

Anhydro Fluid Bed Technologies



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 specialized in supplying the optimal design and engineering with respect to production performance, flexibility, energy efficiency and environmental protection.

SPX FLOW offers a wide range of Anhydro fluid bed technologies for handling numerous applications that give high-quality end-products in the most efficient and economical way.

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 Fluid Bed Technologies

A fluid bed is often used for drying and cooling of powder. The use of a fluid bed enables adjustment of process parameters in order to achieve a superior overall drying economy and powder quality. The fluid bed is also ideal for other kinds of powder treatment such as mixing, agglomeration, dust binding, and instantising.

In a fluid bed process gas (usually air) is passed upwards through a perforated distributor plate and further through a product layer at controlled air velocity in order to fluidize the product. The air velocity is controlled in such a way that the product particles are airborne and move freely among each other, and the product layer behaves like a fluid.

ADVANTAGES

Fluid bed processing offers the following process advantages:

- Very intensive contact conditions between the fluidisation air and the product
- Highly efficient heat transfer between the fluidisation air and the product
- Highly efficient heat transfer between the product and the heating panels
- Highly efficient mixing conditions
- Uniform processing conditions
- Low mechanical impact on the product

PROCESS POSSIBILITIES

Continuous processes:

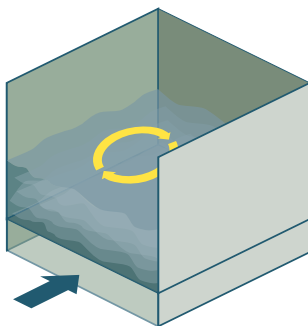
- Drying and cooling
- Drying and cooling with agitated first section
- Contact drying and cooling with heating panels
- Contact drying with heating panels and closed cycle of superheated vapour
- Heating
- Sterilising with heating panels and closed cycle system
- Agglomeration, granulation, and coating

Batch processes:

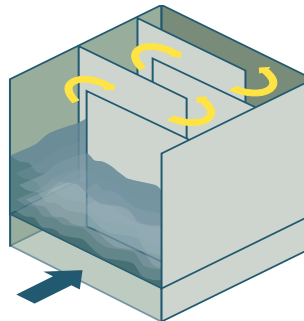
- Drying and cooling
- Heating and sterilising
- Batch agglomeration, granulation, and coating

Anhydro Fluid Bed Principles

Two basic product flow principles are used for the design of Anhydro fluid bed systems:



Back-mix flow principle



Plug flow principle

THE BACK-MIX FLOW PRINCIPLE

With the back-mix flow principle the feed product is mixed with partly dried product. It is used for feed products which need a degree of drying in order to fluidize properly.

The back-mix flow provides a relatively wide product residence time distribution.

THE PLUG FLOW PRINCIPLE

It is used for feed products, which are directly fluidisable. The plug flow provides a relatively narrow product residence time distribution.

FLOW PRINCIPLES IN PRACTICE

Many fluid beds are designed for a mixed flow pattern, i.e. a flow pattern somewhere between the back-mix and the plug flow principles.

In practice, with plug flow principle there will also be a certain degree of back-mixing due to the efficient mixing properties during fluidisation.

Typical Product Applications

With the Anhydro fluid bed equipment, you can produce a wide range of powders for the dairy, food, pharmaceutical, and chemical industries.

Infant Formula

Qualities such as easy dosing, good reconstititional properties, dustless powders, and high nutritional values are obtainable.



Milk Powder

Final drying of milk powders, where aromas, flavours, and colouring as well as protein, fat, carbohydrate, vitamins, minerals, etc. are retained.



Food and Pharmaceuticals

Fluid bed agglomeration, drying and cooling processes are applied to get excellent product qualities.



Chemical Products

Accurate liquid dosing, drying, heat treatment processes and cooling are carried out in Anhydro fluid beds.



Anhydro Fluid Bed Design

SPX FLOW offers a wide range of different Anhydro fluid bed designs enabling us to offer the optimal solution to any application. Many important factors influence the design and shape of fluid beds.

FLOW PATTERN

Plug flow is obtained in three different ways:

- With a long and very narrow fluid bed with relatively low product layer
- With a fluid bed with baffles leading the product through a long and narrow pass
- With a fluid bed with a large number of product sections in series

Back-mix flow is obtained in square or circular beds with relatively high product layer.

SECTIONS

Fluid beds are often divided into several sections in order to:

- Obtain the optimal temperature profile during the drying/cooling process
- Provide a high degree of plug flow

HEIGHT OF THE PRODUCT LAYER

The height of the fluidised product layer influences several process parameters, e.g. a higher bed provides:

- A longer product residence time
- More back-mix flow
- More intense/violent fluidisation
- Higher differential pressure and power consumption

HEATING PANELS - CONTACT FLUID BEDS

By providing a significant part of the required energy through heating panels, the need for fluidising air as energy carrier is reduced. **This has the following advantages:**

- Low air throughput (low energy consumption)
- High thermal efficiency
- Smaller bed area, i.e. smaller and cheaper plant

LIQUID FEED FLUID BEDS

Due to the excellent mixing conditions in a fluidised bed, liquid can be sprayed into the fluidised bed and the liquid is efficiently mixed with the product in the fluid bed.

In some cases fluid beds are designed for liquid feed only. However, in most cases the liquid feed is used together with a normal wet powder product feed.

Such fluid beds equipped with two-fluid nozzles or pressure nozzles are used for:

- Agglomeration
- Granulation
- Coating
- Drying
- Product mixing (e.g. adding liquid additives)



In-line rewet and instantising

FINES SEPARATION

The upper part of the fluid bed is often designed according to the actual need of dedusting or fines separation. By widening the flow area of the upper part a lower air separation velocity is achieved and thereby a smaller fraction of the fine particles is removed with the air, i.e. a larger part of the fines falls back into the fluidised bed.



Inside view of an Anhydro fluid bed with an agitator in the product inlet section



A coating fluid bed



An Anhydro fluid bed for processing of products such as lactose, etc.

Anhydro Fluid Bed Plant Designs

FLUID BED PLANT

In the open fluid bed plant atmospheric air is taken in and passed through the fluid bed plant and then exhausted.

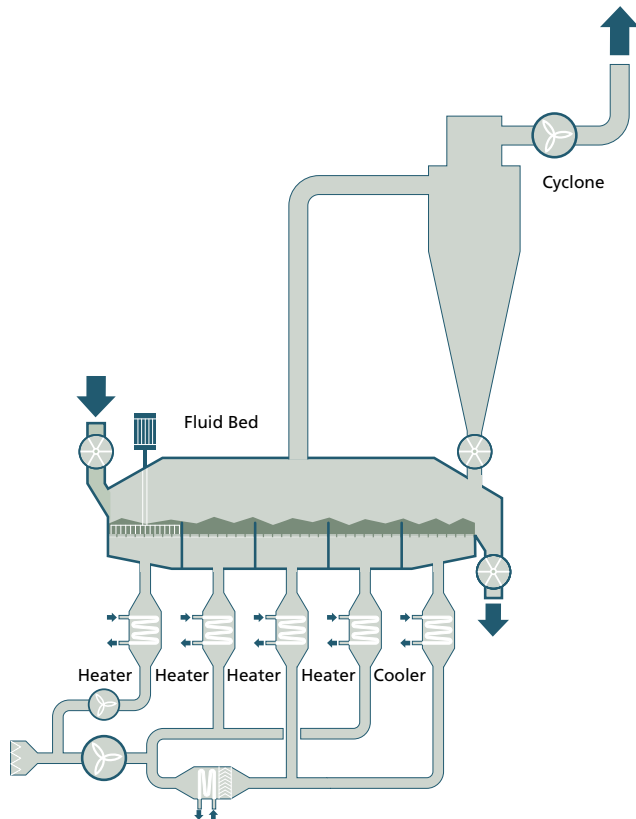
Normally the air is conditioned before it is used in the fluid bed.

The most common air treatments are:

- Heating (directly or indirectly),
- Dehumidifying
- Cooling

In cases where the product poses a dust explosion risk, open systems are equipped with pressure relief systems, pressure suppressing systems, and/or pressure shock resistant components.

Having passed the fluid bed the air is cleaned by separating dust particles, mainly in cyclones followed by wet scrubbers or in bag filters before the air is exhausted to the open.

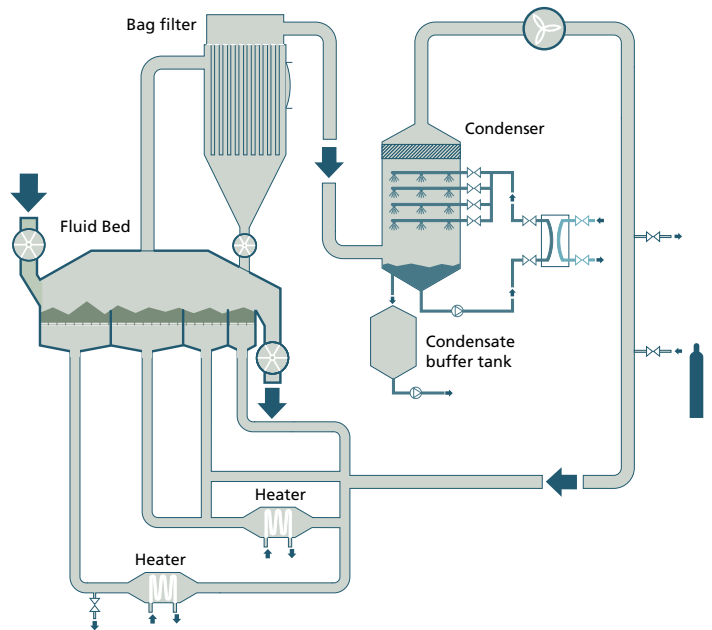


FLUID BED PLANT, CLOSE CIRCUIT SYSTEM

In closed circuit systems the fluidising gas leaving the fluid bed is recycled back to the fluid bed-gas inlet after certain treatments depending on the actual plant.

The most common closed cycle systems are:

- Self-inertising systems
- Inert gas systems
- Superheated water vapour systems
- Superheated solvent vapour system



Fluidised powder

SELF-INERTISING SYSTEM

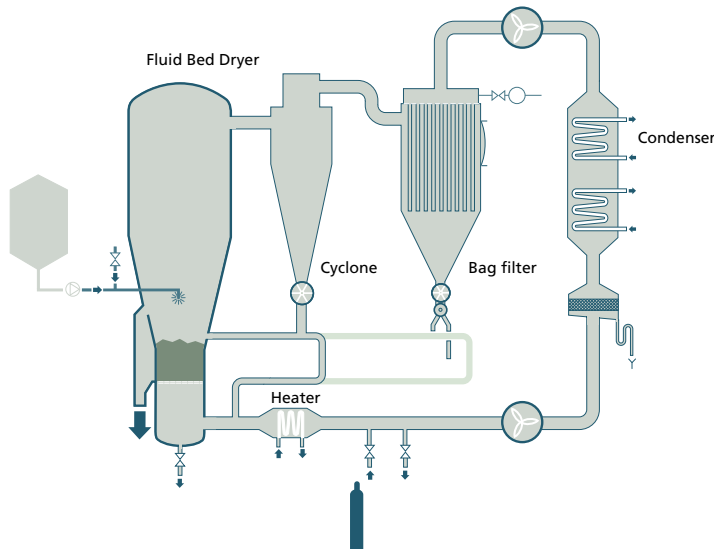
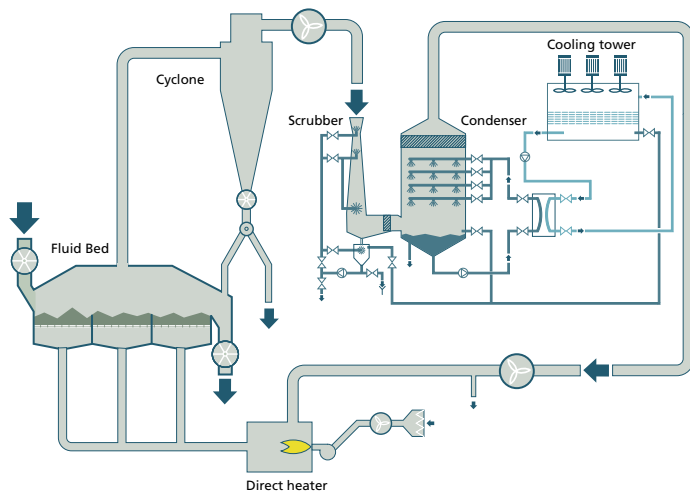
The term "self-inertising" system is used for a drying system, in which the oxygen content is reduced, **and which comprises:**

- Direct heating by gas or oil combustion
- Condenser for the circulating gas, condensing the water vapour

Atmospheric air is supplied as combustion air to the gas or oil burner, and as a major part of the oxygen is used for the combustion, the flue gasses passed on to the system brings down the oxygen content of the circulating gas to a level below the dust explosion level.

In self-inertising systems the composition of the circulating gas is given as a result of:

- The quantity of atmospheric air supplied to the burner
- The combustion process
- The condenser operation conditions



INERT GAS SYSTEMS

In inert gas systems the drying takes place in an inert gas atmosphere – usually nitrogen.

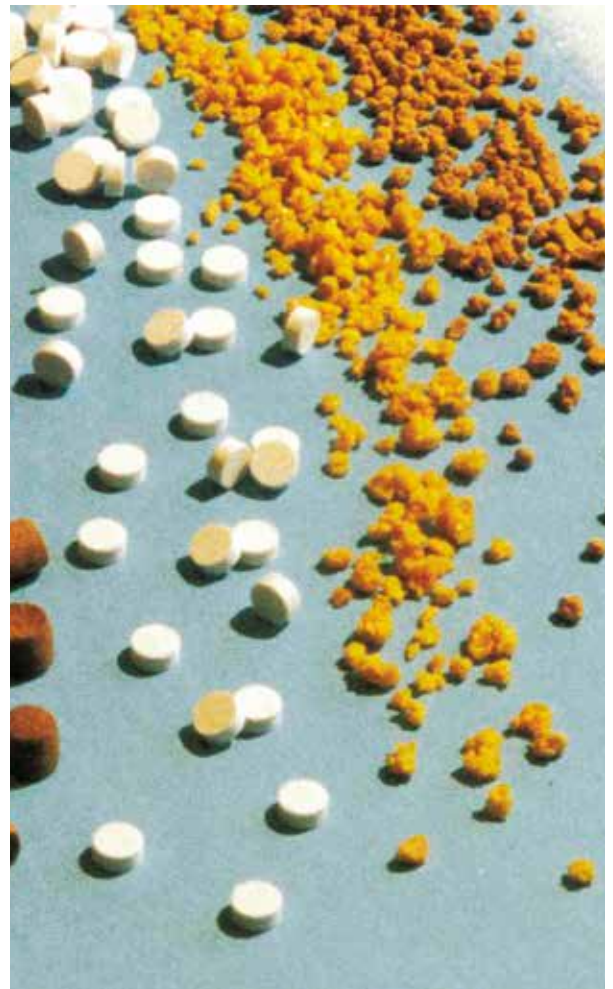
Inert gas systems are used:

- When an organic solvent is to be evaporated in the fluid bed
- When the actual product is sensitive to oxygen
- When other reasons call for a special, specific drying atmosphere

Inert gas systems are designed gas tight and with a small overpressure, and most commonly the inert gas supply to the system is controlled by monitoring the oxygen content of the drying gas as well as the system pressure.

Inert gas systems comprise:

- Indirect heating
- Condenser for the circulating gas recovering the evaporated solvent.



SUPERHEATED WATER VAPOUR SYSTEM

Using superheated water vapour as drying atmosphere in a closed cycle system is mainly interesting for drying non-heat-sensitive products, e.g. waste materials.

Superheated water vapour systems offer several advantages:

- Optimal heat recovery system, as all energy used for water evaporation is recovered
- Low oxygen content for dust explosion and fire protection

Superheated water vapour systems comprise:

- Indirect heating of the circulating gas and/or heating panels for contact heating of the fluidising product
- Heat recovering condenser for the relatively small bleed of water vapour, i.e. the quantity of water evaporation (no condenser for the circulation gas)

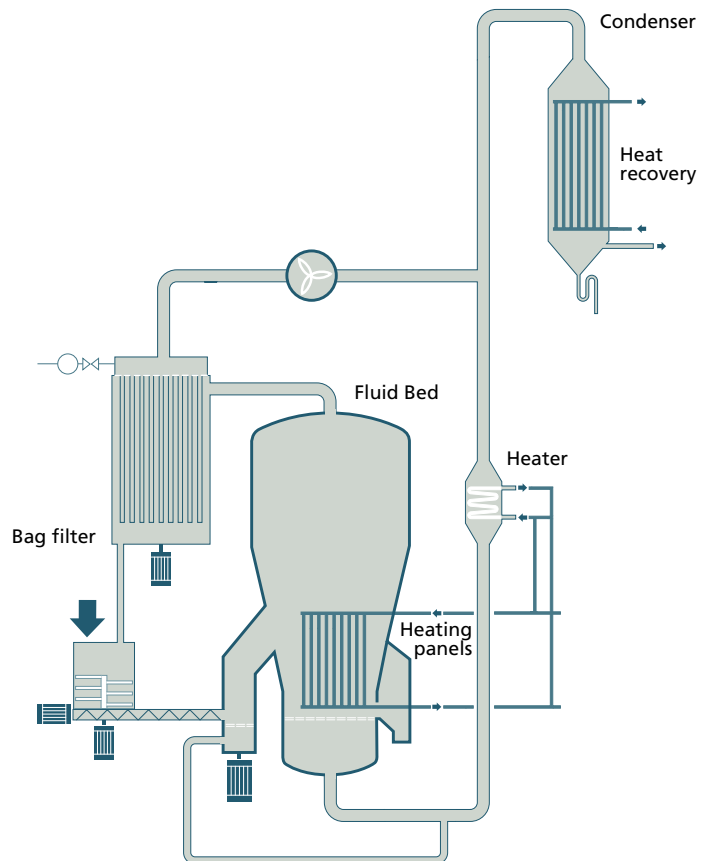


Fluid bed installation

SUPERHEATED SOLVENT VAPOUR SYSTEM

This system works in principle as the super-heated water vapour systems, however, circulating and evaporating organic solvent vapour, e.g. alcohol, hexane, etc.

The principles and advantages are as described for superheated water vapour and the organic solvent is recovered for re-use at the condenser.





Batch fluid beds with removable product containers



Fluidisation test



A pilot installation



Inside view of a fluid bed



Fluid beds are often used in combination with spray drying plants as an integrated fluid bed or as a separate external fluid bed. The advantages are better product quality and a more efficient drying operation.

Global Services for Individual Needs

CUSTOMER FOCUS

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

The SPX FLOW worldwide service organization is ready to provide any necessary spare parts at short notice. Our service technicians can help you rectify problems on site, thus reducing unscheduled downtime to a minimum.

SPX FLOW offers a number of service agreement options, depending on your individual needs, and our service engineers are always available to provide application and development support.

INNOVATION CENTRE

SPX FLOW's state-of-the-art test facility close to Copenhagen, Denmark enables customers to perform confidential product development and trials together with knowledgeable SPX FLOW technologists on equipment ranging from laboratory-scale testing to full-scale pilot production runs. Here it is possible to test applications and processes, thus ensuring fast time to market with optimised performance. Small plants are also available on a rental basis for in-house laboratory trials or demonstration purposes.



SPX FLOW innovation Centre in Soeborg, Denmark



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