Buss-SMS-Canzler

Drying Technology

SMS

We live process engineering
and special manufacturing

Buss-SMS-Canzler

Buss-SMS-Canzler Core Competence Drying

Buss-SMS-Canzler is a leading international supplier of thermal separation solutions for difficult products and mixtures.
We are the world's leading supplier of thin film evaporation technology, this is due to the long-standing experience of the three former companies Luwa, SMS, Buss and Canzler. This long experience and expertise is now incorporated into Buss-SMS-Canzler.
For our customers around the world we develop and manufacture machines and plants for evaporation, processing of highly viscous materials, membrane filtration and drying. Our experience and our test centre allow us to develop customer specific process solutions by applying tailor-made equipment and complete systems.
Buss-SMS-Canzler partners you as consultant, designer and manufacturer through all project stages: from process layout, pilot tests, engineering, mechanical design, manufacturing and documentation, to installation, start up and after sales service.

CP dryer in outdoor test stand

More than 500 dryers worldwide

For more than 50 years we have supplied different types of dryers, adapted to a large variety of applications throughout the world, currently more than 500 dryers. Based on our long-standing experience and supported by lab and pilot tests, the specialists at Buss-SMS-Canzler select the most suitable drying technology for your application. Lab tests in our lab equipment show general feasibility. Tests in our pilot plants provide the basis for the design of our dryers. These studies are not only carried out upon our customers' request, but also to investigate new applications on our own development projects, as for example the TDI recovery in the CFT dryer (page 12).

Four horizontal thin film dryers for a Chinese customer

Drying Technology at a Glance

The Buss-SMS-Canzler range of dryers carries out the following process steps: drying, cooling, heating, calcining, reacting, mixing, sublimation and sterilisation.
The product range covers heating temperatures of -20°C to 400°C, process pressures of 0,01 to 30 bar and residence times from seconds up to several hours.

Buss-SMS-Canzler offers a program of dryers using different operating principles tailored to meet the individual process requirements when treating products with particular characteristics and specific drying behaviour.

Vertical and horizontal thin film dryers with thin product layers on the heat exchange surface, the ROVACTOR® with specific paddles to convey lumpy wet feed, the REACTOTHERM® with self-cleaning hooks for sticky products as well as the CFT dryer with its mechanically agitated fluid bed are technically mature solutions for a large variety of different drying applications.

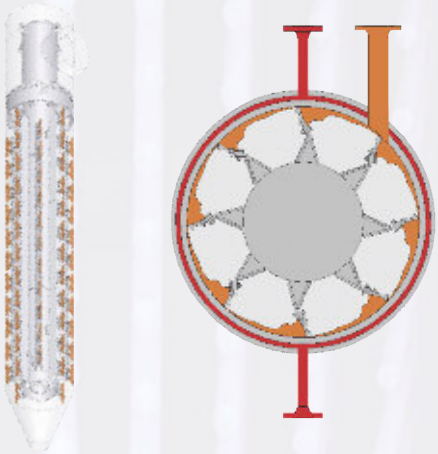
		Vertical dryer	Horizontal dryer	Combi dryer	ROVACTOR®	REACTOTHERM®	CFT dryer
	Heat transfer by	CD	CD	CD	CD	CD	CD
	Operation mode	C	C	C	C	B, C	C
	Pressure on process side	V, A, P	V, A, P	V, A, P	V, A, P	V, A, P	V, A, P
	Product residence time	sec	min	min	(min), hrs	(min), hrs	(min), hrs
Possible processes	Drying	•	•	•	•	•	•
	Heating, Cooling	–	•	•	•	•	•
	Mixing	–	•	–	○	•	•
	Sublimation	–	○	–	○	•	•
	Desublimation	○	○	–	–	•	•
	Melting	–	•	–	•	•	•
	Solidifying	–	–	–	–	•	•
	Reactions	–	○	–	○	•	•
Wet product form	Suspension, Solution	•	–	•	–	•	•
	Thixotropic paste	○	•	○	–	•	•
	Sludge, hardly pumpable	–	•	–	○	•	•
	Filter cake	–	•	–	•	•	•
	Wet powder	–	•	–	•	•	•
	Granular (mm)	–	○	–	•	○	○
	Very coarse (cm)	–	–	–	○	–	–
	Fibrous	–	○	–	○	○	○
Drying behaviour	Crystallising	•	•	•	–	•	•
	„Breaks up" in particles	•	•	•	•	•	•
	Pasty phase	○	•	•	–	•	•
	Sticky/viscous phase	–	–	–	–	•	•
	Crust forming	○	○	○	–	•	•
	Temperature sensitive	•	•	•	○	○	○
	Combustible, explosion risk	•	•	•	•	•	•
	Toxic	•	•	•	•	•	•
	Abrasive	○	○	○	•	○	○

• suitable/applicable
○ fairy suitable/case-to-case evaluation
– not suitable/not used/not applicable

CD = Conduction
C = Continuous operation
B = Batch operation

V = Vacuum
A = Atmospheric
P = Overpressure

Vertical Thin Film Dryers



Thin film dryers are characterised by a mechanically agitated thin product layer. The film thickness is normally in the range of less than one up to a few millimetres.
In vertical thin film dryers the wet feed is distributed over the heated wall by a distributing ring and evenly applied to it in a thin film by hinged pendulum blades. Running downward the product passes typically through an evaporation zone, then a slurry or crystallisation zone and finally a powder zone. Most of the liquid is removed in the evaporation and slurry zone while in the powder zone the surface moisture from the solid particles and some of the internal moisture is driven off.
The volatile components driven out of the product by heat, pass upward through the dryer counter-current to the product flow and are then condensed in an external condenser. The powder obtained at the bottom is discharged continuously via a suitable gaslock system. The total residence time of the product is between 30 and 60 seconds.

Assembly of CP dryer

Manufacturing of CP rotor

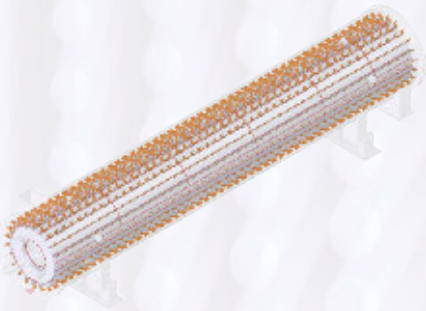
Applications

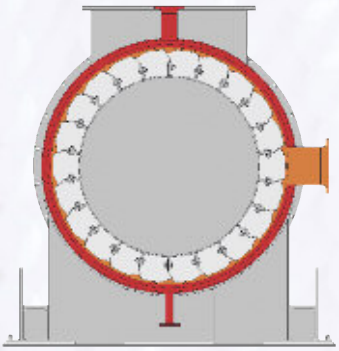
- Agrochemicals (Atrozine etc.)
- Waste water and spent liquors
- Chlorides, bromides, sulfates
- Silane recovery
- Benzosulfonic acid
- Chemical intermediates
- Solvent recovery from waste
- Carbonates, phosphates
- Silicon, silicon carbide
- Xanthates
- Dyes and pigments
- Glycerine
- Sodium formiate
- Baron carbide, baron nitride
- Caffeine, condiments

Process Features

- Continuous processing of liquid and pumpable products to get dry solids in one step
- Gentle treatment of products thanks to short residence time and – if necessary – operation under vacuum
- Fully enclosed design to treat explosive, toxic and hazardous substances
- Complete recovery of solvents
- Contact drying to ensure optimal energy utilization
- Self-cleaning of heat exchange surface, hence a constant high heat transfer

Horizontal Thin Film Dryers





Horizontal thin film dryers are continuously operated contact dryers and used for a broad range of applications under vacuum, atmospheric pressure and overpressure. They consist of a horizontal externally heated shell with end covers, the inlet and outlet nozzles for feed, vapour and final product, nozzles for the heating medium and a rotor with screwed on elements supported in external bearings. The wet product fed through the inlet nozzle is conveyed steadily by the rotor elements along the heated dryer wall in a thin film, allowing an optimum heat transfer and a high evaporation performance.

Vapours pass counter-currently to the product flow and leave the dryer close to the feed nozzle. Entrained particles are removed in the wet zone.
Moisture levels of a few tenth of a percent up to 5% and more can be achieved. The residence time of the product is typically between 5 and 15 minutes.

Applications

- DRYING
  of slurries, sludges, pastes, filter cakes, wet powders
- HEATING and COOLING of solids
- MELTING (Urea etc.)
- REACTION
- MIXING
  of solids with liquids and subsequent thermal processes

Transport of thin film dryer for food industry

Process Features

- Continuous, fully enclosed processing
- Short residence time, small product hold-up
- Low energy consumption
- Superior mixing efficiency
- Flexible through exchangeable rotor elements
- Self-cleaning of heat exchange surface
- Easy access
- High heat transfer coefficient

Thin Film Dryer with pulled rotor

Combi-Dryer

The Combi-Dryer from Buss-SMS-Canzler consists of a combination of a vertical dryer and a horizontal thin film dryer. Special features of thin film contact drying technology:

- Gentle treatment of heat sensitive products due to a short residence time
- Fully enclosed design to treat explosive, toxic and hazardous substances
- Continuous operation
- Small hold-up

Operating method

The wet product is fed into the vertical dryer directly above the heating zone and evenly spread as thin turbulent film on the heat exchange surface by the high speed rotor. The pre-dried product falls from the drying zone of the vertical dryer directly onto the rotor of the horizontal dryer. This rotor conveys the product in horizontal direction to the product outlet on the opposite side of the dryer.
The vapours of both dryers flow in counter-current direction to the product, and then through the vapour nozzle of the vertical dryer into the next process stage.

Advantages of the Combi-Dryer

- Entrained fine particles from the horizontal dryer are removed in the top wet zone of the vertical dryer
- Product loss is minimized due to the compact arrangement
- No intermediate storage or conveying device is required between first and second drying stage
- Different heating media as well as different temperature profiles can be applied

Applications

The dryers are widely used throughout the process industries to convert liquids, slurries and pastes to free flowing solids in continuous, single pass operation.

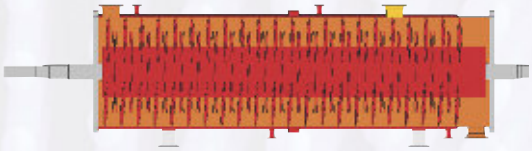
The Combi-Dryer is applied for processing of

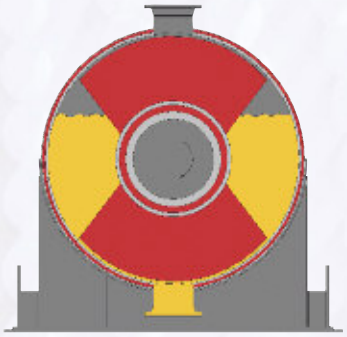
- Dyes and pigments
- Optical whitener
- Polypropylene suspensions
- Organic and inorganic salts
- Polyethylene slurry
- Zeolites

Industrial use of Combi-Dryer

Combi-Dryer

ROVACTOR®





The ROVACTOR® is an efficient contact processor which provides a high local mixing effect for the treatment of filter cakes, powders and pellets. The ROVACTOR® consists of a cylindrical or trough shaped body and a hollow agitator shaft fitted with special paddles in form of segmental discs.
Heating or cooling is provided indirectly by means of steam or a transfer fluid via the segmented rotor discs and the jacketed body.
Continuous or batch processes under vacuum, atmospheric pressure or overpressure are possible. Product residence times can be adjusted in a large range. The processor can be easily protected against wear and tear.

Process Features

- Continuous enclosed processing of toxic, inflammable and explosive products
- Uniform product temperature, processing of heat sensitive products
- Contact drying with low energy consumption
- Low rotor speed: minimum dust production, minimal particle size reduction, suitable for abrasive products
- High heat transfer coefficient: high throughput rates per unit

Rotor of a ROVACTOR®

Applications

CHEMICALS:

- Catalysts
- Carbon, carbon black
- Limestone
- Gypsum
- Sodium chloride
- Detergent additives
- Detergent intermediates
- Uranium oxide

POLYMERS:

- Polyproylene
- Polyethylene
- Polyvinyloxide
- Terephthalic acid

FOOD:

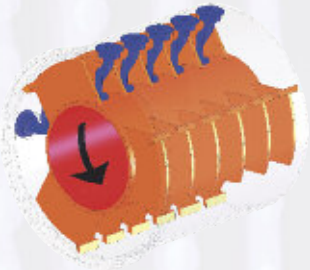
- Cocoa
- Flour
- Sweets
- Pectin

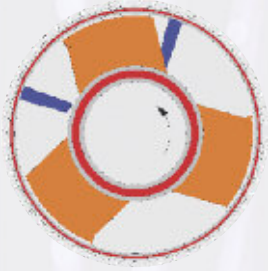
ENVIRONMENT:

- Industrial sludge
- Refinery sludge
- Oil drilling sludge
- Contaminated soil

Large ROVACTOR®
for drying solvent moist synthetics

REACTOTHERM®





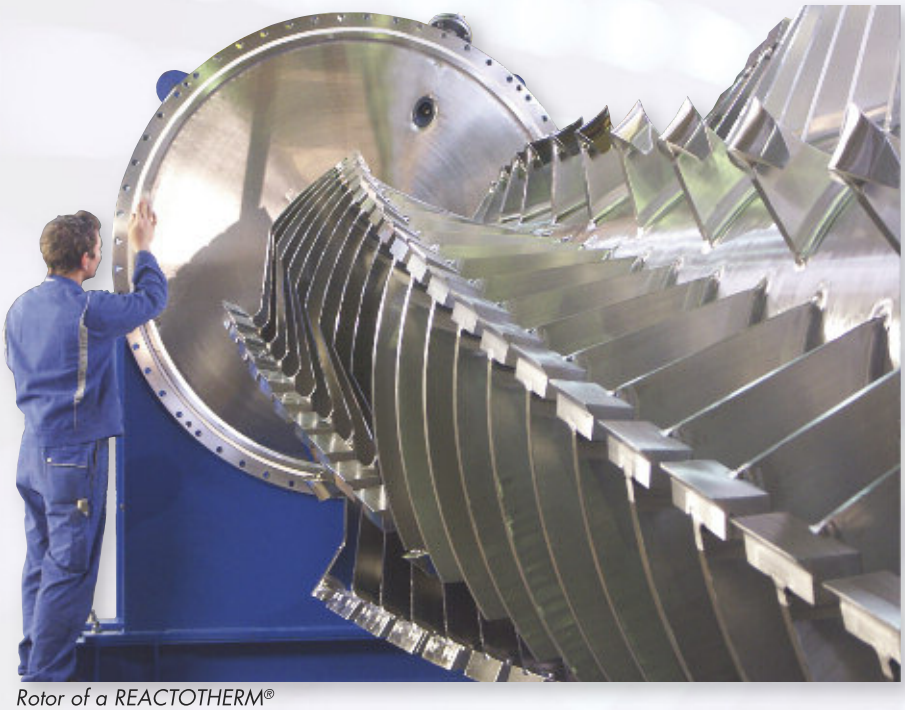
The REACTOTHERM® is used for thermal processing of a wide variety of pasty, viscous, fouling and lumping products. It consists of a cylindrical, horizontal shell and a rotor with segmented discs and mixing bars. Stationary mixing hooks are attached to the inside of the shell. The close clearance between the mixing hooks, the segmented discs and the rotor results in a high mixing and kneading effect and largely self-cleaning properties of the rotor.

The inside of the shell is cleaned by mixing bars avoiding the fouling of heat exchange surfaces and the formation of agglomerates. Shell, shaft and discs can be heated or cooled. Continuous or batch operation under vacuum, atmospheric pressure and overpressure is possible.

REACTOTHERM® for continuous operation

Process Features

- Self-cleaning heat exchange surfaces
- Constant heat transfer with fouling products
- Intensive mixing and kneading effect
- Optimal heat/mass transfer with pasty and sticky products
- Universal use for liquid, pasty and solid products
- Several process steps in one machine



Rotor of a REACTOTHERM®

Applications

DRYING:

- Polymers
- Pharmaceutical intermediates
- Fine chemicals
- Food
- Dyes, optical brighteners
- Antioxidants
- Phosphate salts
- Surfactants
- Paint and varnish sludge

REACTIONS:

- Resorcinol
- Salicylic acid
- Benzoic acid
- Sodium cyanate

RESIDUE TREATMENT:

- Chemical waste with organic solvents
- Radioactive waste

CFT – Combi Fluidization Technology

The main component of the Combi Fluidization Technology is the CFT dryer. This dryer is filled with dry product, which is fluidized by the rotor. The wet product is fed into the hot fluid bed and due to the movement of the bed it is evenly distributed throughout the dry product and dried efficiently.
The formation of sticky/viscous phases, the direct contact of the wet feed with the heat exchange surface and the consequential formation of crusts are avoided to a large extent.
The whole process is comparable to conventional drying with external reflux system, but with the Combi Fluidization Technology the external mechanical work is no longer necessary.
The vapour cleaning is integrated into the drying room of the CFT dryer, so that the vapours can be easily processed in a condenser or rectifier.

This technology can be used for many different applications, as various heating methods are available and temperatures up to approx. 600°C can be reached. The CFT dryer can be operated under vacuum or overpressure.

Many of the slurries and sludges occuring in the field of environmental protection, as e. g. paint and varnish sludges, can be processed under atmospheric pressure.
The Combi Fluidization Technology also offers a very interesting alternative with regard to cost and energy demand compared to the spray drying of products with sticky phases, if no specific properties and conditions of the dry product are required.

CFT lab dryer

Combi Fluidization Technology twin pack

Salt Drying:
Efficiency by Combination

A very common drying application is the drying of salts and salt mixtures, which occur:

- in natural sources
- in down gradients of chemical processes
- as product from the neutralization plant of the flue gas scrubber
- as residue from membrane processes for drinking water abstraction

The composition of salt mixtures may lead to operational malfunctions due to the formation of crusts. In particular, if salt mixtures contain components like sodium sulphate, hard crusts may form on the heat exchange surface. At best these crusts only reduce the performance of the dryer, but if the worst comes to the worst the whole system may shut down.

By combining dryers with different operating principles, such salt solutions can be processed very efficiently, e.g. a salty solution from the flue gas scrubber can be largely dehydrated in a vertical CP dryer. The residual moisture of the product from the first step is removed in the CFT dryer, thus combining a dryer with a very high evaporation performance with a dryer, which safely avoids the formation of crusts. This reduces the design size and improves the operational reliability.

CFT for salt drying

Environmental Protection Worldwide:
Sludge Drying Process

Municipal sludge is increasingly applied as valuable product, as the direct agricultural use will be more restrictive in the future. Industrial sludges have to be incinerated in most cases, so that the pre-drying or full drying of sludges from municipal as well as industrial plants is a mandatory process step in many cases. The following drying degrees can be classified:

Pre-drying to
- 35 to 50% dry solid content prior to incineration in fluidized bed incinerators
- 65 to 75% dry solid content prior to composting or incineration with garbage

Full drying to 85 to 95% dry solid content
- prior to using as solid fuel for cement kilns or coal fired power stations, for pyrolisis, gasification or other conversion processes
- prior to composting, agricultural use and soil reclamation

These are typical applications, where the Buss-SMS-Canzler drying process can show its advantages with an evaporation performance between 0.2 and 8 tons of water per hour. The thin film dryer is characterized by:
- Single pass operation over the sticky or pasty phase; hence no back mixing of dried product
- Low energy consumption
- Self-cleaning heat exchange surface
- Self-inertisation by evaporated water
- Low operating and maintenance costs

These advantages resulted in more than 100 sludge drying installations worldwide, with some being in operation for more than 25 years.

Transport of sludge dryer

Sludge dryer with pulled rotor

Sludge drying plant in USA

TDI Recovery:
CFT Dryer for Economic Processes

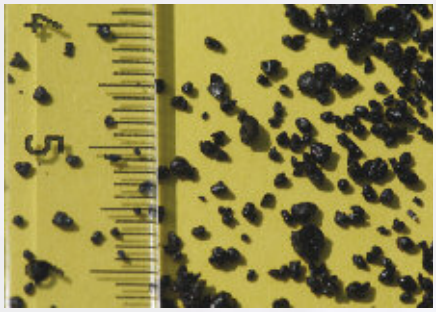
Toluolene-2, 4-diisocyanate is the basis for a large variety of products like glue, soft foams for upholstery and mattresses, shoe soles, varnishes for the automotive industry, planes and trains. 90% of the worldwide production of TDI is used in the production of polyurethane, a foamed synthetics used in many applications. During the TDI production process a large amount of distillation residue, which contains 30 to 70% free TDI, is generated. Therefore it is crucial for the overall profitability of the TDI production process to recover the TDI from this residue. As the TDI recovery is a comparably complex process step, different processes have been developed for the TDI recovery:

- Chemical/physical separation with liquid-liquid extraction
- Chemical transformation with reaction to toluene diamine
- Thermal separation by evaporation and/or drying

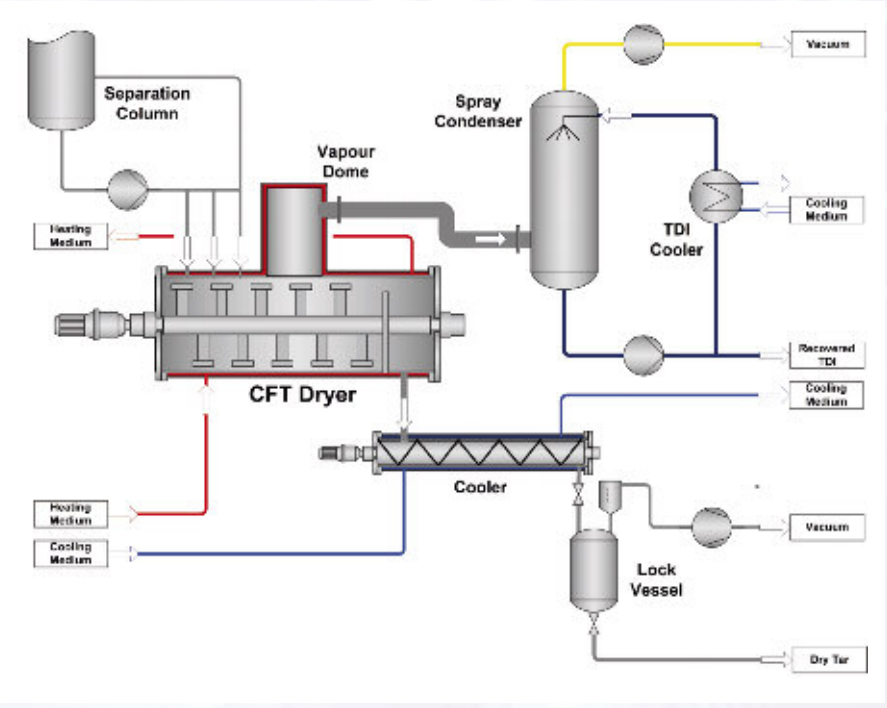
The thermal separation by evaporation including drying allows a 100% recovery of the TDI from the residue and therefore is accepted as state-of-the-art technology.

However, the realization of this recovery process is a demanding application. As soon as the content of free TDI in the residue reduces to approx. 17%, the concentrated residue becomes highly viscous and sticky and suddenly solidifies. Therefore a processor used for the TDI recovery must avoid the blocking of the system with solids. Fluidized bed dryers, which disperse the residue into the fluid bed or contact dryers in robust design with high drive torque for the conveying elements are possible solutions, but result in high operating and/or investment costs. Therefore Buss-SMS-Canzler GmbH developed the TDI recovery in the Combi Fluidization Technology (CFT) dryer.

In the CFT dryer with its mechanically agitated fluid bed the wet product is evenly dispersed so that materials, which pass viscous, pasty, sticky, crust forming or crystallizing phases during drying, can be processed. The operating principle of the CFT dryer offers a simple and economic treatment of the TDI residue, which could be demonstrated in our pilot test centre in Pratteln, Switzerland. The treated residue was continuously dis- charged by gravitation into a cooler. The overall mass balance confirms – 100% TDI recovery.



Final product



TDI recovery process

Drying of Terephthalic Acid:
ROVACTOR® in Long-term Failure Free Operation

Terephthalic acid is the feed product for the manufacturing of PET, which is used in large quantities to produce bottles, foils and textile fibres. The annual production worldwide is more than 40 million tons of PET, produced from the monomers ethylene glycol and terephthalic acid. This shows the importance of PET as a material, which is used in large quantities for many different applications.

For the industrial production of terephthalic acid various processes have been established. The different processes have in common that the reaction to produce the terephthalic acid is realized in a solution, which means the terephthalic acid needs to be dried to obtain the final product, a transparent, free flowing powder. This drying application is very demanding for the process equipment, due to relatively high process temperatures between 180°C and 200°C and the large size of the processors. The high mechanical strain causes fatigue cracks in the welding seams, which are one of the main reasons for operational malfunctions. Based on a detailed analysis of the causes for the damages on terephthalic acid dryers, Buss-SMS-Canzler adjusted the design of its segmented disc dryer ROVACTOR®, so that the welding seams can permanently cope with such strain. As a result our dryers have been in continuous operation for almost ten years without any damage.

Rotor for terephthalic acid dryer

Transport of ROVACTOR® for drying terephthalic acid

Pharmaceutical Industry:
CONTIVAC for Unchanged Product Quality

The CONTIVAC NDP processor was developed by Buss-SMS-Canzler for use in production processes with special hygienic requirements. This processor combines the advantages of continuous thin film drying with a special rotating spray nozzle that allows for CIP cleaning. The individually adjustable heating and cooling zones in the thin film dryer open up new opportunities for thin film drying technology to be used in complex processes.

The basic operations of mixing, reacting, flashing and drying can be carried out in the same machine, with several different substance streams being fed into the processor simultaneously.

The CONTIVAC NDP processor offers manufacturers in the pharmaceutical, fine chemical industries and in the food and pet food industries new possibilities for improvement, which are not available with conventional batch machines.

Batch operated dryers have problems with products, which pass through a sticky, viscous phase during drying.

Such cases require very long residence times, which can cause unwanted side-reactions, thermal damage to the product, and/or colour changes.

Experience has proven that the residence time in the CONTIVAC NDP processor can be reduced up to 500 times.

Further advantages compared to batch systems result from the low investment and operating costs.

The design of the CONTIVAC NDP processor complies with the relevant GMP requirements.

Shaft sealing and bearings are constructed compatible with pharmaceutical requirements (e.g. cartridge construction).

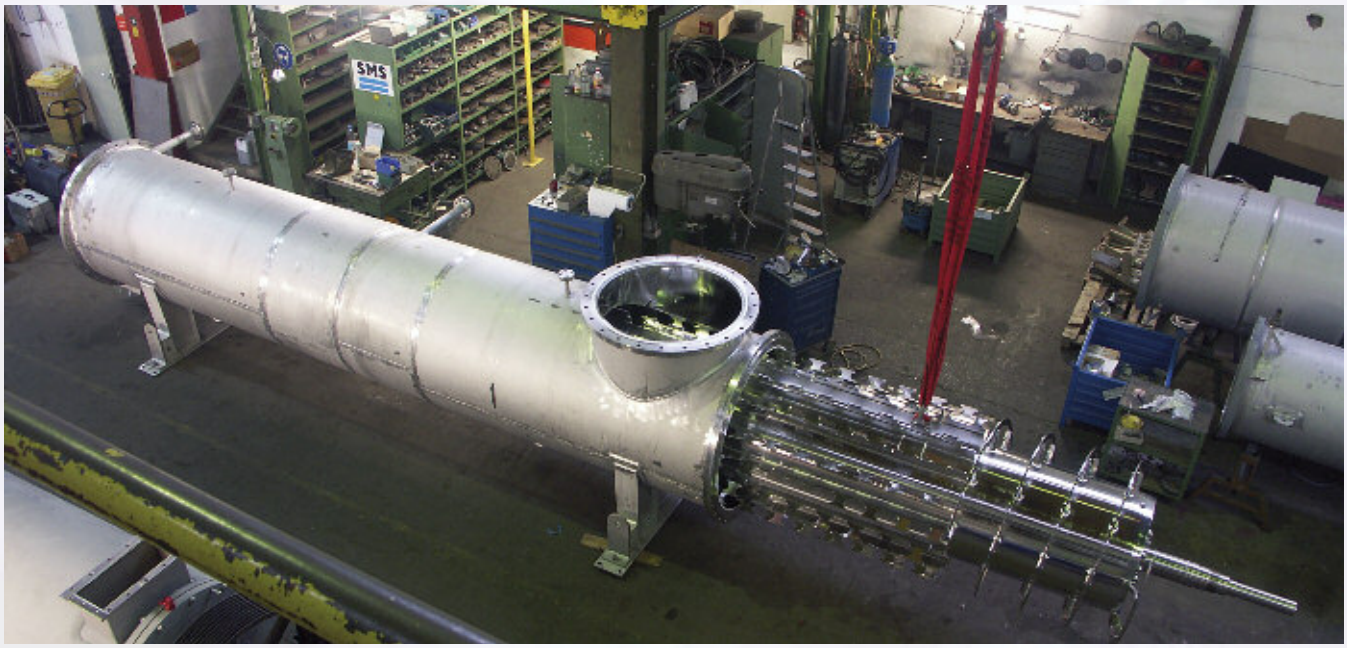
Process Features

- Combination of different basic operations in one machine (no transport problems, no contamination of product)
- Very short residence time (minimum thermal damage to product, high flow rates)
- Very low hold-up (little waste with product changes)

Applications

- Pharmaceutical intermediates
- Food
- Pet food

Rotor detail



Assembly of CONTIVAC

Low Risk Investment Decision:
Your test centre for new developments

Pilot tests are the best way to find the right investment decision.
In Pratteln, Switzerland, we operate a well equipped pilot plant. Process conditions can be easily modified to reach optimized test results. With the parameters from the test results the process and plant engineering can start, all under the responsibility of one project manager.
To find a suitable dryer for your application the following procedures have proven their value:

- General examination of drying behaviour of product
- Drying tests with small product samples in lab dryers to examine general feasibility of our dryers
- Drying tests in our pilot plants to obtain engineering parameters

These procedures provide the necessary information depending on the project stage.

Our test report provides our customers with:

- Documentation of the test assembly
- Description of the test results
- Analysis of the product samples

Professional project realization from one source
We accompany and consult you from the product idea to the optimized quality production. We develop customized process solutions for the thermal separation or concentration of substance mixtures.

We make the process, instrumentation and control design for plant stages and individual components as well as the machine design for the core components, which are mainly manufactured in-house.

Complete service quality
We take care of the delivery to the site of destination, the installation or the supervision of the installation on site as well as the final inspection. Our process engineers plan and supervise start up, test run, optimization of your plant as well as training of the operating personnel. We also offer service and maintenance contracts for preventive maintenance.
Spare parts are available on short call and are shipped once they have passed our quality control.
We offer the automation, optimization or modification of our equipment and plants throughout their entire operating life.

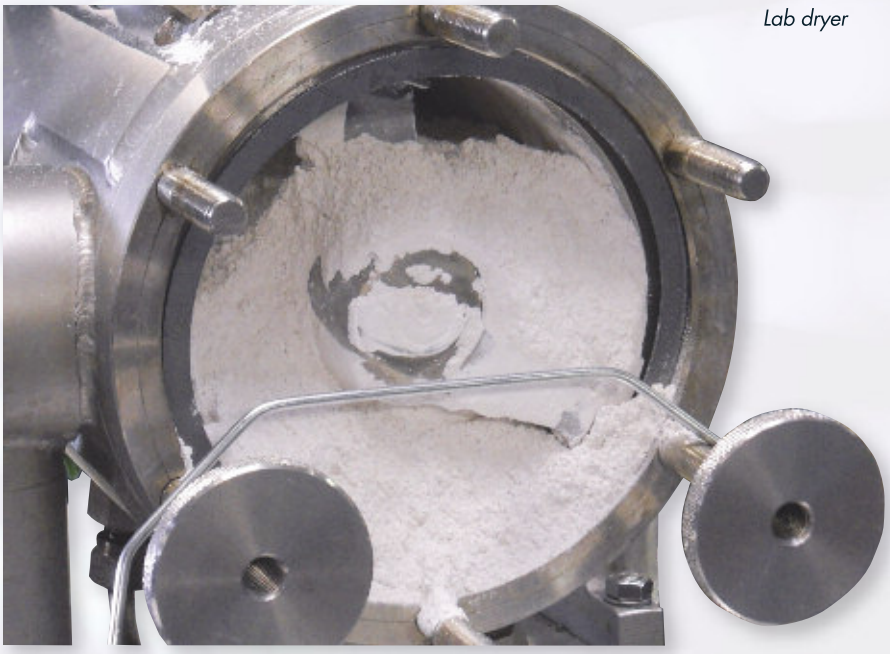
We operate worldwide and are active in the most important markets. Your local contacts guarantee the fast handling of your inquiry and arrange short-term competent advice.

Analytics

- Drying
- Physical definition
- Ionic chemical analysis
- Spectroscopy

- Calcination
- Liquid determination
- Inorganic chemical analysis

- Gas-liquid-reaction
- Chromatography



Lab dryer

Buss-SMS-Canzler

Head Office & Workshop
Buss-SMS-Canzler GmbH
Kaiserstraße 13-15
D-35510 Butzbach
Phone: +49 60 33 - 85 - 0
Fax: +49 60 33 - 85 - 249

Branch Office & Test Center
Buss-SMS-Canzler GmbH
Hohenrainstraße 10
CH-4133 Pratteln 1
Phone: +41 61 82 - 56 - 869
Fax: +41 61 82 - 56 - 766

Branch Office
Buss-SMS-Canzler GmbH
Am Langen Graben 7
D-52353 Düren
Phone: +49 24 21 - 705 -1
Fax: +49 24 21 - 705 - 80

email: info@sms-vt.com
www.sms-vt.com

We live process engineering
and special manufacturing

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