

FUNDABAC®

Filter-Drying Systems

FUNDABAC
CONTIBAC
STERIBAC
DRYBAC



DrM

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3 FUNDABAC® Filters for catalyst recovery in an intermediates production plant



5 FUNDABAC® filters, each 47 m² area, vessel carbon steel, hard rubber lined, ø 1900 mm, internal components PVDF, for the filtration of cellulose fibres, yield per cycle 1.5 to solids of 70% dry substance

DrM

The specialist company for solid/liquid separation

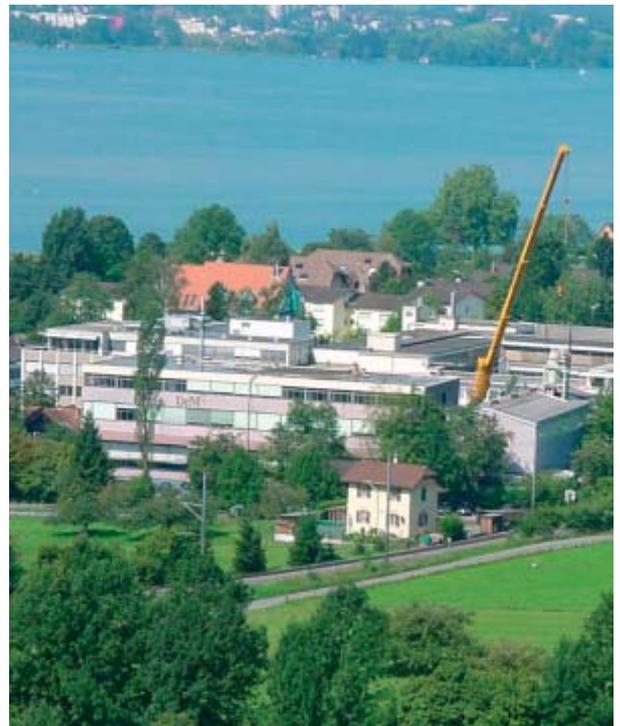


DrM was founded by Dr. Hans Müller, dipl.Ing.ETH (1913-1984), and it is the legacy of this brilliant industrial entrepreneur and creative inventor, whose influence lives on in the chemical process industry. His boundless imagination found expression in more than four hundred inventions for which patents were issued throughout his academic and industrial career. Quite a few of these revolutionized chemical processes in innumerable countries.

The DrM Company continues its healthy and successful development under the ownership and management of his immediate family. The scope of applications for the company's products has grown considerably and DrM's products enjoy a worldwide market in various industries in the chemical, petrochemical, pharmaceutical, steel and food field.

These industries are supported by an active and powerful sales and service network throughout the world. Local presence of our manufacturing partners in the main markets has proven to give valuable support to our customer base.

One of our most important assets however, has always been our flexibility. Fast response to customer requests in terms of feasibility studies, lab and pilot trials, new product design and engineering has given enormous value to our commercial partners, who constantly seek new ways to cut the time to market for their new products.



Our range of products include filters for general purpose solid/liquid separation, for the pharma and biotech industries and filter-dryers for the fine chemicals and pharmaceutical market.

All activities of our company have been certified by DNV for ISO 9001 since 1994, but at the same time we keep a very responsive system which allows us to act quickly without sacrificing our quality standards.

The FUNDABAC® Family

The FUNDABAC® Filter family comprises a series of equipment specifically adapted for the process industries, with high demand on quality and productivity. It has become the industry standard for highly automated and fully enclosed operation throughout the world.



FUNDABAC® wet and dry discharge

The filtered solids are dewatered and discharged by gas blow-back. As an alternative, the cake can be reslurried into another liquid. (See page 6)

CONTIBAC® continuous thickening

This filter type allows continuous filtration without interruption of flow. The solids are flushed back into the liquid and discharged in slurry form. This filtration process mainly applies for processes where continuous flow is required. (See page 8)

STERIBAC® GMP Filter

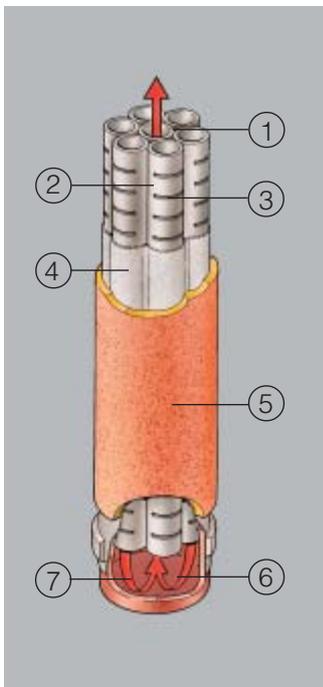
This is a variant of the FUNDABAC® design to comply with the high production standards of pharmaceutical and biotech industries. Surface finish and design of internals allow effective cleaning of all parts in contact with product. (See page 10)

DRYBAC Filter-Dryer

This system is a combination of a FUNDABAC® Filter with a fluidized bed dryer and is designed for the fine chemicals and pharmaceuticals market. This integrated concept allows for considerable productivity improvements at reduced investment costs. (See page 12)

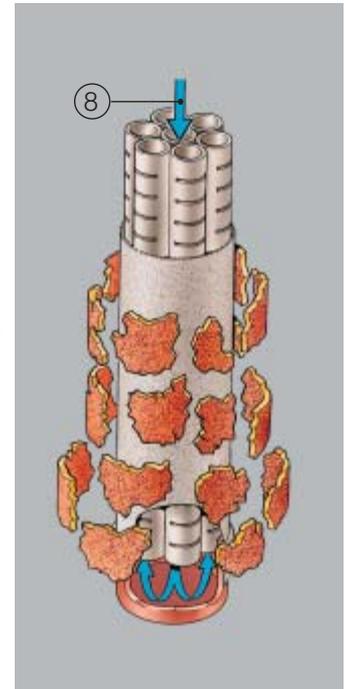
Filter elements – heart of the FUNDABAC®

Formation and drying of the filter cake



- 1 Central tube**
Filtrate collector with solid wall for total displacement of filtrate from the filter element.
- 2 Filter tube**
Support for filter medium
- 3 Typical apertures on filter tubes**
- 4 Filter medium**
Pressed against the bundled filter tubes during filtration
- 5 Filter cake**
- 6 Collection chamber**
Connecting central tube (1) with filter tubes (2)
- 7 Filtrate**
Exits filter element through central tube
- 8 Blow-back gas**
Initiates the discharge of the filter cake.

Discharge of the filter cake



Solids

During the filtration, which takes place in a pressure vessel, the liquid is pressed from the outside through the filter medium. Solids collect on its surface and form a uniform cake. The cake remains on the filter elements due to their concave-convex profile and a continually maintained pressure differential across them.

Filtrate

The filtrate flows downward through the six concentric filter tubes, rises inside the central tube and leaves the filter via the registers mounted in the upper portion of the pressure vessel.

Cake drying

During the pumping out of the heel volume from the filter vessel and the drying phase, gas is forced

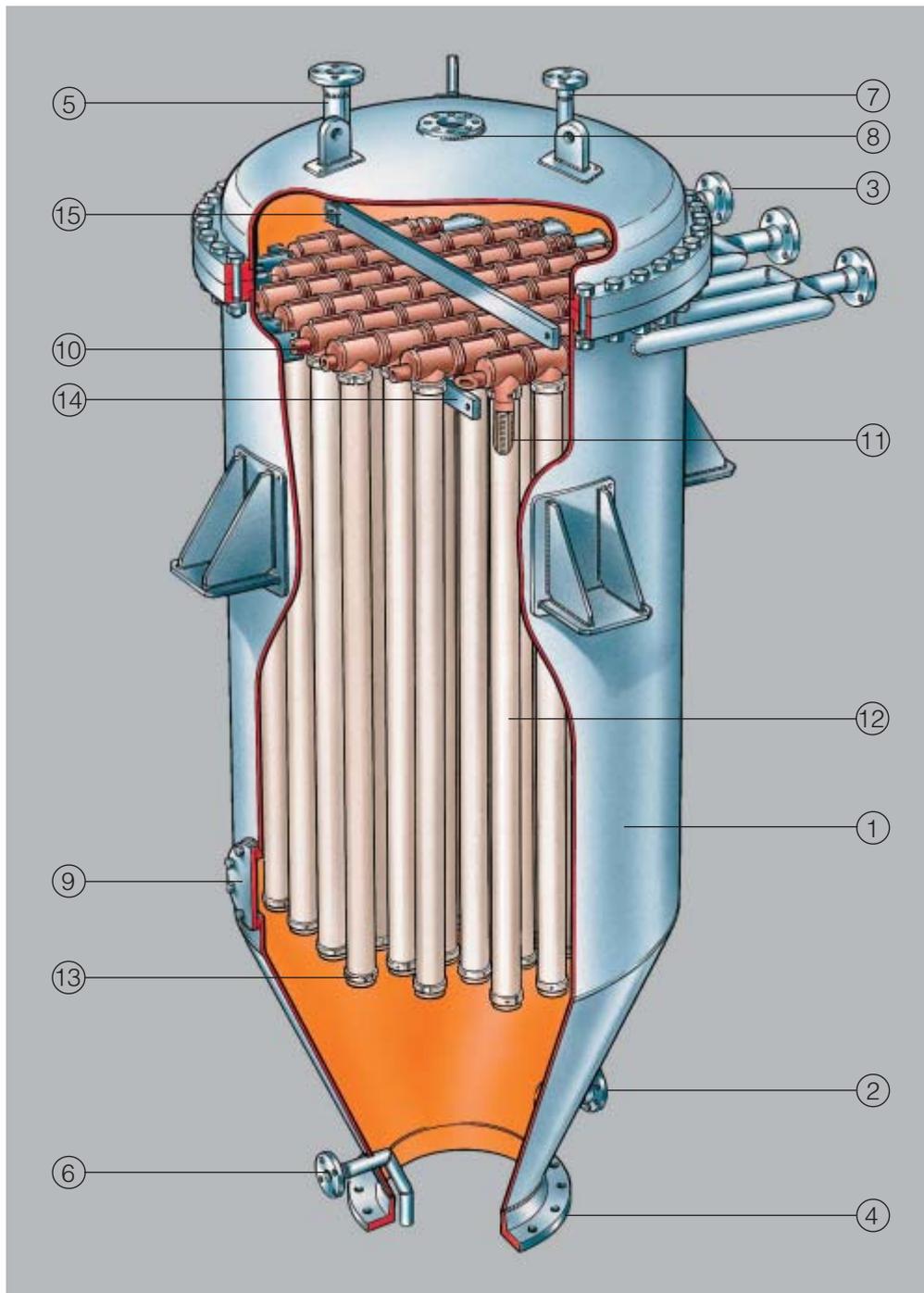
through the filter cake in the direction of the filtration towards the inside of the filter element. At the same time, the central tube guarantees that the cake on the filter element is dewatered and that the remaining liquid in the filter element is displaced by the gas without any trace of liquid remaining.

Cake discharge

After emptying the filter vessel, cake washing and drying, each filter element is subjected to a reverse gas flow pressure shock. As the filter medium expands, vertical cracks are generated in the cake. When the medium reaches its maximum deflection, its movement stops and the cake is thrown off. Filter cakes of 3 to 50 mm thickness are completely discharged.



FUNDABAC® Filter for dry and slurry discharge



- 1 Pressure vessel
- 2 Product feed nozzle
- 3 Filtrate nozzles
- 4 Solid-residue discharge nozzle
- 5 Overflow and vent nozzle
- 6 Heel volume nozzle
- 7 Instrumentation nozzle
- 8 Saddle flange for heel filtration spray jet nozzle
- 9 Inspection port
- 10 Register
- 11 Filter element
- 12 Filter medium (cloth, felt, membrane etc.)
- 13 Cloth clamp ring
- 14 Lower register support bar (only for synthetic internals)
- 15 Upper register support bar (only for synthetic internals)

The FUNDABAC® and its flexible process options improve the effectiveness of your plant

FUNDABAC® filter system: 4 functions in one unit!

1. Filtration and heel volume filtration (Pat.)

The uniform and random distribution of solids throughout the liquid in the filter is achieved by creating an upward flow by means of a controllable overflow. This ensures an even build-up of cake on the filter elements. If at the end of the filtration the unfiltered heel cannot be drained to the feed vessel, heel volume filtration must be carried out. This is achieved by our patented heel filtration process as follows: from the lowest point in the vessel the heel is sucked by the filter pump and returned to the vessel through the centrally located spray nozzle in the cover. There, the sprayed heel is evenly distributed on the filter elements and the liquid pushed through the cake by gas pressure (fig. 2).

2. Cake washing

At the end of the filtration step, resp. heel filtration step, or draining of the filter by gas displacement, the cake can be subjected to the washing step by a suitable wash-phase. The sprayed wash-phase using the heel filtration method significantly reduces the volume of the wash liquid compared to conventional washing (fig. 2).

3. Cake drying

The washed cake is dried by blowing a suitable gas phase, e.g. ambient or hot air, nitrogen or steam through the cake on the filter elements, until the required level of residual moisture has been reached.

The cake remains on the filter medium during the entire process due to the unique geometric arrangement of the tubes in the filter elements. At the end of the drying cycle the pressure vessel is vented and the discharge device opened to discharge the solids.

4. In-situ cleaning of the filter media

In-situ cleaning assures longer life of the filter media. As programmed according to need, the filter media are automatically washed in the closed filter to free them from possibly strongly adhering particles.

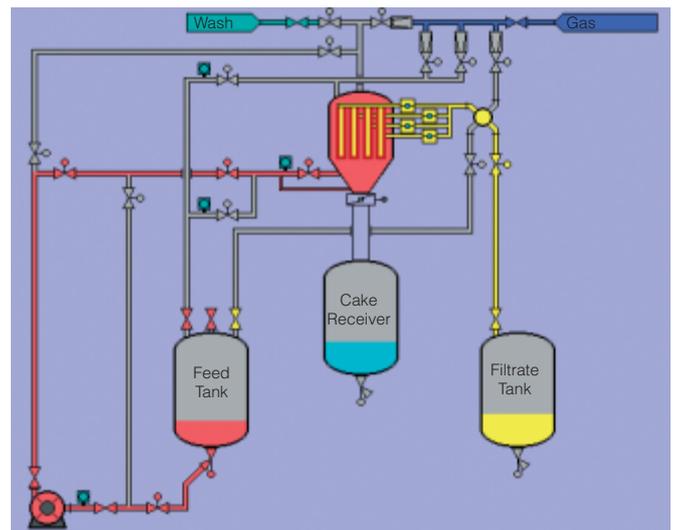


Fig. 1: General Flowsheet of a FUNDABAC® filtration

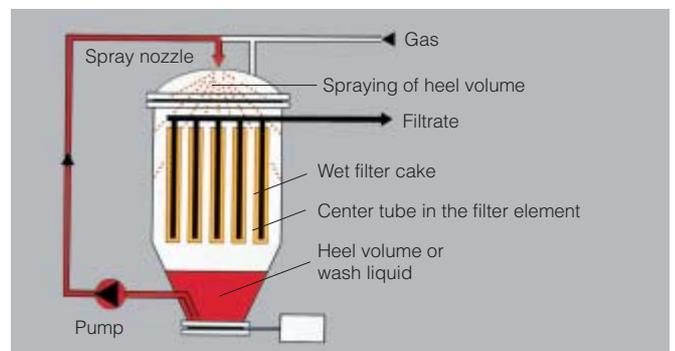
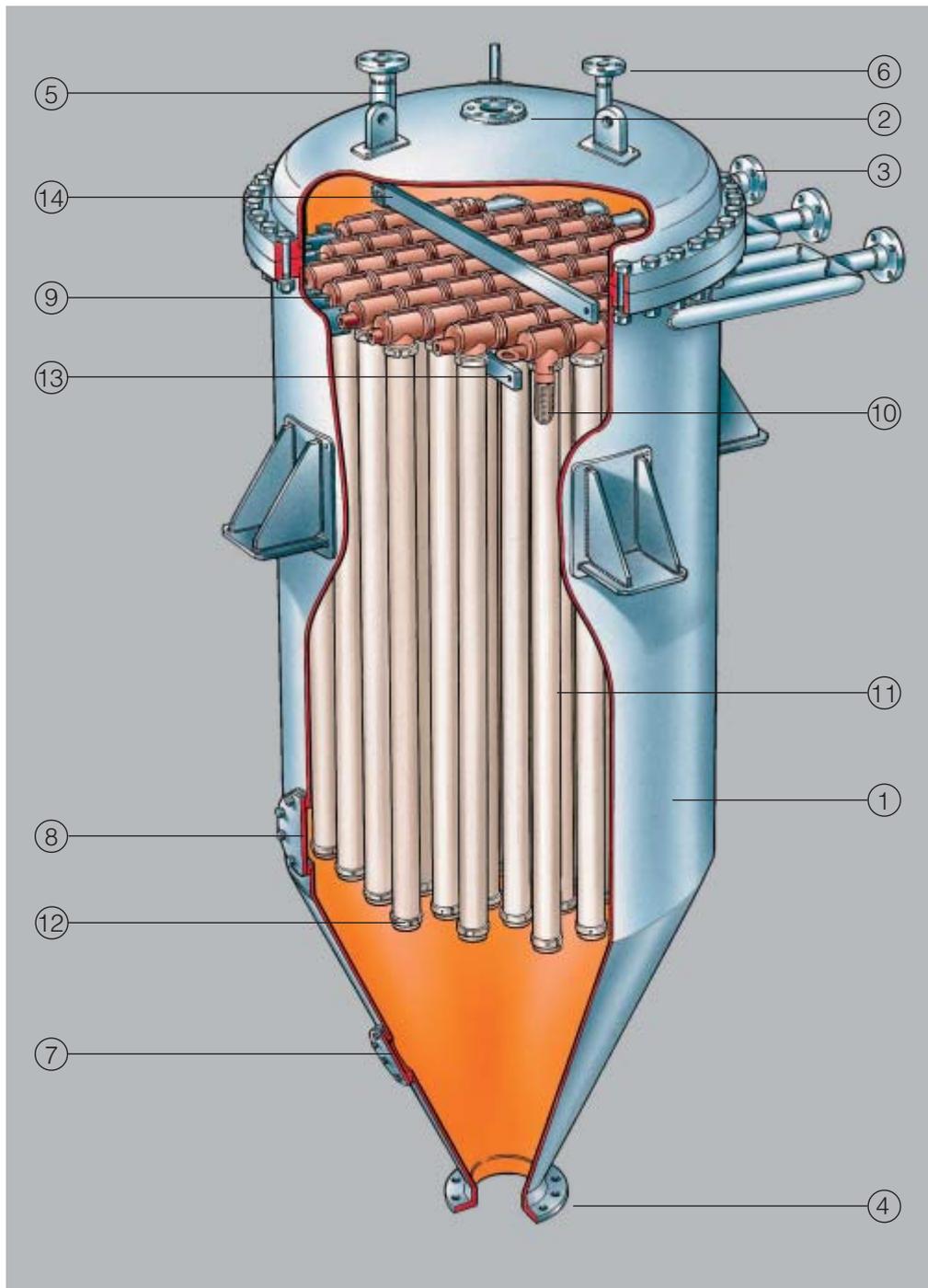


Fig. 2: Schematic of Heel Volume Filtration



Fig. 3: Filtrate outlets including sight glass and manual shut-off valves for each outlet. Outlets are grouped into headers with individual pneumatically actuated valves leading into the filtrate collector.

CONTIBAC®-Filter for continuous thickening



- 1 Pressure vessel
- 2 Slurry feed nozzle
- 3 Filtrate nozzles
- 4 Thickened sludge discharge nozzle
- 5 Vent nozzle
- 6 Instrumentation nozzle
- 7 Probe for sludge detector
- 8 Inspection port
- 9 Register
- 10 Filter element
- 11 Filter medium
- 12 Cloth clamp ring
- 13 Lower register support bar (only for synthetic internals)
- 14 Upper register support bar (only for synthetic internals)

Operation of the CONTIBAC® Filter

Operating modes:

- Semicontinuous operation
- Continuous operation

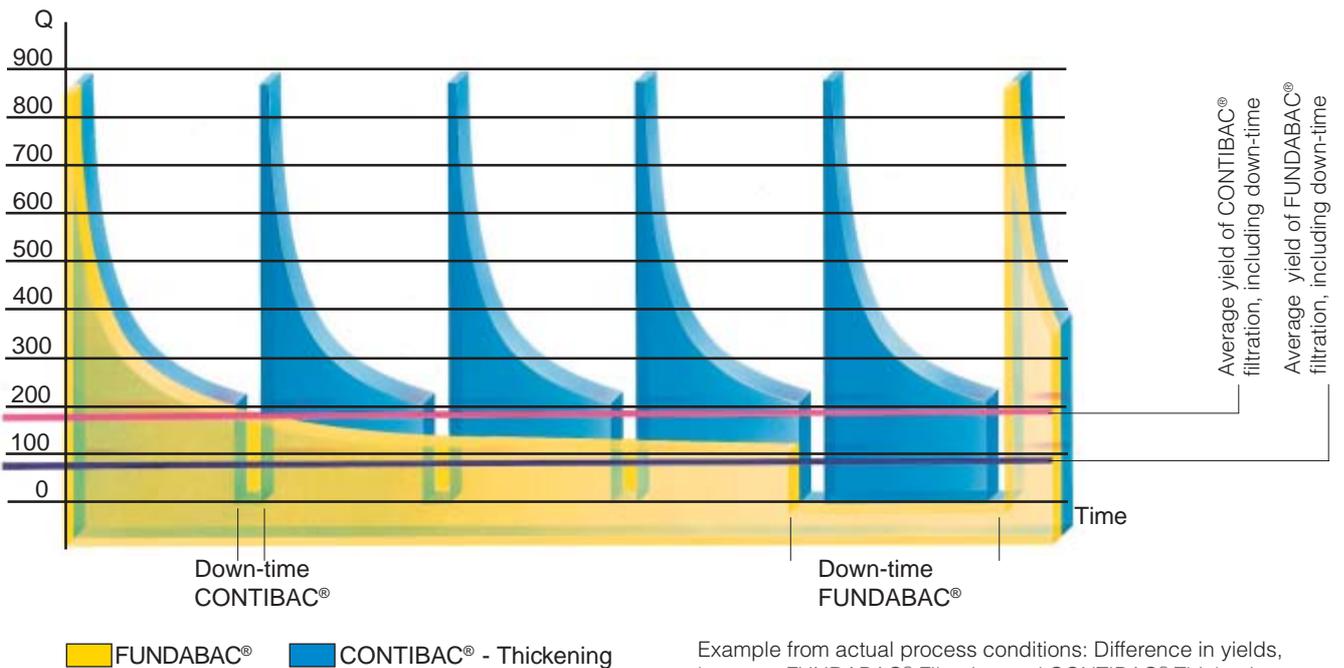
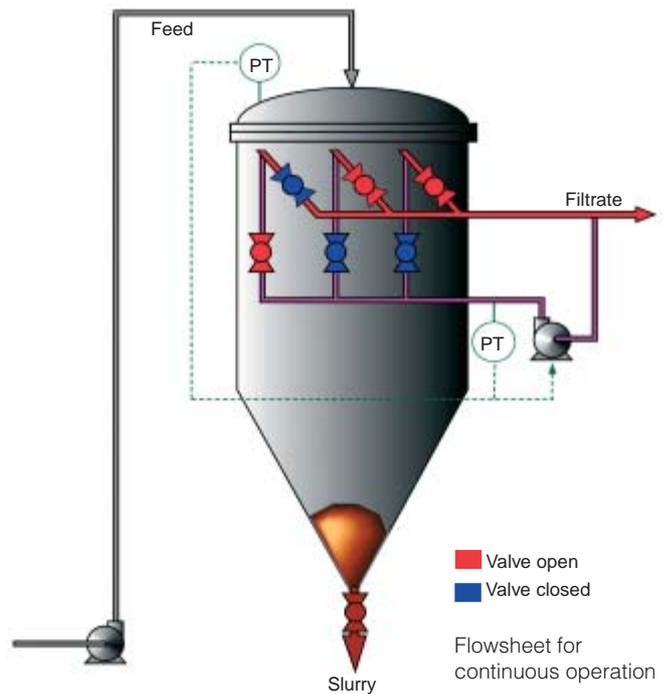
By slightly modifying the FUNDABAC® Filter it can be operated as a continuous thickener, known as the CONTIBAC® System. In semicontinuous operation, the flow is stopped for a brief period to back-flush and discharge the solids, while continuous flow is maintained by sequential back flush of the individual filtrate groups during the filtration.

Clear filtrate as well as high throughput

A clear filtrate is obtained by the use of finely woven media, felts or membranes of fine porosity. For difficult to filter product streams, short filtration cycles build up very thin cakes, which keep the filtration rate high.

Filtration cycle for continuous operation

During filtration all but one filtrate group are in filtration mode, while one group of filter elements is back-flushed. The freed filter cake of this group sediments rapidly into the conical bottom of the filter from where it is discharged. Once this group has regenerated, it commences filtration while at the same time the next group jumps into regeneration.



Example from actual process conditions: Difference in yields, between FUNDABAC® Filtration and CONTIBAC® Thickening

STERIBAC® Filter for pharma and biotech applications

The STERIBAC® is a newly developed filtration system specifically designed according to GMP standards for the pharma and biotech industry. It can offer important advantages as compared to other solid/liquid separation systems such as centrifuges, separators, nutsches or other filters:



30 m² STERIBAC® for Pharma production

No rotating or otherwise moving parts essentially eliminate maintenance and the shedding of particulate matter and allows easy CIP.

Automation of all the filtration steps, from filtration, through washing, down to the enclosed system for the discharge of the dried residue can easily be implemented, even after start-up of the system.

The simple, modular construction of the filtration elements allows adaptation of size, volume and cake thickness in a fully contained system.

Preassembled filtration modules (in the case of product dedicated internals) for quick product changes.

Mobility and flexibility are major criteria in this type of industry. Production cycles are short and batches change frequently. As a result, the equipment must adapt to the required process. Therefore, the machine must be easily transferred from one place to the other. DrM has extensive experience in manufacturing mobile, compact, fully contained and automated filtration systems, which are equipped with the necessary instrumentation, accommodated to the process requirements.

Low maintenance cost further enhances the very reasonable investment, with low operating costs due to the absence of moving parts.



Containment:

Its entirely enclosed design prevents any contamination of the liquid streams and permits in-situ sterilization.

CIP cleaning becomes an easy task, as neither mechanical moving parts nor agitating devices are present. It has been proven that with our applied CIP technology batch integrity can be maintained.

Dry, slurry or reslurried discharge of solids can be changed from batch to batch.

Minimizing waste has become an important factor throughout the industries. The patented spray washing system has reduced the required washing liquids and therefore the running costs drastically.

Heel volume treatment (patented) allows an essentially 100% recovery of products, for both solid and liquid heel and assures batch integrity.



Automated skid-mounted STERIBAC® for Biotech production in hazardous area



Automated skid-mounted STERIBAC® for Biotech production

Model of a STERIBAC® element



Typical applications:

- Separation of biomass from fermenter slurries
- Separation of precipitated solids in downstream processing lines
- Activated carbon treatment of liquid product streams
- Heterogeneous catalyst separation from hydrogenation reactions
- Crystallized product filtration

DRYBAC Filter-Dryer for Pharma and Fine Chemicals

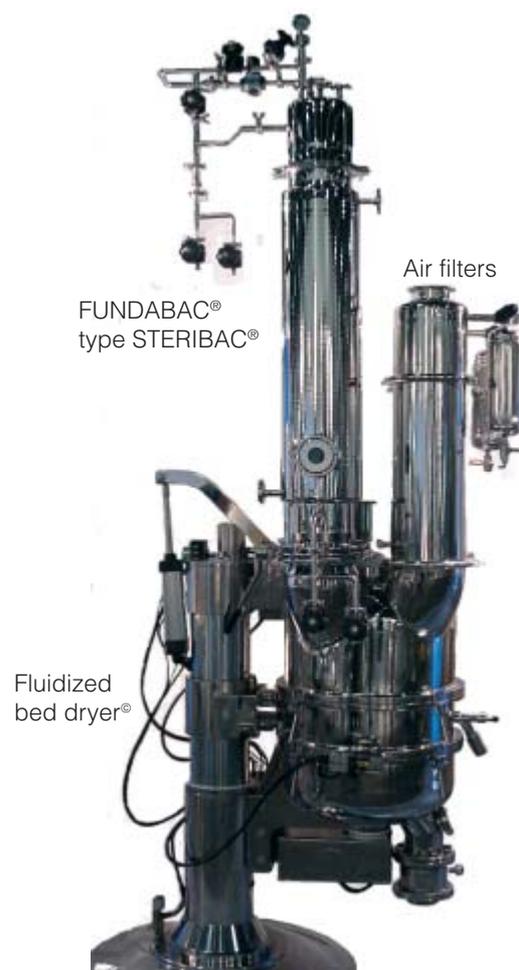
The DRYBAC is a novel development designed to filter and dry small and concentrated slurry batches. Primarily targeted at the pharmaceutical and fine chemicals industry, it comprises two individual process duties within one single and well integrated package: A filtration system for the mechanical dewatering of the slurry and a fluidized bed dryer for thermal drying of the solids to the required dryness.

Both the FUNDABAC® filter system and the fluidized bed dryer are proven technologies for their corresponding duties. However, the novelty of this design is the integration of the two equipment into one integrated system.

Fluidized bed drying has recently found many supporters within the industry due to its considerably shorter cycle time as compared to traditional contact drying. The production lead time for one single batch can be cut from 16 hours to less than 2 hours, reflecting an 8-fold increase in throughput for a given batch. Therefore, the equipment can be sized considerably smaller. Furthermore, the dried product is discharged in powdered form allowing much easier handling and eliminating the requirement of a crusher.



View into the drying chamber. The drying gas enters the dryer from the bottom, passes through the slotted plate and keeps the solids afloat. An agitator assures proper distribution of the solids. The saturated gas then passes through a set of air filters and is recycled back to the dryer after condensation.



Above: completely assembled DRYBAC filter dryer with GMP design

The two equipment work hand in hand and operate in complete coordination: After one filtration cycle, the first solid batch is discharged into the fluidized bed dryer, which now commences its drying cycle. In the meantime, the FUNDABAC® starts its next cycle and discharges again. Once the complete batch is filtered, the dryer proceeds with drying until the required product quality is reached. Discharge then takes place through a side opening. All steps are fully automated.

Quality and know-how for hundreds of applications

Optimization of process significantly lowers cost of investment. Prerequisite for this is the cooperation with a partner, such as DrM, who offers specific filtration know-how based on many years of process experience, whose laboratory technicians, chemists and process engineers can readily draw upon performance data in hundreds of applications.

The parameters of each project can be defined and quantified by the use of some 50 experimental and pilot plant FUNDABAC® available in the field world-wide. The task of optimization is achieved with the cooperation of the specialists from both partners, the client's and DrM's.

Below follows a representative selection of typical processes in which the FUNDABAC® filtration system and the CONTIBAC® thickener system have proven themselves repeatedly:

- Recovery of precious metal catalysts on carbon (Pt, Pd, Rh, Ru) and Raney nickel after reaction steps.
- Removal of activated filter carbon for decoloration and removal of dissolved toxic substances.
- Recovery of products from industrial waste streams for recycling.
- Various separation steps in the production of titanium dioxide.



FUNDABAC® Filters for amine treatment at a refinery



FUNDABAC® in a petrochemical site

- Separation of solids, such as $\text{Me}(\text{OH})_x$, gypsum etc. from flue gas scrubbing plants in power stations and waste incineration plants.
- Removal of impurities in the production of ferric chloride.
- Recovery of zeolites and molecular sieve materials after belt and vacuum drum filters.
- Recovery of polymer granulates from waste streams.
- Separation of bleaching earth and activated carbon from vegetable oils.
- Cleaning of electrolytic baths in the galvanic industries (tin, zinc, nickel etc).
- Various processes in the fine chemical and pharmaceutical industries.
- Clarification of brines in the chlor-alkali industry.
- Clarification of various additives for plastics, fuels and lubricants.
- Filtration of water recycling systems in the glass and ceramic industries.

FUNDABAC® and CONTIBAC®: Combination of high-tech and efficiency

Advantages of the FUNDABAC®

A wide range of process applications

- Radially woven filter media, felts and micro-porous membranes with pore diameters down less than to 1µm offer a wide range of media selection.
- Seamless and radially woven filter media are firmly clamped at both ends of the filter element to securely contain blow-back pressure in the axial direction. This construction allows for high back-wash pressure so that the filter medium can be cleaned before each filtration cycle with filtrate or specific wash liquids. Very fine cloths and membranes can therefore be utilized without danger of blinding.
- The patented heel volume filtration procedure permits batches to be processed with complete integrity.
- The cake can be washed by displacement or spray washing.
- The blow-back of filter elements, group by group, leads to improved blow-back characteristics and prevents the bridging of the discharge opening.
- The central riser tube permits the complete draining of the filter elements. Thanks to this construction, the cake can be dried down to below 20% residual moisture with cold or hot gases or steam.
- Both dry and slurry discharge of solid residue is possible.



High pressure test unit



Test unit in operation

Modular construction: Low investment and low operating costs

- The static filter elements designed with dynamic characteristics eliminate the need for any rotating or mechanically moving parts in the FUNDABAC® or CONTIBAC® Filters. This constructional advantage over mechanical systems results in important savings in maintenance and investment costs.
- The use of plastic components made by injection moulding or extrusion in place of expensive alloys and exotic steels considerably reduces capital investment.
- The distance between the filter elements can be changed to accommodate required cake thickness.

Personnel and environmental protection

Because of the closed static system all contact with product can be avoided and the risk of exposure is significantly reduced. The FUNDABAC® system more than fully meets EPA and OSHA regulations. The system therefore complies with all environmental constraints. The FUNDABAC® is fully safe in handling solvents, strong acids and other toxic products.



Lab scale test unit



Right:
Six FUNDABAC® filters
for catalyst recovery
in a pharmaceutical
operation

High corrosion resistance

The use of different alloy steels, coatings, linings and synthetic filter media virtually covers the complete spectrum of applications, even those requiring operation at high temperatures.

Full automation

It is the state-of-the-art to operate plants with full automation. Various instruments, such as turbidity meters, sludge density and cake thickness probes, flow controllers, pressure switches and level probes permit the execution of complex filtration processes without operating and supervisory personnel.

High operational security

Any breakthrough in a filter media can be isolated by shut-off of the corresponding manual valve.

Know-how and technical support

We offer our clients forty years of experience in the filtration sector. Our customers may select from a range of more than 50 test filters with a filter area from 0.012 m² for laboratory to pilot plants up to 11 m².



Filters for the production of lactose

FUNDABAC® Filtration technology in service all over the world

All over the world FUNDABAC® plants are directly or indirectly involved in the most versatile fields, for the prosperity of mankind.

Made by
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