

Anhydro Evaporation and Drying Solutions

FOR THE CHEMICAL INDUSTRY



SPX Flow Technology Danmark A/S is an international engineering company with a consistent goal to provide our customers with the optimal processing technology and the highest plant performance standards. We have specialised in supplying the optimal design and engineering with respect to production performance, flexibility, energy efficiency and environmental protection.

The chemical industry depends on efficient continuous evaporation and drying processes for the production of high-quality powders with specific product parameters. SPX FLOW recognizes its responsibility both to customers today and the generation of tomorrow by delivering high-performance process solutions with a minimal energy and environmental footprint.

SPX FLOW, Inc. (NYSE:FLOW) is a leading manufacturer of innovative flow technologies, many of which help define the industry standard in the market segments they serve. From its headquarters in Charlotte, North Carolina, it operates a sales and support network, centers of manufacturing excellence, and advanced engineering facilities, throughout the world. Its cutting-edge flow components and process equipment portfolio includes a wide range of pumps, valves, heat exchangers, mixers, homogenisers, separators, filters, UHT, and drying technology that meet many application needs. Its expert engineering capability also makes it a premium supplier of customized solutions and complete, turn-key packages to meet the most exacting of installation demands.

Incorporating many leading brands, SPX FLOW has a long history of serving the food and beverage, power and energy, and industrial market sectors. Its designs and engineered solutions help customers drive efficiency and productivity, increase quality and reliability, and meet the latest regulatory demands. In-depth understanding of applications and processes, state-of-the-art Innovation Centers, and advanced pilot/testing technology further assist in optimizing processes and reducing timescales to reliably meet production targets.

To learn more about SPX FLOW capabilities, its latest technology innovations and complete service offerings, please visit www.spxflow.com.

Anhydro Process Solutions for the Chemical Industry

The Anhydro processing plants are used for many different purposes and within the below-mentioned segments:

- Polymers
- Salts
- Fillers
- Pigments and dyestuffs
- Hard metal
- Agrochemicals
- Ceramics
- Catalysts

CRITICAL CUSTOMER DEMANDS

Plant solutions for chemical manufacturers looking for long-term competitive leadership and profitability need to meet a long line of decisive demands.

These include:

- High product quality and uniformity with consistent product specifications
- High yield at low production costs
- Ability to use the plant for a number of different applications
- Compliance with rules and regulations
- High availability
- Environmental protection
- Safe operating conditions
- New product development with short time to market



CUSTOMISED SOLUTIONS

Anhydro evaporation and drying plants are customized for each specific purpose and are available in a wide range of sizes and configurations. All are based on experience gained from extensive tests and long-term partnerships with customers all over the world. The plants are designed to provide competitive solutions for critical customer demands:

- Total control over a wide range of critical process parameters and product properties such as specific heat treatment temperatures and holding times, solid contents and critical powder characteristics.
- Energy-efficient technology including advanced energy recovery systems ensuring very low energy consumption per product unit produced
- Plant designs capable of handling a variety of applications and ensuring very high yields
- Top quality and reliable components for prolonged service life
- Complete and efficient CIP (Cleaning-In-Place) systems
- Automated process control to ensure long and reliable production runs with constant product quality in compliance with chemical standards and regulations.



Typical Product Applications

The Anhydro evaporation and drying solutions offer the flexibility to produce concentrates and a wide range of powders for the chemical industry.



Anhydro Evaporation Technologies

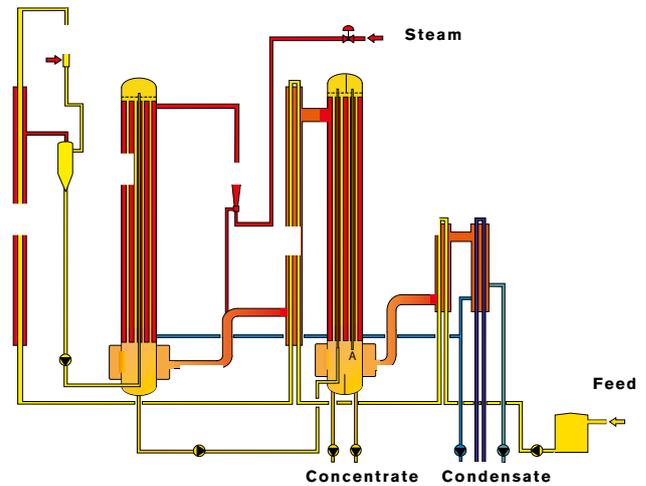
The optimum choice of evaporation technology depends on factors such as viscosity and thermal characteristics of the product, the required output rate, and the available energy supply. Evaporation techniques include single-pass or circulation, single or multiple effect, and thermal or mechanical vapour recompression.

PRIMARY PROCESS – FALLING FILM EVAPORATION

Falling film evaporation is widely applied for concentration of low to medium viscosity organic and inorganic products.

Anhydro falling film evaporators offer:

- Low energy consumption
- High heat transfer coefficients
- Optimum energy utilization
- Short residence time for minimum impact on product quality
- Single-pass evaporation
- Easy building conversion and adaptation to existing facilities



MVR compressor



Anhydro evaporator plant

Beside direct steam heating Anhydro falling film evaporators apply two vapour recompression techniques, to minimise the energy consumption:

MECHANICAL VAPOUR RECOMPRESSION (MVR)

Mechanical vapour recompression requires little or no steam and delivers substantial operational cost savings in areas with an ample supply of low-cost electrical energy.

In MVR, a high-pressure fan powered by an electric motor or a gas or steam turbine is used to recompress the vapour to a higher pressure, resulting in a rise in temperature. This means that the recompressed vapour can be used as the evaporator heating medium, while the condensate is ideal for preheating of the feed product.

THERMAL VAPOUR RECOMPRESSION (TVR)

Steam-heated Anhydro falling film evaporators require an ample supply of live steam to drive the evaporation process through multiple effects. Multi-effect evaporation uses vapour from one effect as the heating medium in a subsequent effect, operating at a lower pressure and temperature.

Multi-effect evaporation thus enables the exploitation of low-grade heat from the evaporator itself for gentle and effective preheating across calandrias with a low temperature difference.



Anhydro evaporator plant

PRE-HEATERS

SPX FLOW can provide pre-heaters and heat treatment units for all evaporation applications: Direct or indirect steam heating tubular and plate designs with or without heat regeneration. Very gentle preheating can be achieved in systems with small temperature differences such as multi-effect systems with thermal or mechanical vapour recompression.

SPX FLOW has developed a pre-evaporation heat treatment process with direct heating and flash cooling to achieve spontaneous heating up to and cooling down from the required temperature.

FINISHERS

Final evaporation to achieve the required degree of concentration can be achieved by a high-concentrator, for example using an Anhydro rising or falling film evaporator. In the case of high-viscosity products and increasing risk of fouling, a finisher with forced circulation is recommended.

CLEANING EQUIPMENT

Evaporators can be equipped with CIP-systems, enabling faster cleaning and shorter downtime without the need to dismantle equipment components.



Calandrias

Anhydro Drying Technologies

The optimum choice of drying technology depends on the characteristics of the feed product:

- High- and low-viscosity liquids and heat sensitive products are spray dried.
- Cohesive and non-cohesive filler cakes are spin flash dried.
- Granulates and powders are fluid bed dried.



Anhydro spray drying plant



Anhydro spin flash® drying plant



Anhydro fluid bed drying plant

Anhydro Spray Drying Plants

For drying of solutions, emulsions, suspensions, and slurries.

Spray drying is a continuous process converting a pumpable liquid into a particulate matter in a single operation. The liquid is atomized into very fine droplets in a drying chamber, where evaporation takes place by contact with hot air, and a powder is formed.

The powder is separated from the drying air in a cyclone or a bag filter system.



From liquid to powder



PLANT DESIGN

SPX FLOW plant design is based on experience gained from many thousands of tests and a very large number of reference plants installed within the chemical industry.

Plant configurations are carefully selected to provide the required powder characteristics. A correct type of atomizer, proper air distributor and drying chamber design are all essential plant elements.

SPX FLOW offers a variety of drying chamber configurations:

- Standard single-stage conical chambers for production of fine powders
- Multi-stage chambers with integrated fluid beds for production of agglomerated powders
- Tall form chambers which are especially suitable for producing large single spherical particles
- Flat bottom chambers with a well defined residence time, suitable for thermoplastic, sticky materials. These chambers require less building height and facilitate easy access for inspection and cleaning

THERMOPLASTIC MATERIALS

Design of chambers for thermoplastic materials, which are sticky at elevated temperatures includes a rotating air broom sweeping the chamber wall with slightly heated air to limit the powder built-up on the wall.

DUST EXPLOSION PROTECTION

When a spray drying plant is designed for drying an organic product, there is a potential risk of a powder explosion. In such case the plant will be provided with pressure relief or explosion suppression systems and fire extinguishing nozzles.

ENERGY EFFICIENCY

By combining spray and fluid bed drying in a multi-stage solution, the residence time is increased and drying is completed at lower product temperatures. The resulting energy saving of 10 - 15% can be further increased by use of heat recovery systems on the exhaust air.

Atomization - The Heart of the Process

SPX FLOW offers two basic types of Anhydro atomizers:

- Centrifugal atomizers, accelerating and atomizing the liquid feed using centrifugal force in a spinning disc. Suitable for many chemical applications and available for feed rates up to 80 tons/h.
- Nozzle atomizers, spraying the liquid feed under high pressure or using compressed air. High pressure nozzle atomization is used in particular when a coarse powder with narrow particle size distribution and high bulk density is required.

The highly successful track record of Anhydro atomizers is based on years of operation with a wide variety of chemical products under different conditions:

- All surfaces in contact with product in high alloy stainless steel or other corrosion-proof materials
- Easy access for inspection and cleaning
- Special atomizer design for high uptime and uniformity
- Few wear parts with no gear wheels and other vulnerable wear components
- No vibration and very little noise
- Low power consumption
- Variable atomizer speed and temperature adjustment
- Automatic bearing lubrication system
- Steam injection option for centrifugal atomization for high-density powders with low air content
- Controlled flow nozzles enabling precision control of particle size
- Possibility for substitution of one atomizer type for another in the same drying chamber for different applications



Centrifugal atomizer



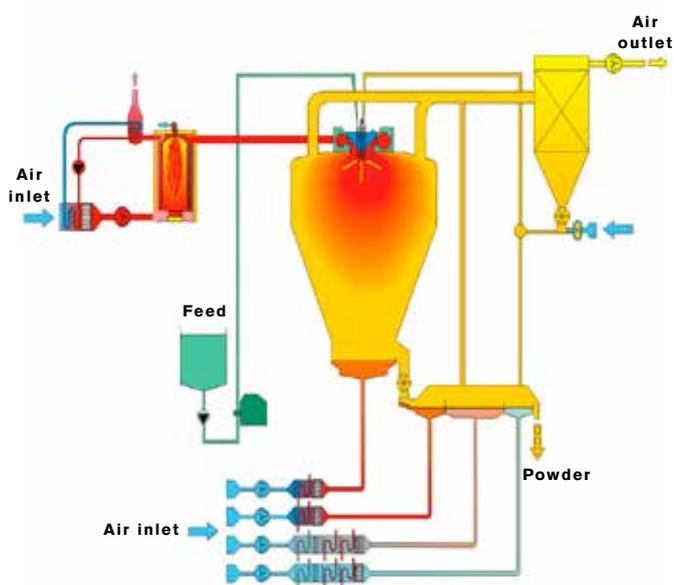
Nozzle atomizer

Typical Anhydro Plant Configurations

ANHYDRO SPRAY BED DRYING PLANT

Specially designed for the production of dust free powders with a high mechanical strength.

The drying chamber is provided with an integrated fluid bed. The feed is sprayed co-current to the drying air towards the fluid bed, where an adjustment of the fluidization rate enables full control of the fines fraction to be removed from the product.



The fines are conveyed with the drying air to the wet zone in the drying chamber top, where the fines agglomerate with the wet droplets. Fines carried out together with the air are separated from the air in a cyclone system or a bag filter, and the fines are re-circulated to the atomizer zone for agglomeration.

The powder is further dried and cooled in an external fluid bed before discharge. The agglomerated powder produced is dust-free with an average particle size of 100 - 350 microns.

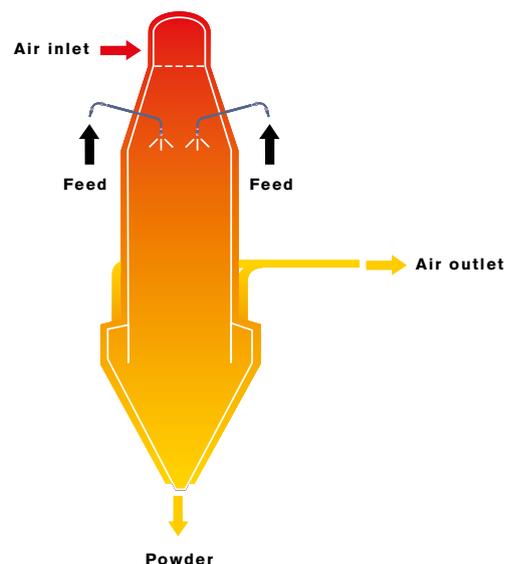
ANHYDRO TALL FORM DRYING PLANT

Specially designed for the production of large spherical single, non-agglomerated particles.

The feed is atomized at a low-pressure co-current to the drying air being introduced at the chamber top as a laminar flow.

The chamber has a large cylindrical section providing sufficient residence time for large particles to dry out under gentle conditions. The main part of the powder is discharged at the chamber bottom and can be further dried or cooled in an external fluid bed.

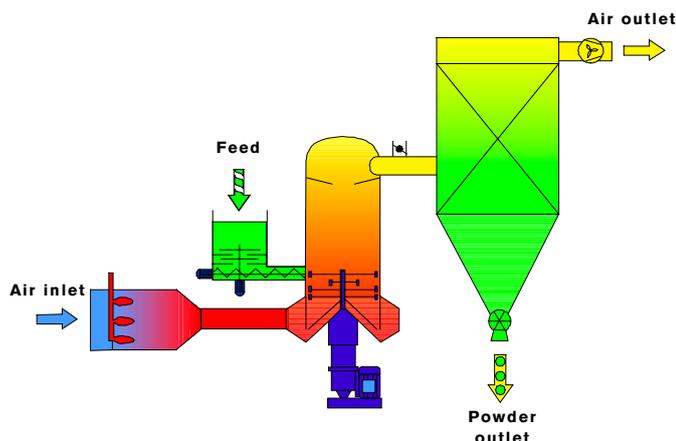
The fines are conveyed with the drying air to a separation system. Many tall form drying plants are provided with a bustle on the cylinder for the air outlet, minimizing the dust fraction of the powder.



Anhydro Spin Flash® Drying Plants

The Anhydro spin flash® drying plant is patented and widely adopted by customers within the chemical industry all over the world.

Anhydro spin flash® drying solutions are designed for continuous drying of pastes and filter cakes, as well as high-viscosity liquids.



The feed material is screw-fed to the compact drying chamber and disintegrated by the agitator at the bottom of the chamber. The product is fluidized by the hot air entering tangentially. The dried powder leaves the chamber at the top through a classifier and is separated from the drying air and discharged from a bag filter.



Feed vat



An Anhydro spin flash® drying plant

Anhydro spin flash® drying solutions are available with capacities ranging from a few kilos up to 40 tons powder per hour.

The continuous spin flash® drying process offers many decisive benefits:

- High drying efficiency providing low energy costs
- Continuous processing with short processing time
- Low operator overheads and minimum maintenance costs
- Controlled residence time enabling high temperature drying
- Controlled particle size
- Very fine powder production eliminating requirement for milling
- Limited space requirements
- High-pressure, shock resistant chamber for safe drying of flammable products
- Available in FDA and cGMP compliant configurations

Anhydro Fluid Bed Plants

The Anhydro fluid bed plants are designed for a numerous applications, such as drying, cooling, agglomeration, coating, and product mixing.

The process takes place by fluidizing the feed material in a controlled air flow, determined by the particle size and bulk density of the feed material.

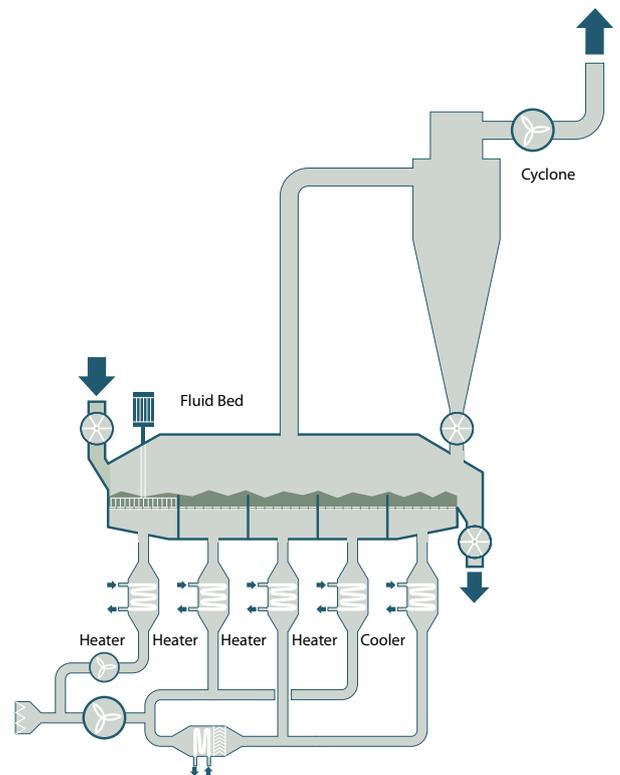
The process is very well suited for heat sensitive materials.

Plugflow fluid beds with a large number of sections leading the product through a long and narrow pass are used for products with requirements of a well defined residence time.

Backmix fluid beds of square or circular shapes are used with higher fluid bed product layers, which provide a long residence time.

Heating panels can be provided for the fluid beds thereby applying a significant part of energy, reducing the airflow and making the plants smaller.

Nozzles are installed in fluid beds for agglomeration and coating purposes



Examples of various Anhydro fluid bed plants



Anhydro Small Scale Plants

SPX FLOW offers a comprehensive range of Anhydro small scale plants within spray drying, spin flash drying, evaporation, and fluid bed drying.

Anhydro small scale plants are used worldwide by customers in the food, dairy, chemical, pharmaceutical and environmental sectors for R&D purposes and small scale production. Over the years more than 1,200 small scale plants have been supplied by SPX FLOW.

The Anhydro small scale plants have all been designed to provide:

FLEXIBILITY

Based on a modular design with a substantial number of optional items, which enable our customers to customize each plant to match their exact requirements.

SAFETY

For machine and personnel is a top priority in the design of Anhydro small scale plants. All plants comply with the strictest factory standards and all spray dryers include protection against dust explosions as standard.

PROCESS CONTROL

For easy, efficient, and safe operation as well as continuous monitoring of the process. All Anhydro small scale plants control systems are based on an industrial PLC system with a soft-touch colour screen as the operator interface.

EASY CLEANING/SANITARY DESIGN

In order to increase the efficiency and yield, Anhydro small scale plants have been designed with emphasis on ease of cleaning and a sanitary design.

SCALABILITY

With Anhydro small scale plants being designed according to the same quality and process specifications as our large scale production plants, most process parameters can be transferred for upscalable results.

Within the range of Anhydro small scale plants, SPX FLOW currently offers:

- Small scale spray dryers in sizes ranging from 1 - 500 kg/h (2 - 1,102 lb/h) -water evaporation. Available in 3 different configurations: Single-stage, multi-stage, or closed circuit.
- Small scale spin flash dryers in sizes ranging from 5 - 120 kg/h (11 - 264 lb/h) water evaporation.
- Small scale evaporators in sizes ranging from 20 - 200 kg/h (44 - 441 lb/h) water evaporation
- Small scale fluid bed dryers with capacity of up to 100 kg/h (220 lb/h)



Anhydro MicraSpray 400 multi-stage

Optimizing Yield and Efficiency

Efficient separation of the powder from the air leaving the drying plant as well as limitation of powder loss mean optimised production yield and compliance with environmental regulations.

ANHYDRO CYCLONE SEPARATORS

Anhydro cyclones are used for separation of powder and air. With a separation efficiency in excess of 99%, cyclone filters provide a reasonable emission for many products.

Further cleaning of the drying air can be made using wet scrubber, bag filter, or electrical precipitator systems.

ANHYDRO BAG FILTER SYSTEMS

Anhydro bag filters replacing cyclones provide higher collection efficiency. The filter bag materials can handle relatively high outlet temperatures, and the automatic cleaning system ensures a high and constant separation efficiency with an emission of less than 10 mg/Nm³. Further cleaning of the air can be made using absolute filters. The bag filters are available in CIP-cleanable versions.

CIP CLEANING

Automatically controlled "Cleaning In Place" (CIP) of product contact parts in an Anhydro plant can be supplied. The system will clean the plant with minimum manual interaction very fast and efficiently. This is particularly important when the plant is used for many different products, and for short operating campaigns.



Anhydro bag filter



ANHYDRO CLOSED CIRCUIT SYSTEMS

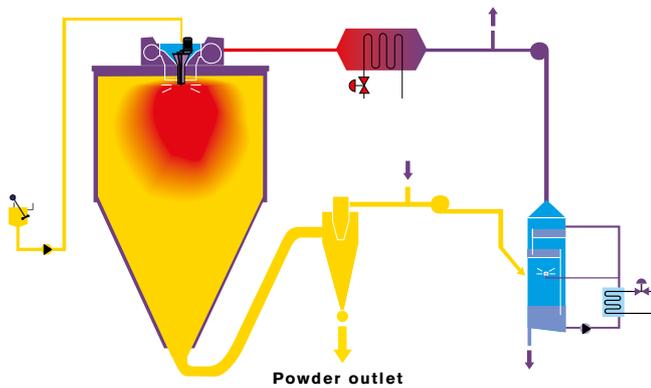
In case the product is dissolved or suspended in an organic solvent, the product is oxygen sensitive or toxic a closed circuit system is provided, eliminating the risk of an explosion, emission of product and unpleasant odour into the surroundings.

Explosions caused by inflammable solvents are avoided by use of an inert gas such as nitrogen or carbon dioxide in a sealed system. In other cases the inert drying medium can be generated by means of direct gas heating, which is self-energizing, maintaining an oxygen level below 5%.

The drying medium is conveyed to a condenser, where the evaporated solvent is removed. The drying medium is recycled and heated before entering the drying chamber.



Small scale plant for pilot production



PROCESS AUTOMATION

Automated process control is essential in order to optimize key process settings such as feed rate, temperature, pressure, residence time, particle size, moisture content, bulk density etc.

Anhydro drying plants are controlled from a central control panel, providing the operator with an end-to-end overview of all production parameters. PLC based automation systems enable plant performance optimization, rapid troubleshooting, and real-time recording of critical process data providing complete traceability. Process data can also be passed on to a local network or to a remote computer via a dedicated dial-up line or the Internet.



Global Services for Individual Needs

CUSTOMER FOCUS

SPX FLOW can assist in designing complete evaporation and drying solutions as well as in optimising process parameters, plant maintenance and spare parts services.

As strict health, safety and environmental regulations become more widespread, customers all over the world are focusing more and more on the impact of their activities on their surroundings. SPX FLOW engineers are committed to designing and delivering sustainable, and high-performance solutions with a minimum energy footprint and environmental impact.

A service and maintenance agreement with SPX FLOW ensures maximum plant operation time, emission control, and timely spare parts deliveries, as well as the ability to adopt fixed service budgets.

INNOVATION CENTRE

SPX FLOW's state-of-the-art innovation facility close to Copenhagen in Denmark enables customers to perform confidential product development and trials together with SPX FLOW experts, thus ensuring fast time to market with optimised performance immediately after commissioning.

Alternatively, we can install small scale test plants at your site for a limited period for demonstration purposes or pilot-scale production.

ENGINEERING STANDARDS

Environment protection is incorporated in accordance with local rules and regulations and is a key point in the plant design. SPX FLOW ISO 9001:2008 certified. All our plants meet the CE marking and ATEX requirements, where applicable.



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