

Process Technologies



Evaporation
Technology



Drying
Technology



High Viscosity
Technology

sms-vt.com

SMS
Inside
Excellence

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We offer the world's largest selection of thin film and short path evaporators. We provide custom-designed equipment to customers for substances which are difficult to evaporate, such as viscous, fouling- and temperature-sensitive liquids.

10-15 Drying Technology



Depending on the specific requirements, we are able to combine vertical and horizontal thin film dryers as well as CFT dryers with other components to process toxic, explosive or otherwise difficult-to-handle substances in a safe and efficient manner.

16-21 High Viscosity Technology

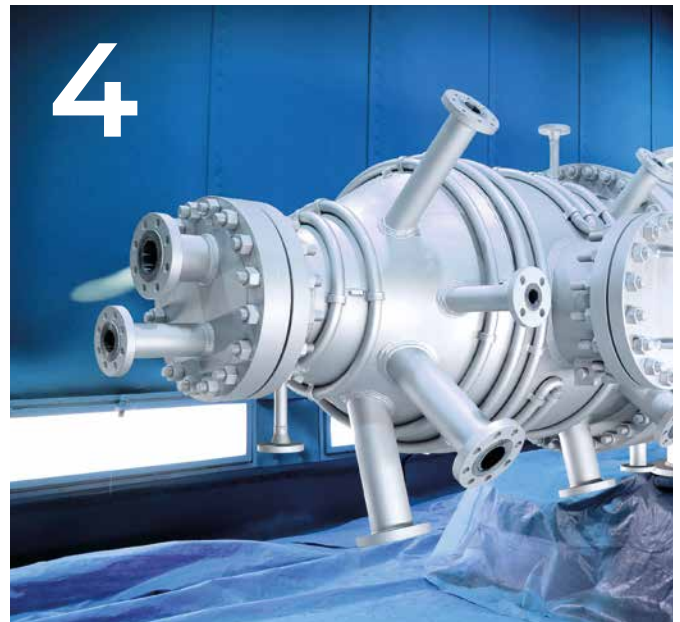


Our thin film processors and large volume reactors for manufacturing and processing polymers are world-leading and guarantee high quality, efficiency and excellent process results.

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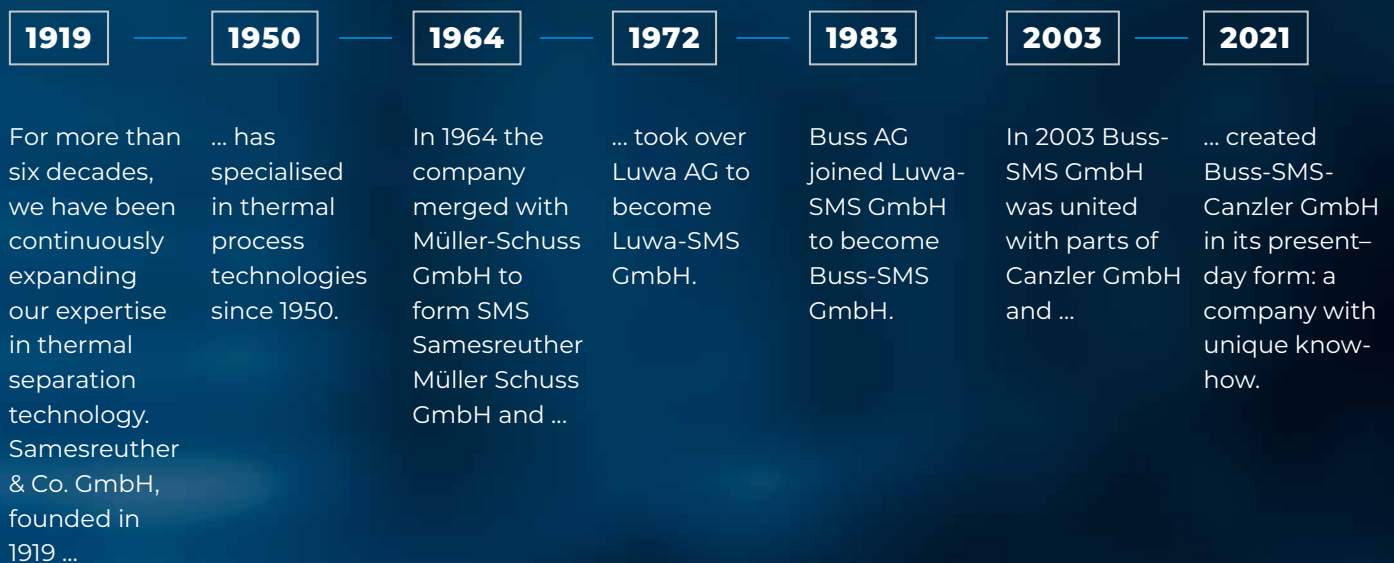
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Inside Excellence

Buss-SMS-Canzler is the global leader in delivering processes for thermal separation of substances that are difficult to handle, and the world's number 1 in thin film evaporation technology.

We develop and manufacture plants and equipment for evaporating, drying and processing highly viscous materials. As experts in process and application know-how, we have been delivering top quality in numerous industrial sectors for decades: from advising and process planning, engineering and production through to service. Everything is 100% made in Germany and Switzerland. Our focus is always on providing exceptional precision, high efficiency, innovation, and investment security.



» We have been setting groundbreaking standards in thermal separation technology for many decades. We are your specialist when it comes to professional processing of difficult-to-handle substances. «



Evaporation Technology





From single items of equipment up to complete plants

For us, optimising the processes of your production plants means perfectly coordinating individual process stages and components for greater economic efficiency.



Whether you require thin film evaporators or short path evaporators, we build and plan custom-designed equipment up to entire single- and multi-stage plants to suit your specific process requirements. When it comes to planning, we always keep the whole production chain in mind: we combine our thin film and short path evaporators with static evaporators and

columns to create a system which will match your requirements.

You will gain enormous added value: a plant with outstanding increased effectiveness.

» As the world leader in thin film evaporation technology, we offer tailor-designed equipment and plants, which are long-lasting, precise, highly efficient, and innovative.«

Our evaporator product range:

- ✓ Thin film evaporators (vertical and horizontal)
- ✓ Short path evaporators
- ✓ Static evaporators for special requirements
- ✓ Entire evaporation plants



INFO

More information is available on our website at:
www.sms-vt.com/technology/evaporation-technology





Thin Film Evaporation Technology – The Problem-Solver

SMS combines more than 60 years of experience and numerous references from Luwa, Samesreuther, SMS, Buss and Canzler in the manufacturing and application of thin film evaporators.

Based on our combined expertise, we plan, design and manufacture thin film evaporators featuring various rotor types in a horizontal, vertical, cylindrical and conical design for co-current and counter-current operation.



SMS thin film evaporators set standards

Because they are perfectly adapted to your individual needs, they are a real problem-solver for challenging tasks:

- ✓ Distillation
- ✓ Separation
- ✓ Concentration
- ✓ Stripping
- ✓ Deodorisation
- ✓ Degassing
- ✓ Reaction
- ✓ Continuous processing

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More information is available on our website at:
www.sms-vt.com/technology/evaporation-technology/thin-film-evaporator



The special characteristics of thin film evaporators compared to other evaporator types are:

- ✓ Processing of viscous, fouling, contaminated and temperature-sensitive liquids
- ✓ Processing of liquids with high boiling points, which are hard to achieve with other equipment
- ✓ Short residence times and narrow residence time distribution
- ✓ High evaporation performance
- ✓ Low hold-up with minimal losses at product changes



Thin Film Evaporators

To thermally separate a mixture of substances, a thin film is produced on the heated wall of a cylindrical or conical thin film evaporator. SMS achieves outstanding performance ensuring the full use of this heated wall.

The blades and wipers fitted on the rotor evenly spread and rotate the liquid as a thin film on the heated wall. This process results in an excellent heat transfer performance of viscous products with up to several ten thousand mPas. In addition, the formation of deposits is avoided, and the intensive mixing also protects temperature-sensitive products from overheating. An extensive selection of possible wiper elements allows a perfect adjustment of the design in terms of the product characteristics.

Typical applications

- | | | |
|--------------------|---------------------|--------------------------------|
| ✓ Bisphenol A | ✓ Polyacrylonitrile | ✓ TDI pre-polymer |
| ✓ Butanediol (BDO) | ✓ Lecithin | ✓ MDI |
| ✓ Caprolactam | ✓ Tall oil | ✓ Fruit and vegetable extracts |
| ✓ Glycol | ✓ Solvent | ✓ Waste oil |
| ✓ Acetic acid | ✓ Coffee | ✓ Catalysator recovery |
| ✓ Epoxy resin | ✓ Sorbitol | ✓ Cacao mass |
| ✓ Formaldehyde | | |

Another important task entails the rotor stabilising the liquid film on the heating surface at very high evaporation rates. This enables evaporation in the area of nucleate boiling without the liquid film rupturing from the heating surface in the process. The liquid film is pressed against the heating surface by the effect of the centrifugal force.

The advantage is that an adverse film evaporation mode is avoided in which a vapour layer with insulating effect is formed under the liquid film. This functional principle allows extremely high specific evaporation rates to be achieved in thin film evaporators – resulting in shorter residence times and an important increase in efficiency and effectiveness of your plant.



Short Path Evaporators

The perfect equipment for temperature-sensitive products.

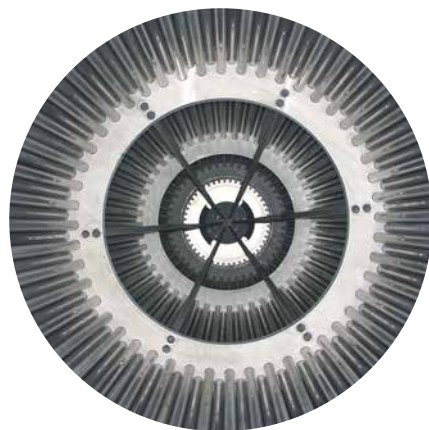
SMS short path evaporators guarantee excellent results when evaporating, concentrating, distilling or devolatilising temperature-sensitive high boiling mixtures. A newly invented and unmatched distribution system on the rotor initially distributes the liquid supplied homogeneously on the circumference in order to use the heated surface right from the start. The internal condenser minimizes the pressure loss due to its short distance from the evaporation surface. Therefore, short path evaporators can operate under fine vacuum and with correspondingly low boiling temperatures. Even extremely heat-sensitive products, such as vitamins and flavorings, can be distilled without causing any thermal damage.

The advantages of the SMS short path evaporator:

- ✓ Very good vacuum of up to 0.001 mbar (a) and low evaporation temperatures
- ✓ Short residence times and small amounts of product in the evaporator
- ✓ Newly invented and unmatched feed distribution system
- ✓ Unique droplet separation for outstanding distillate quality with lowest possible pressure loss

Typical applications

- ✓ Monoglycerides
- ✓ Vitamins
- ✓ Silicone oils
- ✓ PTMEG
- ✓ Waxes
- ✓ Omega-3 fatty acids
- ✓ Waste oil
- ✓ Coal tar pitch



INFO

More information is available on our website at:
www.sms-vt.com/technology/evaporation-technology/short-path-evaporator



Hyvap and Hyvap Skids

The Hyvap thin film evaporator and complete Hyvap skids from SMS are the perfect answer to the increasing demand by the pharmaceutical, cosmetics and food industry for gentle concentrations of heat-sensitive, viscous and fouling products.



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More information is available on our website at: www.sms-vt.com/technology/evaporation-technology/hyvap



Typical applications

- ✓ Pharmaceutical cannabis oil
- ✓ Albumin solutions
- ✓ Pharmaceutical plant extracts
- ✓ Polypeptide extracts
- ✓ Protein solutions
- ✓ Phospholipids and fats
- ✓ Algae extracts

The Hyvap is a thin film evaporator with a horizontal design that allows easy access to and inspection of the inside as well as controlled and reliable CIP cleaning.



The technology of the new Hyvap combines the proven advantages of our conventional horizontal thin film evaporator DKH with these new features:

- ✓ Cantilever rotor design
- ✓ Convenient rotor extraction for cleaning
- ✓ No bearings in product space
- ✓ Mechanical seal with hygienic design
- ✓ Polished surfaces
- ✓ Sight glasses for inspection during operation

The hygienic design of the SMS Hyvap and SMS Hyvap system fulfils all current GMP requirements.





Drying Technology





SMS offers customised contact dryers for solutions, suspensions, slurries, pastes, filter cakes, and moist granules.



Solutions, suspensions, slurries, pastes, filter cakes, and moist granules are all typical feed materials to be dried in the:

- ✓ Environmental sector
- ✓ Chemical industry
- ✓ Food industry and
- ✓ Pharmaceutical industry

SMS recommends contact drying with its main feature: direct heat transfer through contact of the product with the heating surface. Contact drying allows drying under vacuum and thus low temperature processing.

The principle of contact drying offers you many advantages and real added value:

- ✓ No need for carrier gas
- ✓ Virtually no outlet air treatment
- ✓ Heat recovery
- ✓ Straightforward vapour condensation at high temperatures
- ✓ No back-mixing of product, direct feeding and direct drying
- ✓ Evaporation of high boiling solvents
- ✓ Drying of temperature-sensitive products

*» In our test centre, we test your product with our dryers.
Our challenge is to exceed your expectations. «*

The SMS dryer portfolio comprises:

- ✓ Vertical thin film dryers
- ✓ Horizontal thin film dryers
- ✓ CFT dryers



More information is available on our website at:
www.sms-vt.com/technology/drying-technology





Vertical Thin Film Dryers

Vertical thin film dryers consist of a cylindrical, vertically-arranged body with heating jacket. A rotor inside the body is equipped with rows of pendulum blades along the full length of the dryer.

The vertical thin film dryers operate as follows: The wet feed is spread by the pendulum blades in a thin layer onto the heated wall. During this process, the volatile components evaporate continuously out of the product layer at high evaporation rates. The pendulum blades are designed with a minimum gap to the heated wall to prevent fouling deposits on the heating surface, which would reduce performance.

The product enters the dryer at the top. Evaporation starts immediately after the boiling point has been reached. First, solids are formed in the slurry zone. The material is then dried to powder under continued shearing by the pendulum blades. The final solid product is discharged by gravity at the bottom of the dryer via a suitable air lock.

The operation principle and the design of the vertical thin film dryers offer unique advantages:

- ✓ From liquid to solid in one step
- ✓ Little product hold-up
- ✓ Short residence time
- ✓ Vacuum and atmospheric operation
- ✓ High performance even with fouling substances

Typical applications

- ✓ Drying of salts such as chlorides, bromides, sulphates, carbonates, xanthates, phosphates and neutralisation salts
- ✓ Wastewater treatment
- ✓ Silane recovery
- ✓ Silicone drying
- ✓ Glycerine recovery

INFO

More information is available on our website at:
www.sms-vt.com/technology/drying-technology/thin-film-dryer



Horizontal Thin Film Dryers

Sewage sludge, industrial sludges, chemical products, pharmaceutical ingredients and high-value proteins are typical products to be dried advantageously in a horizontal thin film dryer.



This type of dryer is a continuously operating contact dryer, which offers the following unique advantages:

- ✓ Broad range of feed product properties: liquids, pastes and solids
- ✓ Vacuum and atmospheric operation
- ✓ Drying of products forming sticky phases
- ✓ Little product hold-up
- ✓ Fast start-up and shutdown
- ✓ Little residual product inside dryer after shutdown
- ✓ Inert atmosphere in closed body

The horizontal thin film dryer consists of a horizontally-arranged heating jacket with end covers and a rotor with bolted-on blades. The wet product is fed through the inlet nozzle and picked up by the rotor blades, applied to the heated wall, and continuously conveyed towards the outlet nozzle at the opposite end of the body. The vapours stream counter-currently to the product flow and leave the dryer close to the feed nozzle.



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More information is available on our website at:
www.sms-vt.com/technology/drying-technology/thin-film-dryer



CFT Dryers

Some products cannot be handled with conventional drying technology because they undergo multiple changes of their state from liquid through highly viscous, pasty, sticky, crust-forming and finally to solid state.



Tar and paint sludges, TDI distillation residue, contaminated soils, sticky slurries, coal slurries, crust-forming salt solutions, yeast, starch and some proteins display such behaviour. The solution for drying such materials successfully is represented by Combined Fluidisation Technology (CFT dryer). This type of dryer combines the advantages of fluidised bed drying with contact drying. The CFT dryer can handle liquid, semi-solid or solid feedstock in continuous operation because of its working principle.



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More information is available on our website at:
www.sms-vt.com/technology/drying-technology/cft-combined-fluidisation-technology





The CFT works with a hot mechanically-fluidised bed of solid product particles, which is fluidised mechanically by a rotor equipped with blades. The dryer is heated through the dryer shell and optionally via the rotor shaft. The feed material is distributed to the fluidised hot particle bed. Because of the intensive contact of the feed material with the large hot particle surface, the volatiles evaporate instantly. Thus, no viscous, pasty or sticky phase exists inside the hot particle bed and no wet product comes into contact with the heated surfaces.

The working principle of the CFT allows processing in the solid phase at any time. Single-train process solutions for large capacities can be realised with high flexibility in respect to capacity and composition of the feed material. The CFT processing results in easy-to-handle solid products. New applications can be tested in the SMS test centre on lab and pilot scale dryers.



High Viscosity Technology





SMS offers its customers a unique range of processors for highly viscous products and the associated application technology.



Thin film processors:

- ✓ Filmtruder and Viscon

Large volume reactors:

- ✓ Reactotherm – single-shaft reactor
- ✓ Reacom & Reasil – twin-shaft reactor

Decision criteria are:

- ✓ Viscosity range
- ✓ Product residence time
- ✓ Product temperature
- ✓ Heat and shear sensitivity
- ✓ Vacuum / Pressure
- ✓ Mixing requirements

Various SMS technology systems master a wide variety of different process steps, such as:

- ✓ Mixing of viscous & elastic materials/ blending
- ✓ Polymerisation
- ✓ Polycondensation
- ✓ Concentration
- ✓ Devolatilisation
- ✓ Separation of solvents/monomers
- ✓ Sublimation and desublimation

The appropriate system is selected based on the application, process characteristics and process requirements. To achieve tailor-made solutions, we offer our customers a special service of joint development of complex applications in technology, starting with PES (Preliminary Evaluation Study) and followed by comprehensive feasibility studies and trials.



More information is available on our website at:
www.sms-vt.com/technology/high-viscosity-technology



Thin Film Processors

Our thin film processors Filmtruder and Viscon specialise in the concentration, purification and devolatilisation of products with viscosities of up to 10,000 Pas.

The rotor of the vertical thin film processors Filmtruder and Viscon mechanically generates a thin product film on the inner wall of the heated body. The intensive surface renewal creates excellent conditions for heat and mass transfer and produces a high level of devolatilisation.

The design and arrangement of the rotor blades enable the transport and discharge of viscous products. The large free vapour space compared to the low product hold-up allows a high evaporation ratio in a single pass without the risk of any product being carried into the condensation system.





Application field

- ✓ Resins
- ✓ Adhesives
- ✓ Cellulose fibres
- ✓ Spinnable solutions
- ✓ Thermoplastics
- ✓ Pharma intermediates
- ✓ Food ingredients
- ✓ Biopolymers
- ✓ Recycling materials
- ✓ Specialty chemicals
- ✓ Silicone fluids & gums
- ✓ Polymers & elastomers
- ✓ Devolatilisation of thermal- and shear-sensitive products

Key characteristics & benefits of our thin film processors:

- ✓ Short residence time
- ✓ High and homogeneous product quality
- ✓ Unique surface renewal and film distribution for high level of devolatilisation
- ✓ Large free vapour space in relation to low product hold-up
- ✓ Wide range of product grades handled in one unit



INFO

More information is available on our website at:

[www.sms-vt.com/technology/
high-viscosity-technology/
thin-film-processor-viscon-and-
filmtruder](http://www.sms-vt.com/technology/high-viscosity-technology/thin-film-processor-viscon-and-filmtruder)



Key characteristics & benefits of our twin-shaft reactors

- ✓ Processing difficult products with phase changes
- ✓ Homogeneous product quality for complex rheological products
- ✓ High surface renewal efficiency
- ✓ Long product residence times (adjustable) in Reacom
- ✓ Processing thin feed material to highly viscous end product in Reasil
- ✓ Large production capacities
- ✓ Reliable, robust design
- ✓ Precise and uniform temperature control due to large heat exchange area
- ✓ Effective self-cleaning to minimise dead zones, product accumulation and product degradation

Reasil / Reacom

The large-volume, twin-shaft reactors Reasil and Reacom were developed for intensive mixing, kneading and devolatilisation as well as the polymerisation of highly viscous products.



The versatile reactors are characterised by very large process volumes and excellent self-cleaning. The two co-rotating rotors of Reacom and the counter-rotating rotors of Reasil provide plug flow capabilities of products with a wide range of viscosities. The high degree of self-cleaning is achieved by the intermeshing of specially shaped rotor elements. The rotors and shells of both processors can be heated or cooled.



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More information is available on our website at:
www.sms-vt.com/technology/high-viscosity-technology/large-volume-processor



Reactotherm

The Reactotherm is a universal processor, with an intensive mixing and kneading effect and good self-cleaning capabilities. It masters thermal processes with pasty, viscous, crust- and clump-forming products and is designed to be operated either continuously or batch-wise.

The Reactotherm consists of a cylindrical, horizontal shell and a rotor which features segmented discs and mixing bars. Mixing hooks are flanged onto the shell. The small gap between mixing hooks, segmented discs and the rotor shaft produces a high mixing/kneading effect and self-cleaning of the rotor. Shell, shaft and disc elements can be either heated or cooled.



Key characteristics & benefits of a Reactotherm processor:

- ✓ Large heat exchange surface per unit volume
- ✓ Good kinematic self-cleaning capabilities
- ✓ Processing with wide range of product characteristics
- ✓ High production capacity with adjustable residence time
- ✓ Good mixing properties and capacities for phase transition
- ✓ Wide range of product grades handled in one unit
- ✓ Different process steps / process combines in one single unit



More information is available on our website at:
www.sms-vt.com/technology/high-viscosity-technology/large-volume-processor



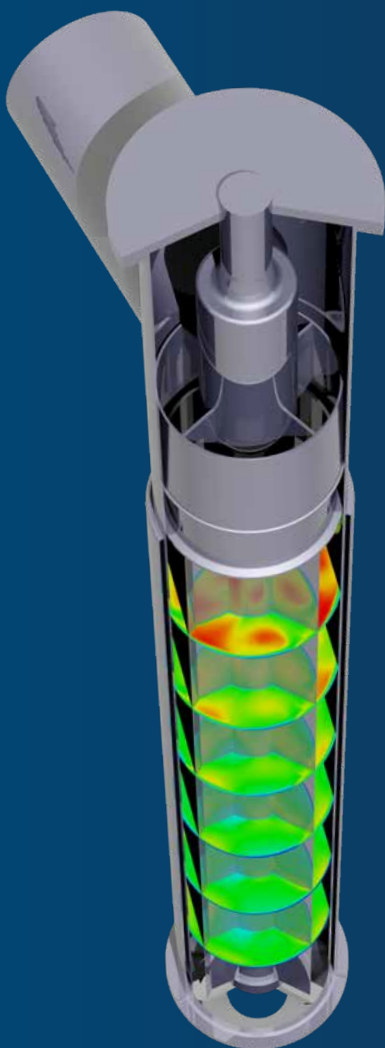
Tools for Tailor-Made Equipment and Innovations

The basis of our application- and customer-oriented development capabilities is the know-how and experience of our engineers.

Two important tools for successful innovation provided by SMS are:

- ✓ Computational Fluid Dynamic, Discrete Element Method and other computations and
- ✓ Lab-scale and pilot test facilities in our test centre in Pratteln (Switzerland)

The application of these tools and close co-operation with our clients result in exceptional solutions.



Computations

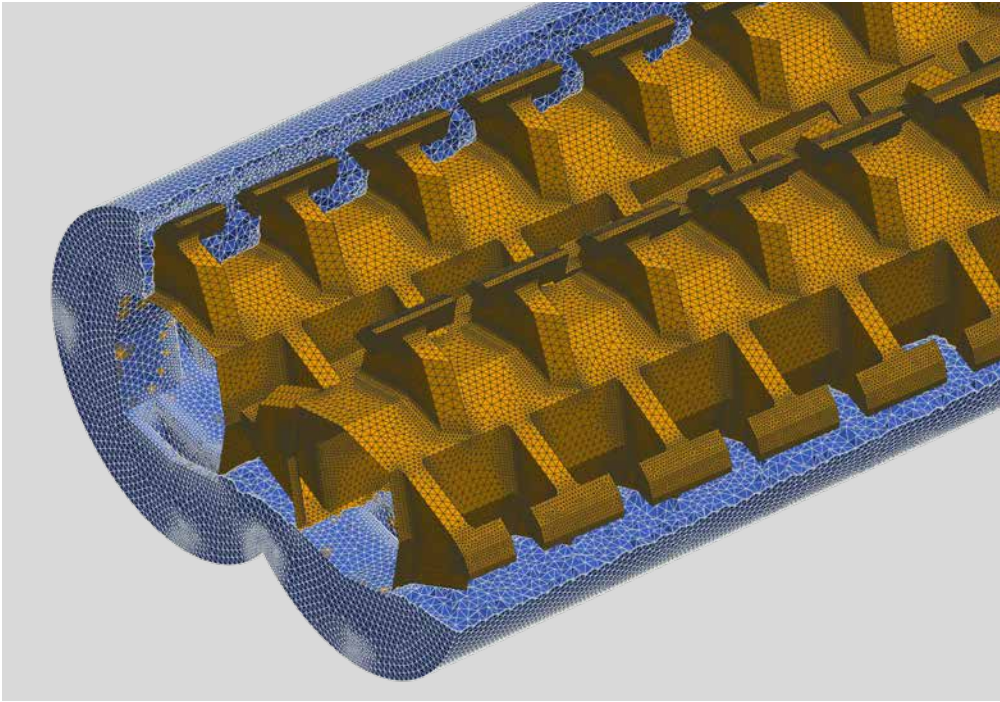
Computational Fluid Dynamics (CFD), Discrete Element Method (DEM) and other computations provide deep insights into the processes inside our equipment and therefore perfectly support troubleshooting in case of unexpected events, equipment design and process optimisation.

Since SMS does not offer standard equipment, standard solutions in computation do not fulfill our requirements. Therefore, we develop special tools to allow computation of the processes inside our equipment.

Our CFD tool for evaporator computation is a unique software. It enables us to compute the fluid dynamics including heat and mass transfer in thin film evaporators, making it possible to further develop our thin film evaporators and adjust them to new applications based on the detailed information about the process within the evaporators. Thus, our software provides greater cost-effectiveness, safety and efficiency in the development of excellent separation methods.

The advantages of CFD-based evaporator computation:

- ✓ Detailed understanding of the processes inside thin film evaporators
- ✓ Perfect adjustment to the application
- ✓ Reliable design also for new products, in some cases even without availability of product for test centre trials
- ✓ Minimisation of error sources in development
- ✓ Economic, time- and cost-efficient development process

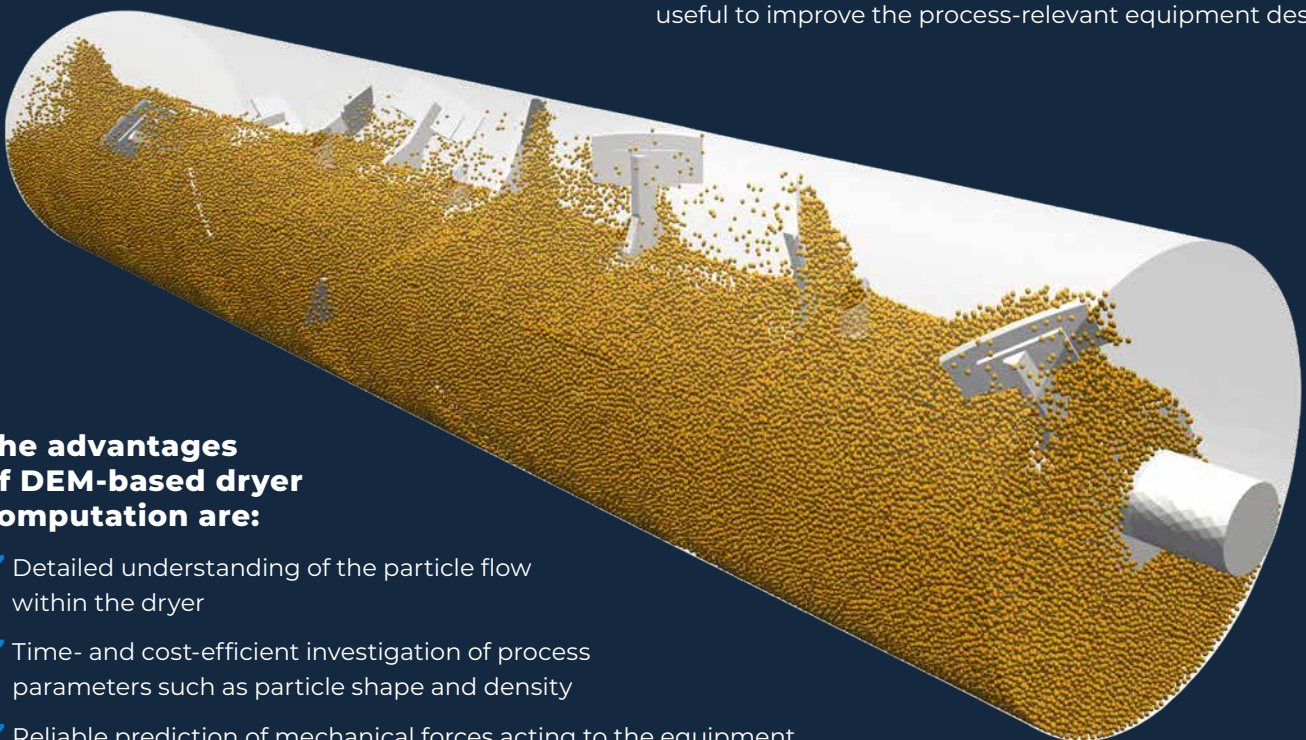


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More information is available on our website at:
www.sms-vt.com/company/expertise/cfd



DEM computations allow the calculation of particle flow and the resulting forces and torques acting to the rotor of our Combined Fluidisation Technology (CFT) dryer. This offers the opportunity to further develop the mechanical design of the equipment. Since some of the specifics of the process are linked to the particle flow, the results are also useful to improve the process-relevant equipment design.



The advantages of DEM-based dryer computation are:

- ✓ Detailed understanding of the particle flow within the dryer
- ✓ Time- and cost-efficient investigation of process parameters such as particle shape and density
- ✓ Reliable prediction of mechanical forces acting to the equipment
- ✓ Minimisation of error sources in development



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More information is available on our website at:
www.sms-vt.com/company/expertise/test-centre



Test Centre

Trials provide basic information on feasibility, data on product quality and equipment design parameters. Trials prove the ideas of our engineers and the results of calculations, even for newly developed processes.

Therefore, trials are a safe way to reach the objectives of application and customer-oriented R&D projects and finally to make the very best investment decisions. It is with this in mind that we present our test centre and laboratory in Pratteln (Switzerland) with 20 pilot plants for evaporation, high viscosity and drying technology.



An essential part of our test centre is the chemical and physical laboratory to analyse samples. This enables us to test the handling of your products, even if they are flammable and toxic. With customised test plants and equipment, we are able to implement your specific process solutions. The extensive equipment at the test centre enables us to modify process conditions as required. Since we have pilot equipment for all our technologies available, we are able to test optimal combinations like pre-concentration by evaporation combined with a drying step, or a setup with a series of evaporators. Once the essential plant parameters have been defined, process and plant engineering can begin with the same project manager having responsibility. These close links considerably reduce the time required to develop, plan and implement the plant.

Trials at SMS provide secure investment thanks to:

- ✓ Feasibility studies for new products
- ✓ Design of new plants and plant stages
- ✓ Basic trials for scale-up to the operational scale
- ✓ Optimisation of existing processes

Our test centre offers you:

- ✓ Laboratory tests, for example in a glass evaporator for small product quantities
- ✓ Semi-industrial trials and preliminary trials in evaporators, contact dryers and high viscosity plants
- ✓ Production of samples for research, marketing and authority approvals
- ✓ Analytical laboratory to determine the product characteristics



Engineering Service

Our services start with an analysis of your individual requirements.

Based on your requirements and our experience, we select the process and design the equipment. Lab-scale and pilot tests in our test centre as well as computations by our experts in computational fluid dynamics (CFD) generate the necessary data to develop your innovative production process. Our dedicated project team will advise and support you in each phase – from the initial idea through to optimised quality production.

Our experts perform all the necessary steps – from process planning with basic and detailed engineering, calculation and design, to assembly or supervision through to delivery to the intended destination, final inspection and commissioning. In addition, they train the operating personnel on-site. We also offer maintenance and servicing for your plant and equipment.



INFO

More information is available on our website at:
www.sms-vt.com/company/expertise/engineering



Elements of our engineering service from a single source:

- ✓ Advice and feasibility studies, license exploitation
- ✓ Process development and design, Project management
- ✓ Plant design, incl. pre, basic and detailed engineering
- ✓ Advice, procurement and delivery
- ✓ Design, calculation and manufacturing of key components
- ✓ Installation, assembly and start-up
- ✓ Performance records and training
- ✓ Procedures according to GMP
- ✓ Optimisation, upgrading and automation of existing plants
- ✓ Planning according to national and international standards and regulations

Customer Service and Support

Assistance and support in all matters – fast, competent, goal-oriented.



That is our claim! Our specialists work in-house as well as on-site to meet this demand. Our goals: short downtimes, highest quality, perfect service, satisfied customers.

Our services:

- ✓ Competent contact persons
- ✓ Experienced field service staff for repairs and maintenance that can be deployed world-wide
- ✓ An extensive spare parts warehouse
- ✓ Retrofits
- ✓ Conversions according to customer requirements – almost everything is possible here!
- ✓ New construction of all parts such as rotors, heating jackets, bearings etc. for all our operating evaporators, no matter how old they are
- ✓ Repairs of all evaporator components
- ✓ Advice on spare parts stock and maintenance
- ✓ Remote service
- ✓ Maintenance contracts



More information is available on our website at: www.sms-vt.com/after-sales





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