

SPICES, TEA AND DRIED VEGETABLES

CUTTING, FINE GRINDING, CRYOGENIC GRINDING



HOSOKAWA ALPINE

PROCESS TECHNOLOGIES FOR TOMORROWSM



APPLICATIONS: MEDICINAL HERBS AND TEA

Complete Alpine systems have already been supplied for a vast number of different teas and tea blends. Alpine leads the market with special technology for complicated processing problems and offers extensive know-how for a wide variety of requirements in many fields, for example:

- Production of coarse-cut tea for infusions
- Production of closely fractionated, fine-cut tea with a low dust content for tea bags
- Production of initial products for downstream processes, for example extraction
- Separation of leaves and stalks from seed pods, e.g. rose hip seed pods
- Fine grinding of naturally occurring root, leaf and bark drugs for use as active ingredients in tablets and ointments
- Production of product granules from fine dust

APPLICATIONS: SPICES

Spice grinding is one of the most challenging size reduction tasks. Spices are extremely different, both in their structure and in the ease with which they can be ground.

Hosokawa Alpine supplies complete systems for the whole range of spices and dried vegetables as well as for every fineness demand and end application, whether it be for sauces, soups, cheese, sausages, spice blends, bakery products or for immediate consumption. Dependent on the problem specification, we offer equipment and systems for the following process steps: cleaning, crushing, cutting, fine grinding, cryogenic grinding with CO₂ or LN₂, screening, mixing, compacting and packaging, etc., either tailored to individual products or in the form of multi-processing systems.

Because spices and dried vegetables differ so widely from each other, among other things in their hardness, size, oil content, shear resistance and viscosity, we offer different systems that are tailored to the respective specification:

- Classifying with Multi-Plex zigzag classifiers MZM
- Cutting with Rotoplex Ro granulators
- Fine grinding with Ultraplex UPZ mills
- Fine grinding with Contraplex CW pin mills
- Cryogenic grinding with UPZ or CW mills



APPLICATION TESTING CENTRE

With an area of 3000 m² spread over 4 storeys, Hosokawa Alpine's application testing centre is one of the largest testing facilities in Europe for the wet and dry processing of powdery products.

With over 60 ultra-modern systems both on a production scale as well as on a laboratory/pilot plant scale and the associated testing laboratory, we offer the most comprehensive range of testing equipment to permit optimum system design and determination of the process-technological guaranteed values.

Made up of test engineers, lab assistants, system assistants and mechanics, the 20-strong team in our testing centre is fully conversant with the technical features of the systems and moreover has a vast fund of experience in handling a great variety of different products.

CONTRACT GRINDING

Our subsidiary in Cologne - Hosokawa Micron Powders GmbH - offers a wide range of services revolving around contract grinding and processing. We would be happy to put you in contact.

ALPINE'S PERFORMANCE RANGE

CONSULTING SERVICES

Clarification of different technical solutions, product-specific processes, consideration of safety aspects, different system concepts, e.g. pressure-shock-proof, inert gas mode, CIP/SIP/WIP, etc.

TRIALS, ANALYSES, RENTAL MACHINES

Grinding and classifying trials, laboratory analyses, determination of energy requirements and production costs, manufacture of product samples, rental systems.

ENGINEERING

Initial design stage:

Concept studies, basic engineering, flow-charts, installation planning, safety concepts, e.g. ATEX, project documentation.

Detail planning:

P & I diagrams; calculation and layout, specification of components, design, programming and networking of visualisation systems, structural steel engineering with static calculations, planning the piping and ductwork, official acceptance of subcontractor work.

PROCESS AUTOMATION

Control cabinets, conventional control units (Plexwire), process control with PLC, visualisation systems, process data archiving, logic diagrams, teleservice connection for remote maintenance.

DOCUMENTATION

- Operating instructions and manuals
- "As built" documentation
- Software documentation
- Documentation as per 21 CFR Part 11 for the pharmaceuticals industry
- CE certification

MANUFACTURING

The producing sector of our company includes our sheet metal and structural steel engineering shop for the manufacture of complex subassemblies, also in pressure-shock-proof design, as well as our machine shop with an extremely wide range of production machines. Between 2007 and 2014, new production facilities were built in three building stages for our production and assembly departments, for our apprentice training shop and several associated offices.

ASSEMBLY

- Assembly of complicated subassemblies and machines of different design and dimensions
- Design consultancy in all manufacturing issues
- Test runs, acceptance procedures by our customers (FAT)

ENGINEERING PLANNING & SUPERVISION

- Project coordination
- Installation and assembly of complete systems on the customer's site by competent field service erection engineers - anywhere in the world
- On-site supervision

COMMISSIONING

- Commissioning, training, test runs, system hand-over (SAT)

SERVICE

Our range of services includes spare parts supply, maintenance/maintenance contracts, inspections, servicing, repairs, general overhauls, system upgrades, training.



➤ Zigzag Classifier

IMPORTANT FEATURES

- Low-maintenance and low-wear classifier
- Reliable in operation, overload-proof
- Insensitive to changes in the composition of the feed material
- Simple operation
- Wide application range

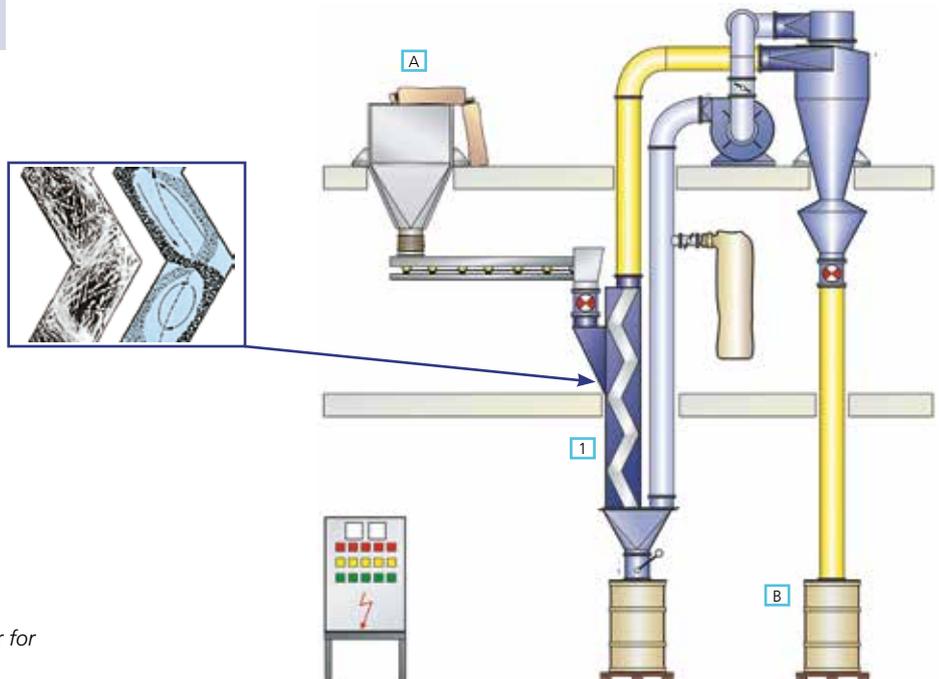
MULTI-PLEX[®] ZIGZAG CLASSIFIER

The zigzag classifier is employed to remove stones, stalks, metal and heavy parts from a great variety of different products or for post-cleaning and separation of paper, film, fibres and hair, etc. Dependent on the product, the light fraction is used either as the end product or is processed further for fine-cut products.

HOSOKAWA ALPINE manufactures a range of designs in numerous machine sizes as single-tube or multi-tube classifiers for sharp separations in the range $d_{97} = \text{ca. } 0.3$ to 10 mm. The throughput rate ranges between several kg/h for the laboratory classifier up to approx. 200 t/h for the multi-tube classifier. Classification takes place in every kink of the zigzag tube, thus permitting an extremely high and steplessly adjustable precision. The result are clean fines, i.e. light material, even in the case of overload.

In the food and feed industry, the Multi-Plex zigzag classifier is used in the following areas:

- Separation of stones, metals and/or hair or sand, etc. from raw spices
- Dedusting and removal of insects (larvae) from freeze-dried herbs
- Removal of impurities from hibiscus blossoms for tea
- Oleaginous fruits: classifying system to separate the liberated soy beans or sunflower seeds
- Separation of pulse shells and pods to enrich the protein content



1 Zigzag Classifier

A Product feed

B End product

- System example with zigzag classifier for the classification of tea



ROTOPLEX GRANULATORS

Spices, herbs and tea are reduced to uniformly fine, clean-cut granules with a minimum of dust using the Rotoplex granulators. The patented cross-scissor-cut rotor makes the Rotoplex granulators ideal for the production of fine- to coarse-grained products. Typical applications are:

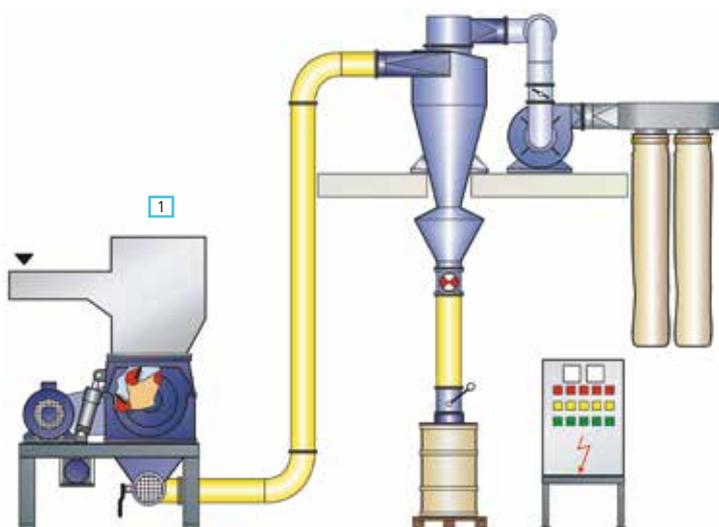
- Ginger
- Oregano
- Chestnuts
- Chilli
- Garlic
- Fruit teas

Another typical application area is the preliminary size reduction of large spices as a stage for fine grinding.

PRACTICAL EXAMPLES

Product - Ro 28/40	End-product fineness	Throughput kg/h*
Carrots	95 % < 4 mm	1,000
Garlic (dried)	95 % < 1.6 mm	175
Pepper	95 % < 2 mm	220
Mushrooms	95 % < 3 mm	250
Celery	95 % < 4 mm	600
Spinach	95 % < 4 mm	250
Lemongrass	95 % < 2 mm	100
Onion	95 % < 2.5 mm	1,000

* Guide values for cutting at normal temperature and standard product properties. Kindly contact our friendly sales team for any questions relating to the fundamental properties and deviations from the rule.



➤ Rotoplex Granulator Ro 28/40

MACHINE SIZES

Granulator Ro	Scale-up factor	Drive (kW)
Ro 28/28	0.7	7.5
Ro 28/40	1	11
Ro 28/60	1.5	18.5
Ro 36/60	1.8	22
Ro 40/63	2.2	30

1 Granulator Ro with feed chute

- System example with Rotoplex granulator for integration into spice systems



➤ 630 UPZ with plate beaters

IMPORTANT FEATURES

- Varied applications thanks to the easily exchangeable grinding elements
- Assuming cryogenic grinding, also suitable for greasy/oily products
 - For sticky products, the system can also be operated with conditioned air
- Different designs available:
 - Pressure-shock-proof/pressure-relieved as per ATEX
 - Gas-tight
 - Standard/tangential discharge
 - Mild or stainless steel
- Connection flange to customer requirements
- Bearing protected against dust ingress by air rinsing (automatic intake or forced rinsing)
- Permanently lubricated bearing or bearing designed for relubrication
- Safety equipment conforms to European standards
- Optional: wear-protected design
- Optional: tools for grinding track disassembly

ULTRAPLEX FINE IMPACT MILLS UPZ

Universal in operation for the size reduction of soft materials up to 3.5 on the Mohs' scale.

The material properties, and especially the wear behaviour, dictate selection of the mill. UPZ mills are the mill of choice for root spices, seeds, fruit skins and husks with a high ash content and extremely hard seed pods such as rose hips.

The moisture content, purity, content of essential oil as well as the origin all play a role.

The mill door can be hinged open wide to permit easy cleaning. The feed material is charged centrally through the mill door. All grinding elements can be fitted in the machine housing.

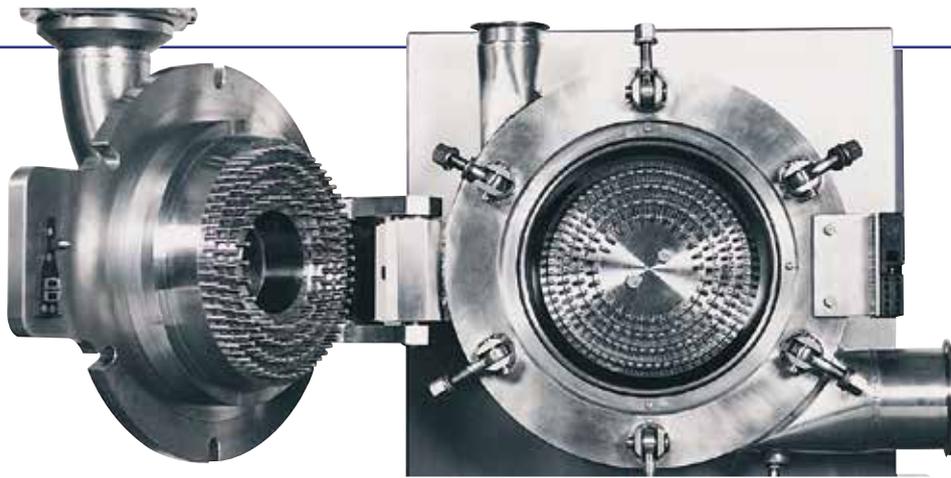


PRACTICAL EXAMPLES

<i>Product - spices</i> 315 UPZ	<i>End-product fineness</i>	<i>Throughput kg/h*</i>
Chillies	95% < 500 µm	200
Ginger	95% < 220 µm 95% < 400 µm	150 250
Cardamom (capsules)	95% < 500 µm	200
Coriander	95% < 650 µm	240
Caraway	95% < 650 µm	130
Curcuma	95% < 450 µm	450
Bay leaves	95% < 320 µm	150
Pepper	95% < 400 µm	300
Mustard	95% < 950 µm	250
Cinnamon	95% < 150 µm	100

<i>Product - dried vegetables</i>	<i>End-product fineness</i>	<i>Throughput kg/h*</i>
Carrots	95% < 500 µm 95% < 160 µm	725 450
Garlic	95% < 400 µm	650
Parsley	95% < 180 µm	300
Celery	95% < 300 µm	250
Spinach	95% < 70 µm	100
Onions	95% < 200 µm	1,000

* Guide values for grinding at normal temperature, low air humidity and standard product properties. Kindly contact our friendly sales team for any questions relating to the fundamental properties and deviations from the rule.



➤ 250 UPZ Ultraplex in stainless steel design



MACHINE SIZES

Fine impact mill UPZ	Scale-up factor	Drive (kW)
250 UPZ	0.5	11
315 UPZ	1	18.5
500 UPZ	2	37
630 UPZ	3.6	75
800 UPZ	4.5	90
1000 UPZ	6.3	110
1250 UPZ	9	250
1400 UPZ	14	315

GRINDING ELEMENTS

The fine impact mills UPZ are equipped with interchangeable grinding elements, thus giving the user a maximum degree of flexibility, which besides the actual grinding performance is becoming more and more important. The UPZ is widespread in the international spice industry as a universal all-round mill for granular to ultrafine end products. It is suitable for just about every type of spice except for those with an extremely high content of oil.



UPZ beater disc unit

Suitable for grinding compact, coarse lumps of material in one step to medium fineness.



UPZ swing beater unit

Heavy-duty beaters made of wearproof cast metal. For medium end-product fineness values.



UPZ plate beater unit

High air flow for cool grinding of heat-sensitive and sticky materials.



Sieve ring or sieve insert

Available with a huge variety of hole widths.



Baffle-ribbed grinding tracks

Short with sieve, long with annular gap.



Triangular-ribbed grinding tracks

Without sieve.



CONTRAPLEX® PIN MILLS C, CW

Thanks to their universality, especially in the case of extremely greasy and heat-sensitive spices for which other systems are totally unsuitable, Contraplex mills are considered the classic spice mills. Even with spices that are extremely critical in terms of grinding, these mills are perfect for continuous operation over long periods.

In counter-rotating mode, the Contraplex pin mill achieves much higher relative speeds than the UPZ fine impact mill. The fineness can be adjusted by altering the pin disc speeds. The centrifugal forces acting on both discs ensure that even moist, greasy and sticky products such as nutmeg/mace, cardamom or mustard seeds can be processed.

The design with the wide-chamber housing is ideal for processing such critical products. The feed material is often embrittled by intensive mixing with liquid nitrogen. The speed and rotational direction of the two pin discs can be selected such that in spite of high end-product fineness values, the grinding process is gentle to the product with optimum retention of the essential oils.

PRACTICAL EXAMPLES

Product - spices 250 CW	End-product fineness	Throughput kg/h*
Cardamom	95% < 400 µm	200
Coriander	95% < 450 µm	215
Caraway	95% < 650 µm	150
Nutmeg	95% < 700 µm	550
Cloves	95% < 600 µm	240
Paprika	95% < 400 µm	200
Pepper	95% < 400 µm 95% < 300 µm	200 85
Pimento	95% < 500 µm	150
Mustard seeds	95% < 500 µm	260
Spinach	95% < 70 µm	200

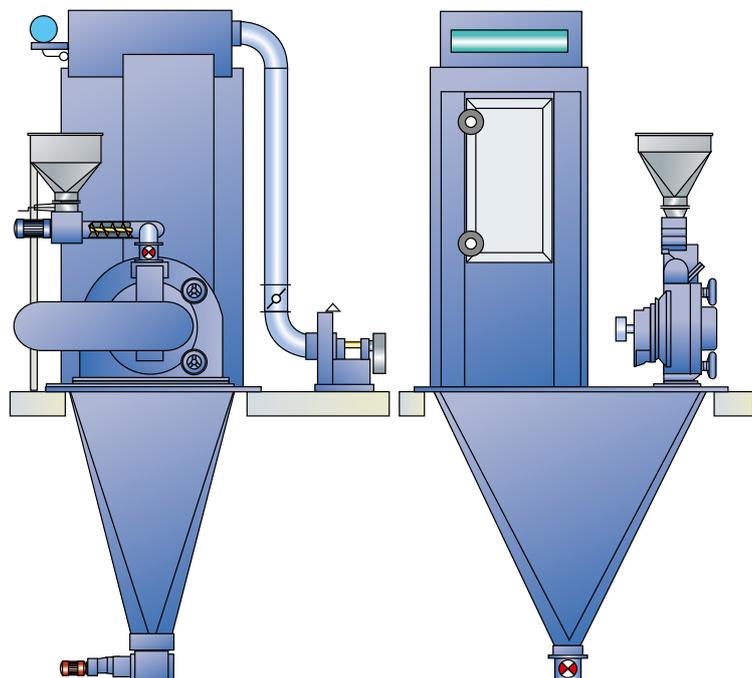
* Guide values for grinding at normal temperature, low air humidity and standard product properties. Kindly contact our friendly sales team for any questions relating to the fundamental properties and deviations from the rule.

IMPORTANT FEATURES

- The wide-chamber housing prevents the formation of deposits and thus ultimately machine blockages
- Different types of pins available
- Robust drive solution
- Grinding fineness - pin mill with counter-rotating pin discs achieves extremely high relative speeds
- Intensive, agglomerate-free and homogeneous mixing-grinding
- Trouble-free continuous operation



➤ 250 CW Contraplex



MACHINE SIZES

Fine impact mill CW	Scale-up factor	Drive (kW)
160 C	0.4	5.5 / 7.5
250 CW	1	7.5 / 15
400 CW	2.5	22 / 37
630 CW	5	2 x 55
800 CW	11	2 x 110
1120 CW	22	2 x 250

INSTALLATION EXAMPLES

The figure above shows a Contraplex pin mill in silo-mounted mode. The silo is dedusted by the filter and fan mounted on the same base plate. Dependent on the peripheral conditions such as the product or system configuration, the

system can also be designed to include extraction to a cyclone or filter. These variations can also be used for other mills such as the fine impact mill UPZ. Over and above this, all systems can be realised in closed-circuit design.



➤ 800 CW Contraplex in stainless steel design



FINE GRINDING AND CRYOGENIC GRINDING

The heat generated during the grinding of spices leads on the one hand to evaporation of the essential oils and on the other hand causes the heat-sensitive fats to melt. In the worst case, this can cause the grinding elements to clog up and the entire mill to block and stall. Because of this and to optimise the product properties and process control, cryogenic grinding is employed with these types of products.

Generally speaking, CO₂ and LN₂ are used as the cooling agents. The product and the system are cooled either by direct injection of the cooling agent into the mill or, if longer residence times or lower temperatures are necessary, by pre-cooling and embrittlement of the material in a screw cooler.

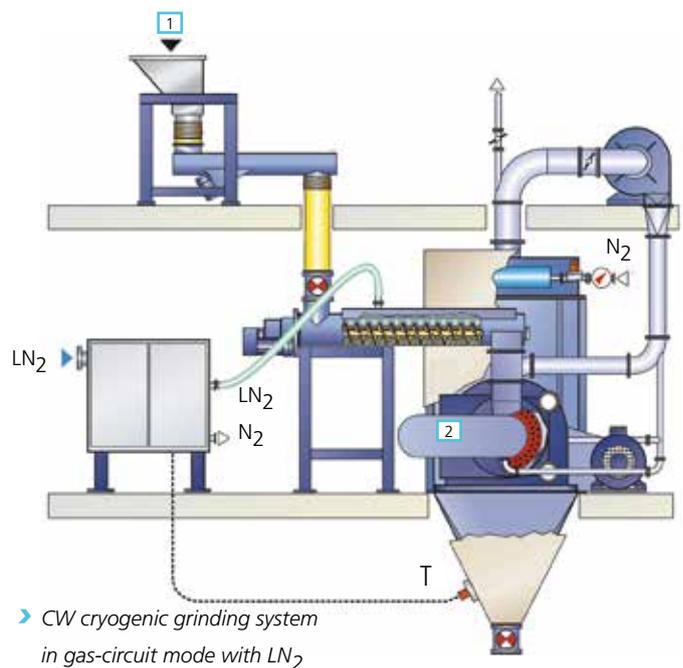
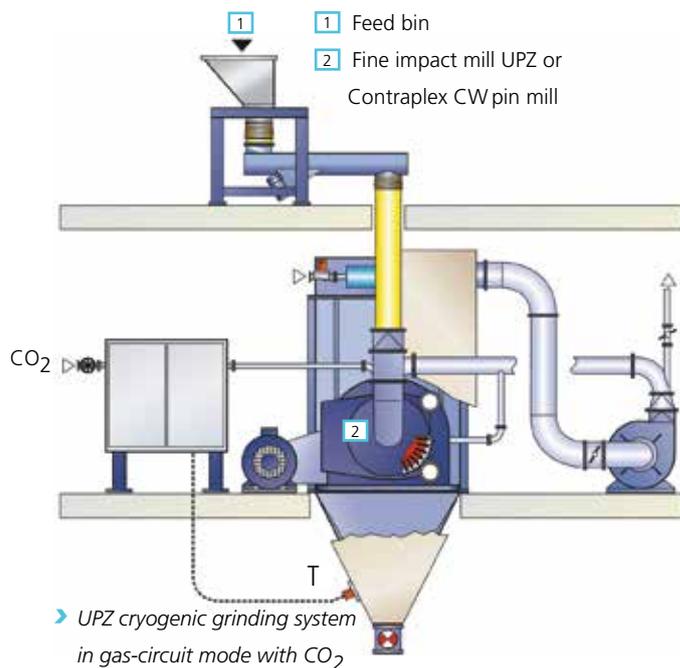
Because cryogenic grinding reduces the loss of essential oils (approx. 3 - 10% loss) in comparison to grinding at normal temperature (approx. 15 - 43% loss), it is possible to improve the aroma and flavour. In addition, the grinding performance is about twice as high and the risk of fire is eliminated.

CRYOGENIC EQUIPMENT

The systems are designed especially for operation under cryogenic conditions.

These include:

- Vacuum-insulated nitrogen tank, ductings and tubing (provided by the customer)
- Insulation of the closed-circuit system
- Stainless steel design on account of condensation
- Cryogenic control valve unit for exact dosing of the requisite amount of nitrogen
- Screw cooler to cool the feed product
- Temperature control, O₂ monitoring





PRACTICAL EXAMPLES

Product	Mill	Throughput kg/h	End-product fineness
Blueberries	315 CW	265	95% < 500 µm
Curcuma	250 CW	212	95% < 120 µm
Caraway seeds	250 CW	212	95% < 450 µm
Mace	315 UPZ 250 CW	68 240	95% < 600 µm 95% < 220 µm
Nutmeg	315 UPZ 250 CW	162 380	95% < 200 µm 95% < 150 µm
Cloves	250 CW	187	95% < 200 µm
Pepper	315 UPZ	273	95% < 150 µm
Juniper berries	315 UPZ	275	95% < 650 µm

► The products are processed at temperatures of between 0°C and -80°C. The temperatures are based on our project experience and testing centre trials.

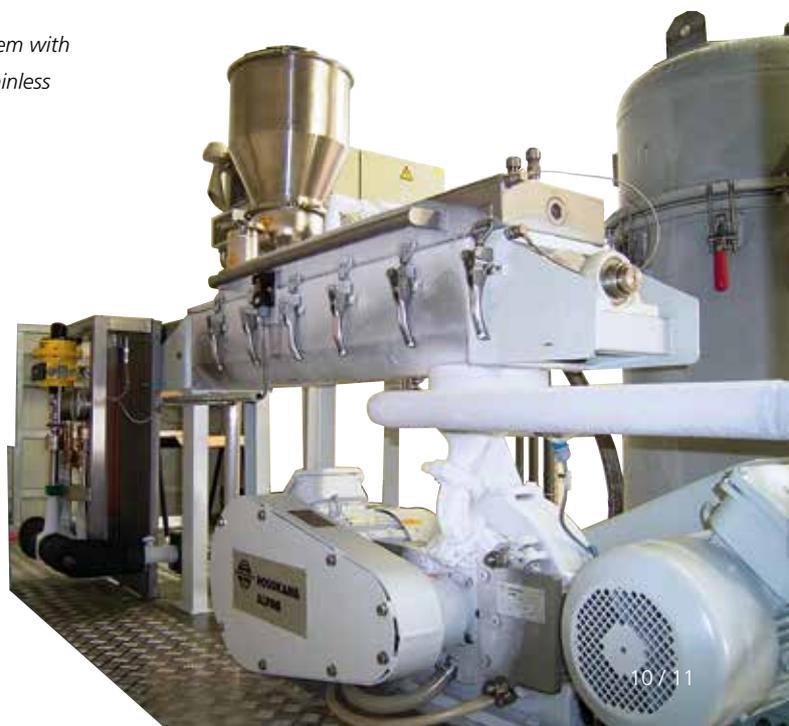
ESSENTIAL OIL CONTENTS IN COMPARISON

Spice	Original		Standard grinding		Cryogenic grinding LN ₂	
	v/g (= ml/100g)	%	v/g	%	v/g	%
Black pepper	3.37	100	2.21	65.6	3.09	91.7
Cloves	17.3	100	11.5	66.5	16.5	95.4
Mace	16.1	100	9.10	56.5	14.5	90.0
Pimento	3.19	100	2.71	85.0	3.08	96.6
White pepper	3.38	100	1.95	57.7	3.19	94.4



► Cryogenic grinding system with Ultraplex 100 UPZ in stainless steel design

► Cryogenic grinding system with Contraplex 160 C in stainless steel design



HOSOKAWA ALPINE Aktiengesellschaft
P. O. Box 10 11 51
86001 Augsburg
GERMANY

Address for visitors and deliveries:

Peter-Doerfler-Straße 13 – 25
86199 Augsburg
GERMANY

Tel: + 49 821 / 59 06-0
Fax: + 49 821 / 59 06-101
E-mail: food@alpine.hosokawa.com

www.hosokawa-alpine.com

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HOSOKAWA ALPINE Aktiengesellschaft

Hosokawa Alpine is a member of the Hosokawa Micron Group, a high-performance manufacturer of systems for powder and particle processing, systems for the confectionery industry as well as plastics processing machines and systems. The group is known and reputed the world over for its power of innovation, constant product care and market-oriented R&D. The most important group resources are R&D, engineering and manufacturing as well as customer service in all global markets.

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