooling. As a rule, fine impact mills are normally used although the process can also be applied with many other types of milling systems.

Linde has over 30 years of extensive know-how in the field of cryogenic grinding – know-how we gladly make available to our customers. We give support in the choice of suitable processing as well as in optimizing existing plants.

## Advantages that speak for themselves:

- ▶ Improvement in productivity through optimum particle-size and often increased throughput
- ▶ No caking of the product in the mill
- ▶ Low sign of wear of grinding tools
- ▶ Ground material with cut-off edges has excellent pouring properties
- ▶ Inert milling atmosphere provides protection against fire, explosions and product oxidation
- ▶ Composite materials are separated in the mill

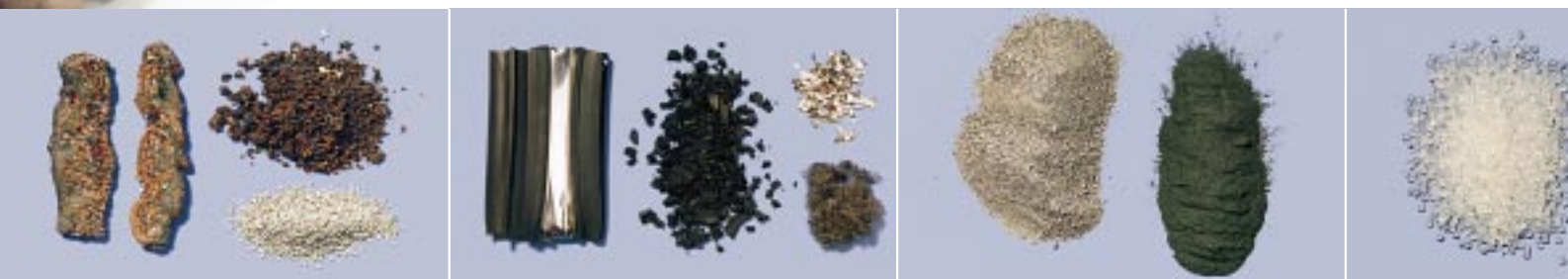
## Linde offers a full service:

- ▶ Consulting on technical application
- ▶ Carrying out of experiments in laboratory and production mills
- ▶ Adaption of present grinding-systems for use in controlled temperature grinding
- ▶ Supply of proven cooling systems, e.g. mill cooling system, screw coolers, cooling hopper, etc.
- ▶ Profitability analysis

Whether rubber, plastic, metal, composites, spices, pharmaceuticals, waxes or other materials, the applications for cryogenic grinding are many and varied.

## Numerous application possibilities:

- ▶ Fine size reduction of thermoplastics and elastomers are typical applications for the cryogenic grinding process.
- ▶ Spices, which may lose much of their aroma as a result of grinding heat, retain a maximum in quality thanks to the gas cooling. Heat sensitive fat will not melt.
- ▶ Oxidizable materials, e.g. fine metal powder, are best protected in an inert gas atmosphere.
- ▶ In the treatment of production residues the cryogenic grinding process guarantees high product quality and recycling of composites enables separation of the individual components.



*Composite material*

*Cryogenic ground composite material separated into plastic and aluminium*

*Composite material casement section seal*

*Cryogenic ground sealant of a window frame separated into plastic, metal and fibres*

*Iron-aluminium alloy, coarse-grained*

*Cryogenic ground iron-aluminium alloy powder*

*Polyamide pellets*

# Cryogenic Size Reduction for a Multitude of Materials ...

## Cryogenic grinding plant for spices

A dosing wheel delivers the required quantity of spice, e.g. pepper, to the mill. The temperature-controlled supply of liquid nitrogen or carbon dioxide ensures the material does not heat up from the heat arising during grinding. Finely pulverized, the material falls through the mill's sieve and leaves the mill through a cellular wheel sluice.

The mill gas is purified in a filter and the excess gas released by a butterfly valve. The remaining gas is returned to the mill. In this way gentle, dry and continuous grinding is possible. The controlled low temperature prevents the product from caking in the mill. The grinding process works continuously and the product retains a maximum of aroma.

### Cryogenic grinding data, e.g. for pepper

Particle size:	700 µm
Production rate:	750 kg/h
Nitrogen consumption:	0.25 kg/kg pepper
Driving power:	35 kW

## Cryogenic grinding plant for thermoplastics

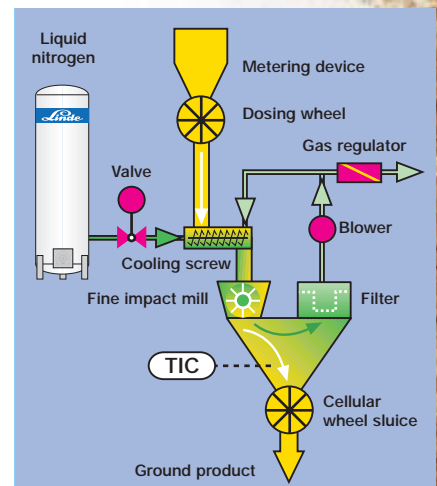
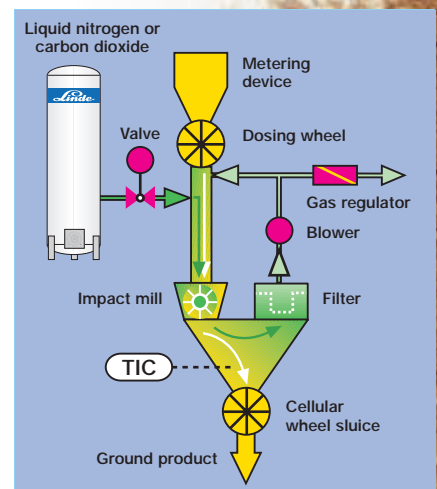
A dosing wheel meters the plastic pellets, e.g. PE or PA, into the mill. The grinding heat would normally cause these thermoplastics to melt, rendering them ungrindable. The cold of the liquid nitrogen prevents this by embrittling the material in the cooling conveying screw. The cryogenic ground plastic and the gas drop into a collecting bin. The pulverized product leaves the mill for further processing through a cellular wheel sluice.

The mill gas is purified in a filter and a quantity corresponding to the amount of nitrogen fed into the system released. The remaining gas is passed back to the mill for utilization of the residual cold.

### Cryogenic grinding data, e.g. for polyamide

Particle size:	80 µm (d50)
Production rate:	350 kg/h
Nitrogen consumption:	1.25 kg/kg polyamide
Driving power:	21 kW

Schematic of a cryogenic grinding plant for spices ▼



Schematic of a cryogenic grinding plant for thermoplastics ▲



Cryogenic ground polyamide



Nutmeg

Cryogenic ground nutmeg



Peppercorns

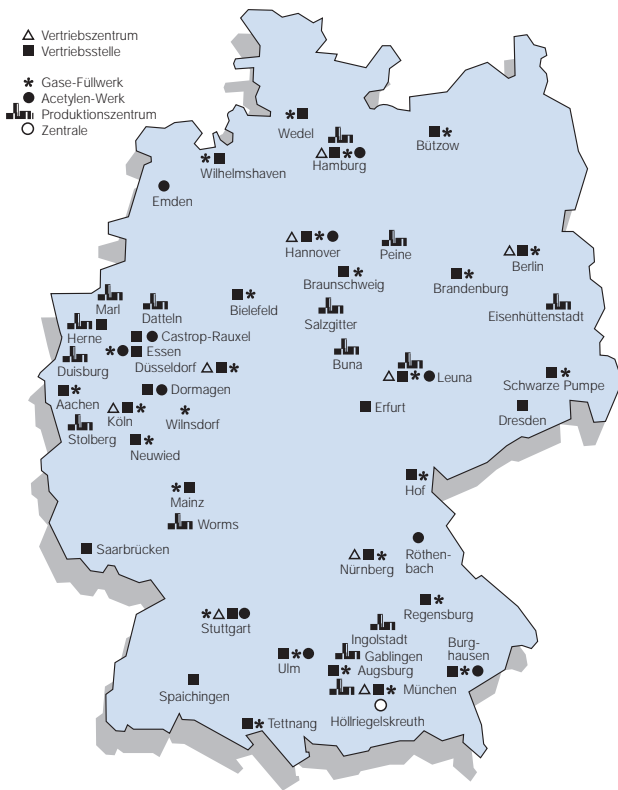
Cryogenic ground pepper



Allspice berries

Cryogenic ground allspice

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