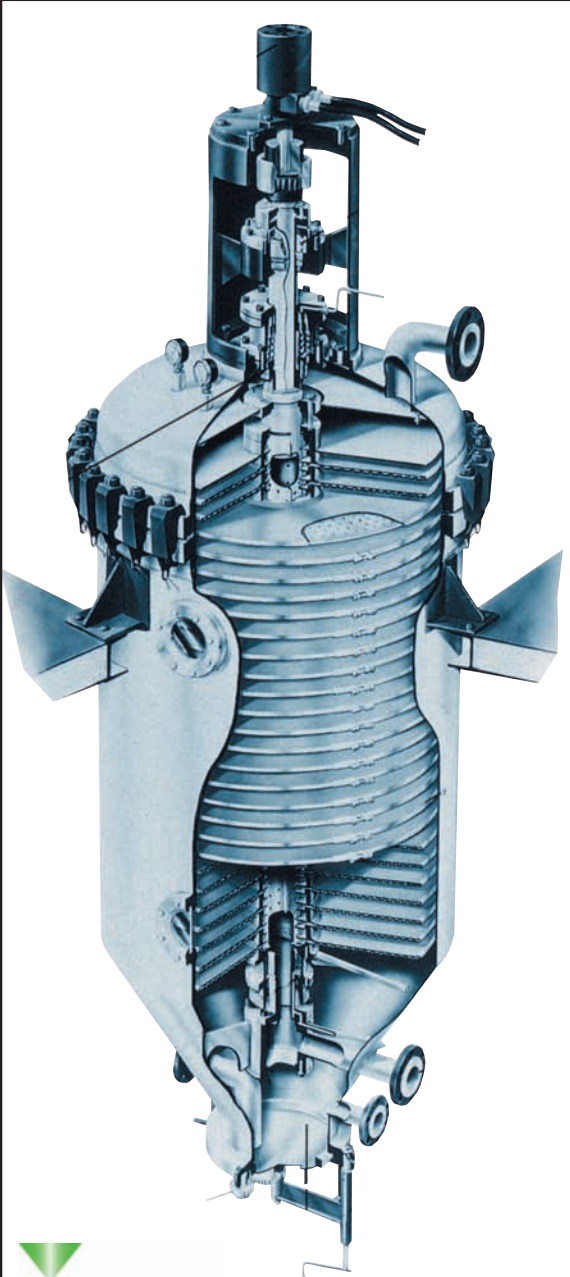


FUNDAMENTALES




chemap



FILTER SPARES by

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INFOLABEL AG

INFOLABEL AG is the manufacturer of Chemap®-Filters which have been proven and tested in over 5000 different types of application. The company's services range from the engineering of Chemap®-Filters and complete filtration systems to support with spare parts and expert knowledge.

Complete project documentation allows the systems supplied to be provided with spare parts for decades.

Expert engineers who have specialised in filtration process engineering support customers in the defining and design of instruments and optimise the complex process steps together with the customer, making the filter become an efficient element in the production process. With Chemap®-Filter test facilities, performance parameters necessary for the definition of the optimal configuration can be evaluated in our own laboratories or in a field test on the customer's premises.

With the assembly and commissioning of Chemap®-Filter systems, INFOLABEL AG engineers offer comprehensive support. Professional support is available for the entire lifetime of the Chemap®-Filters, which in many cases is more than 40 years.

The Chemap®-Filter system can be constructed to be fully-automated. The Chemap®-Filter is designed for process-integrated and efficient filtration, with follow-up treatment levels too if required, in a closed system.

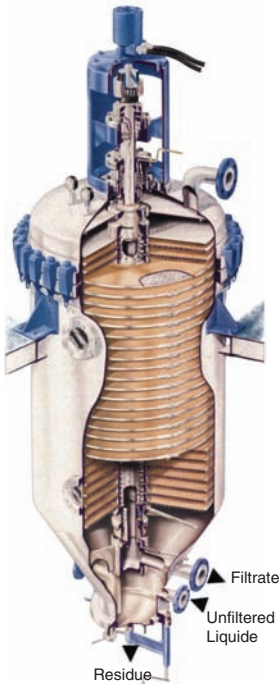


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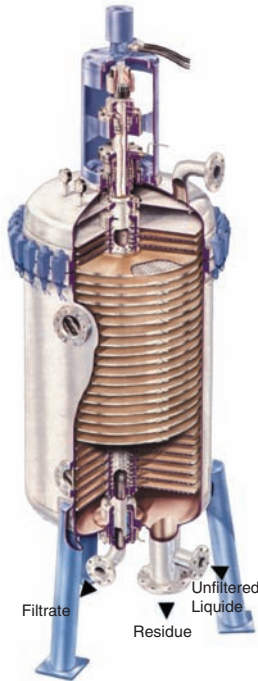
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Chemap®-Filter design

Chemap®-Filter Typ R



Chemap®-Filter Typ A



Type R filter

This is the ideal unit for the discharging of dry filter cake. Therefore, it is the system of choice where the products themselves build up as solid matter or where the impurities must be removed in dried form. Through the implementation of a slurry cylinder, this type can also be used for slurry discharge.

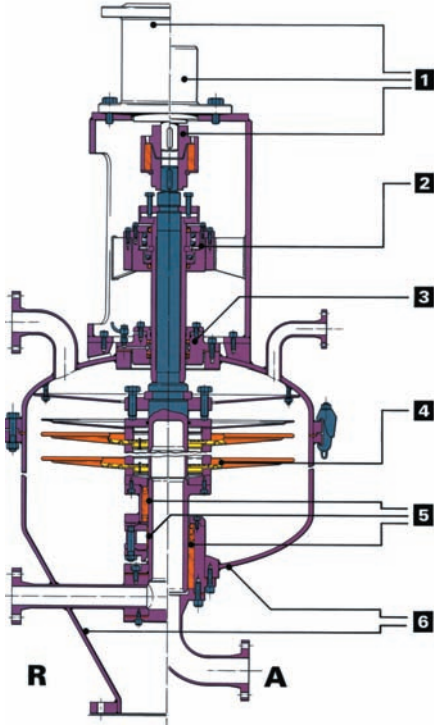
Type A filter

This is implemented in places where the only issue is slurry discharge. It therefore serves primarily as a clarification, or rather, cleaning system in the processing of fluid products and if separated solid impurities can be disposed of or further processed as slurry.

Advantages of Chemap®-Filters

Features	Advantages	Use
Construction	Closed system	Dangers of poisonous or explosive materials are avoided
	Equal filter cake thickness	Sterile processes are possible
	Fully-automatic cake discharge using rotation	No product loss
Horizontal cone-shaped buckle plates	Complete drain of fluids	No fluid residues which could hinder cake drying
	Rest volume filtration, or rather, cake washing and extraction in cascade filtration	No filtrate loss
	Plates are self-supporting and don't require any support at the edges which hinders the cake discharge	No mixing of the different fluids with subsequent washing
Upper drive	Main bearing cannot come into contact with fluid	Minimum need for washing agents or solvents
	Permits cone-shaped vessel end for dry discharge	Prevents breakdowns due to corrosion at the main bearing
		Eliminates need for additional equipment dealing with the extraction of filter cakes

Construction of the Chemap[®]-Filter



1 Filter drive

The filter drive, either hydrostatic or electric, is linked to the filter shaft by an elastic coupling. The hydrostatic version is linked directly, the electric version, when they are fitted vertically, via a reduction gear box, and using a V-belt reduction when fitted horizontally, whereby the torque from the electric motor is applied to the reduction through a hydraulic starting coupling.

2 Upper bearing

A radial self-aligning bearing absorbs a part of the radial power during rotation, and an axial bearing absorbs the entire weight of the filter unit. The upper bearing is separate from the upper seal and cannot be reached in the event of the fluid leaking.

3 Upper seal

The sealing surface of the upper seal is located on a corrosion-resistant bearing sleeve on which the filter unit is hung. Lip seal or stuffing boxes are available as different seal variations, with

or without fluids, mechanical seals and a hydraulic bellows seal. The bellows seal is closed during filtration, and open during rotation.

4 Filter plate

The filter plates, stacked on the sleeve shaft with spacer rings and seals forming a filtration unit, are tensed by means of the clamping device above against the support underneath the bottom plate, whereby the top plate is a non-filtering flow protection plate. The cross section shows the layout of the individual elements such as the gauze, support mesh, outer clamping ring, buckle plate, flow ring, seals and spacer rings. Due to the slight cone-shape form of the plate, complete fluid discharge is guaranteed.

5 Lower bearing and seal

With the R-type filter, the rotating bearing and seal is connected to the filter shaft, whilst the spigot is fix-mounted to the bearing star in the filter vessel. This layout can also be constructed with the A-type filter. With the design shown for the A-type filter, the rotating spigot is connected to the filter shaft, whilst the seal is fix-mounted from below onto the filter vessel. The lower bearing consists of a bearing sleeve made from materials such as PTFE and graphite etc., with a two-sided lip seal. With the R-type configuration, the so-called 'PTFE sleeve seal' underneath the bearing guarantees the highest level of filtrate.

6 The filter vessel / pressure vessel

In the filter cover, there is the distributor plate which is required principally for residual volume filtration. With R-type filters with the cone-shaped lower part, the clarified filtrate connection is welded onto the cone horizontally with the bearing star; with the A-type filter with a dished end, it is secured with a vertical outlet on the lower seal housing.

The filter vessel is also supplied with a heating or cooling jacket; there are also support brackets and legs for assembly.

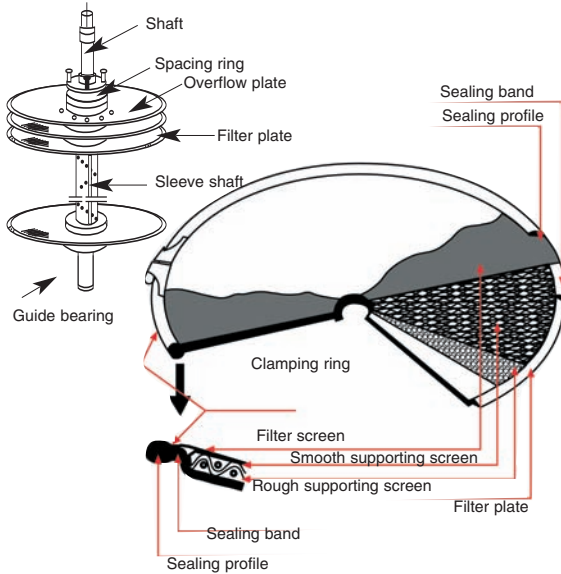
The pressure vessels are built according to the respective acceptability standards such as STV, TÜV, ASME, B.S., ANCC, Stoomwezen, China Stamp etc.

Materials range, depending on corrosion demands, from mild steel to stainless steel and from Hastelloy to Titan; rubber-coated designs can also be supplied.

The design of the Chemap®-Filter can be broken down in 5 components:

1. The filter unit hanging in the pressure vessel
2. Upper main bearing and sealing
3. Lower bearing/sealing
4. Pressure vessel
5. Drive unit

The filter element



The filter element carries the so-called “filter medium”, formed through the solid matter phase and/or through a filtration aid.

It is in this filter medium where the actual separation takes place. Depending on the filter medium, a purely mechanical separation takes place, or else an additional absorption if substances such as active coal are concerned. All of the important processes take place on or around the filter element with this filter layer.

In contrast to other filter systems, the discharge of the medium happens automatically due to centrifugal force, without the need for any manual intervention.

The conicity of the plate is so low that discharge is not obstructed. In theory, the number of operative components in the filtration unit is practically none. Components of this type would only have to be considered if the gradient was considerably larger.

The filter element in the form of a round, slightly-conical plate, tensed on the upper side with a filter screen, is the most important component in the Chemap®-Filter.

The reason why the conical form is so important will be explained later in detail.

The drive unit

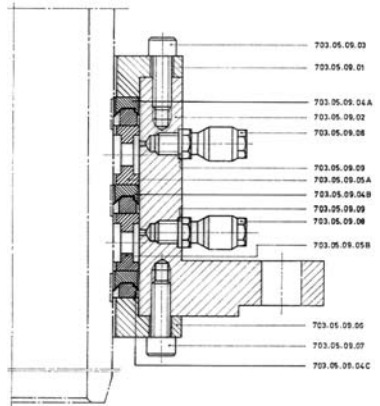
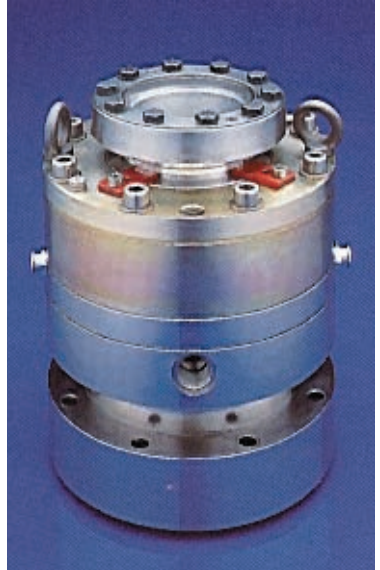
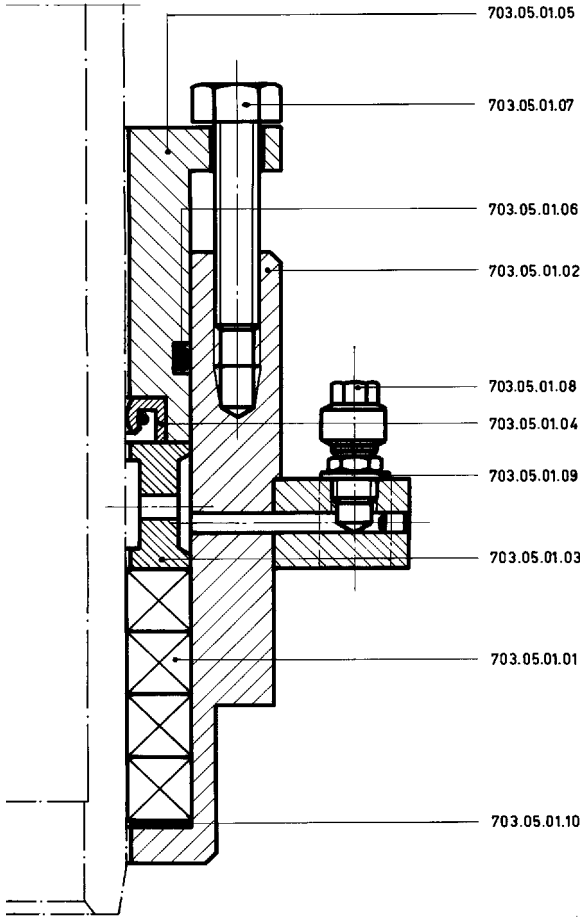


In the standard design, the drive unit consists of an axial drive with a built up, frequency-controlled electric motor. The rotation speed can be altered using a frequency controller.

In particularly small spaces, a lateral drive can be implemented over a V-belt and a hydraulic starting coupling. With this design, the acceleration of the filter unit is fixed using the hydraulic starting coupling.

For the operation of several filters, or for application in explosion-proof systems, the implementation of a hydraulic drive is recommended, whereby only one pressure unit is required. This can be constructed outside the explosion-proof zone.

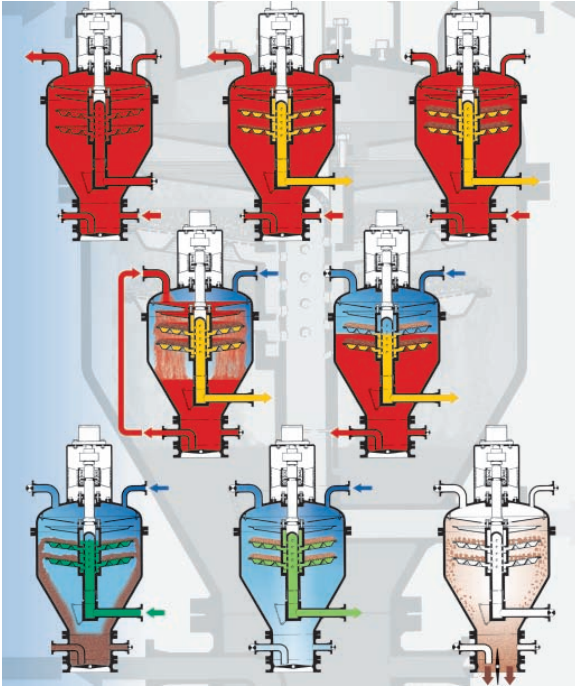
The seals



As can be seen in the illustrations, the type of seal can be adjusted depending on the respective process requirements.

Pressurized bellow seals can be implemented if processing corrosive or toxic products, or with increased requirements in order to guarantee the complete protection of the surroundings and the product.

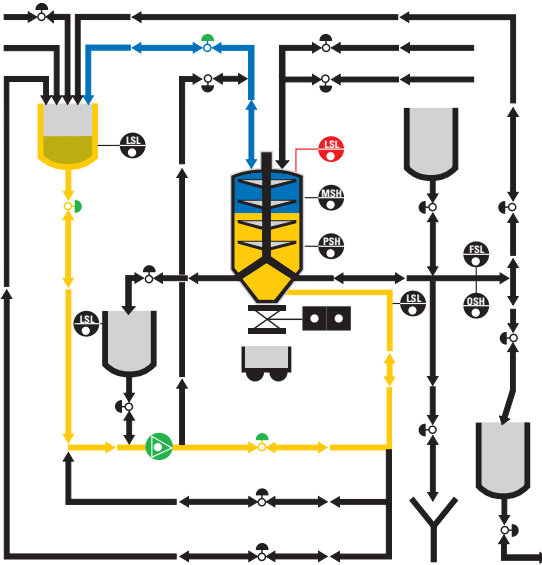
The Chemap®-Filter as a processing component



Here, the process steps of the Chemap®-Filter are displayed. There is a whole range of further process steps which go far beyond simple filtration, such as washing and drying of the filter cake.

A particular speciality is the filter plates being slightly tilted towards the inside, through which the filtrate is able to be completely discharged. This residual volume filtration over the entire filter surface is one of the characteristics of the Chemap®-Filter. Thanks to filter plates lying horizontally and being stacked on top of one another, the residues are left behind undamaged on the plates. They can therefore, if necessary, be treated further. In the Chemap®-Filter, a multitude of process steps can be carried out automatically and in a closed system.

The filling of the filter



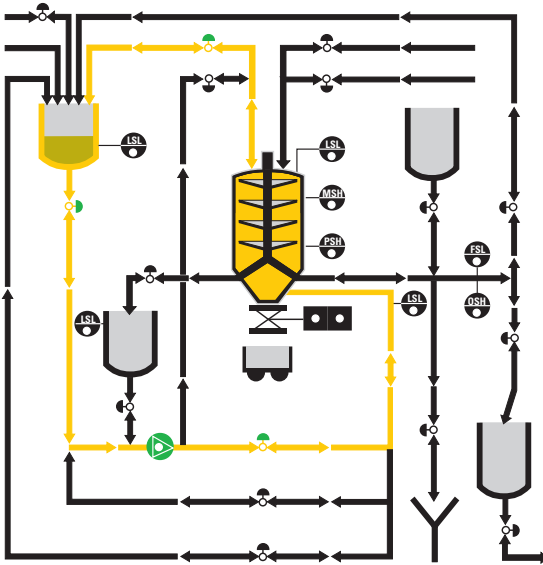
One technique which is typical of a Chemap®-Filter process shall now be analysed in detail.

The following images show the progression of the process phases which are necessary or possible for filtration. Each discontinuous process begins with the apparatus being filled-up.

Depending on the process, with precoat filtration the filter is filled with clarified filtrate or a clear auxiliary material (filter aid), and with direct filtration with a cloudy suspension.

The filter is filled using a pump and the gas phase found in the filter is guided back into the receiver vessel via the collector pipe and the ventilation pipe. If the filter is full, the product flows back to the receiver vessel via the ventilation. The circulation runs as follows: Receiver tank – filter – receiver tank.

Homogenisation



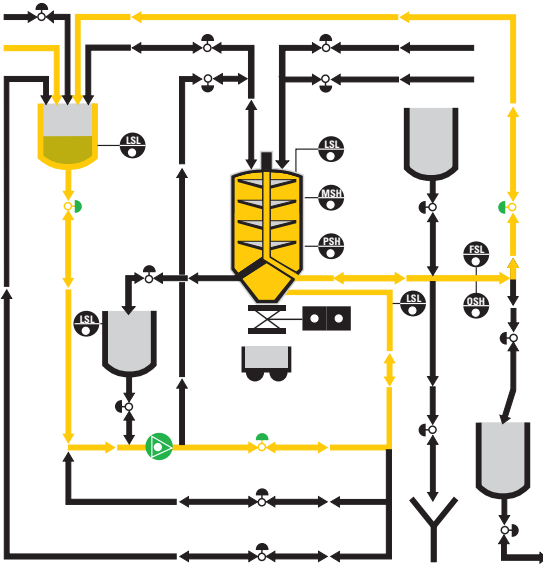
Circulation back into the receiver tank is necessary to obtain homogenised distribution of the solid matter to be filtered in the whole fluid. This homogenisation lasts 5 – 15 minutes, depending on the situation.

In order to achieve perfect homogenisation, it is a basic rule that the vessel volume must circulate around 1 to 1.5 times.

After the filling phase, the goal is to perfectly homogenise the solid matter phase and the liquid phase.

An even distribution of solid matter in the filter and auxiliary vessel is the basis of the following process..

Recirculation

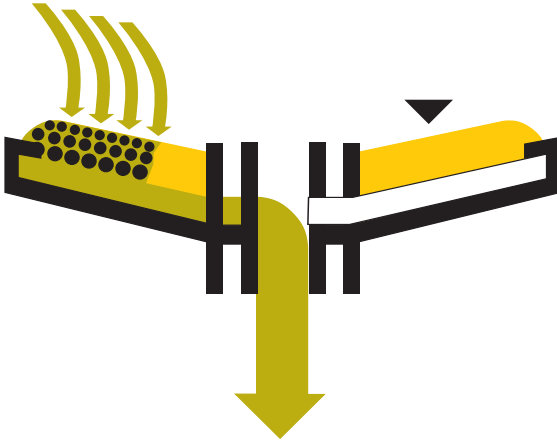


Recirculation into the receiver tank with the possible addition of a filter aid requires careful monitoring with regard to the backpressure and the Δp progression, in other words guaranteeing that an even filter layer is formed on each plate.

In many different types of filtration, pre-coating is applied to the filter screen in order to obtain the desired filter effect and in order to protect the screen. The pre-coating suspension is brought into the filter from the pre-coating tank by means of a pump. Constant overflow from the filter back into the pre-coating tank prevents sedimentation of solids.

The filtrate flows through the filter plates in the sleeve shaft and from there back into the pre-coating tank. The length of time it takes for the pre-coating depends on the application; however it normally lasts around 20 minutes.

The filter medium



The choice of the right filter screen depends on the granulometry of the solid matter. The coarse-grained percentage of the matter must be sufficient to form a first layer. It is important to know that the degree of filtration is primarily achieved through correct precoating or pre-filtration. The only condition for the filter is, of course, the impermeability of all seals.

Now we start to form selectively the filter cake on the filter screens of the product to be filtered, or of the precoating medium.

The filter screen together with the solid matter layer now forms the so-called “filter medium”.

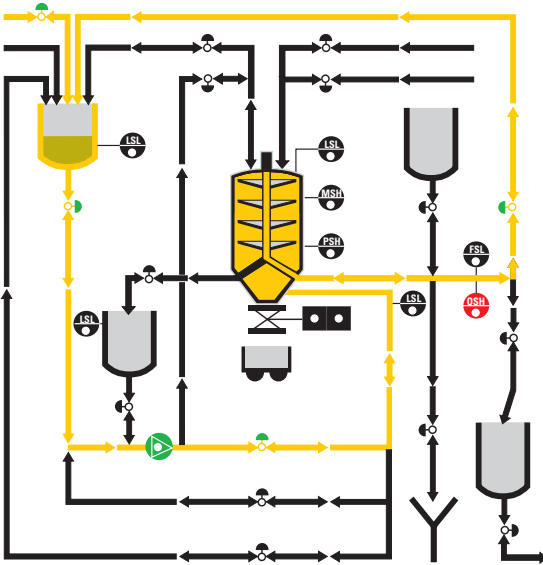
This precoating process has to be carried out with a relatively high flow velocity.

Rule-of-thumb: around 2000 l/m²/h, $h \pm 1000$ l,
 depending on the sedimentation velocity
 of the solid phase.

This sedimentation velocity depends on many different factors, for one on the specific weight of the solid matter, and for another on the viscosity and/or the surface tension of the fluid.

With the implementation of filtration aids, the addition of around 1kg/m³ is necessary to build a layer around 3-4 mm thick. Conventional filtration aids have a bulk density of around 250 – 300 g/l, which corresponds to a volume of 3 – 4 l/kg. 1 l/m³ resulting in a layer thickness of 1 mm.

Pre-filtration



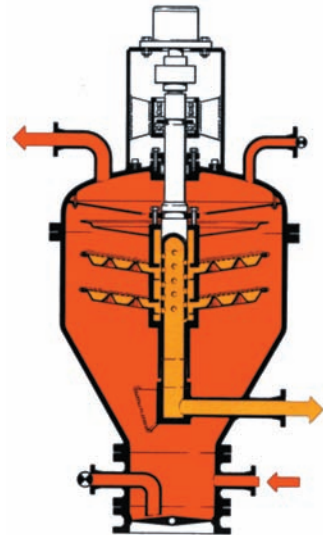
Pre-filtration is then only necessary if the fluid phase is altered between pre-coating and filtration, or if the highest of requirements have been set regarding the filtrate.

Again, as long as the right choice of filter screens or filter cloth and filter aid has been made, this phase should not last longer than 2 to 3 minutes.

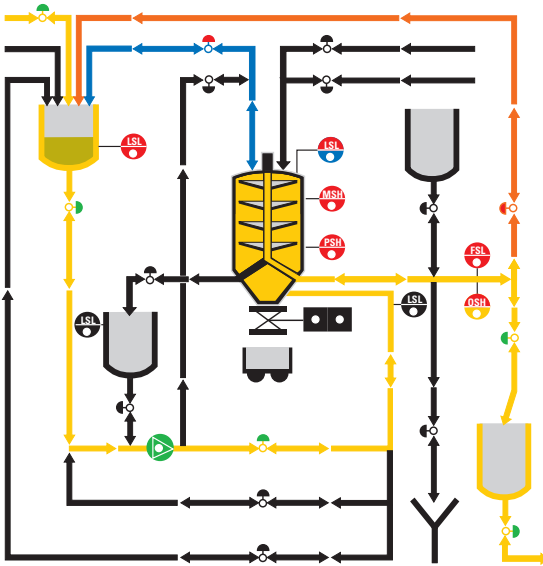
This intermediate phase must above all be seen as a “test step”, whereby the clarity of the filtrate can serve as a testing criterion.

This intermediate phase is often implemented if interruptions occur in the overall process, in which the filter is implemented, due to incorrect product feed or absorption levels which are too low. With this, operations can be maintained without completely interrupting the filtration process.

The Δp in this phase is, to a large extent, an indicator for the quality and the level of the filter layer.



Types of filtration



We consult these two criteria as a basis for the calculation of the active surface of a filter.

With “cake filtration”, the whole thing can, for the most part, be calculated, as long as the volume of the incoming solid matter is known. The space available for the cake in the filter depends on the surface and the gap between the individual filter elements. The measurement unit is the litre.

The situation is completely different with so-called “surface filtration”.

The “specific filtration performance” in $l/m^2/h$ cannot be calculated in practical terms; experience and tests are needed for this. In this area, it should be in particular taken care of the “sample” being representative. Possible deterioration or alterations in the granulometry can completely skew the results of a test.

- The pressure and pressure difference progression during the filtration phase determines the type of filtration. Practically all criteria can be identified from this pressure progression. It is also very important during filtration that the required small level of excess pressure occurs at the filter output.
- A vacuum, generated by a pump or an extremely-long downpipe, must be avoided in all cases. With downpipes which are too long, a vacuum breaker must be installed.

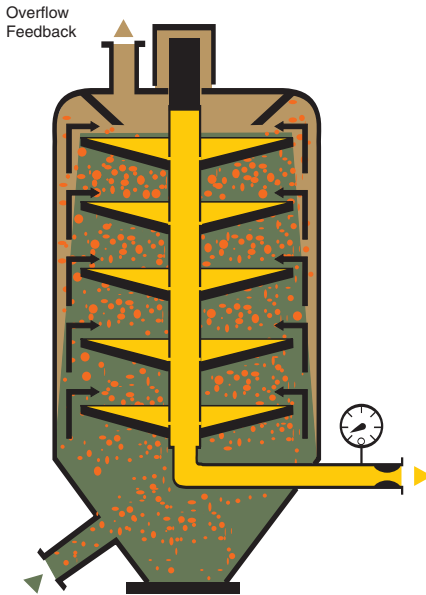
Filtration, or rather the separation phase, plays the main role in the overall process. In general, there are two filtrations methods which can be decided between:

1. so-called “cake filtration”, whereby the cake volume limits the cycle duration

and

2. so-called “surface filtration” with a relatively permeable cake, whereby the maximum pressure defines the cycle duration.

The feed to the filter



Filtration with lower specific filtration performance can be problematic in a vertical filter vessel.

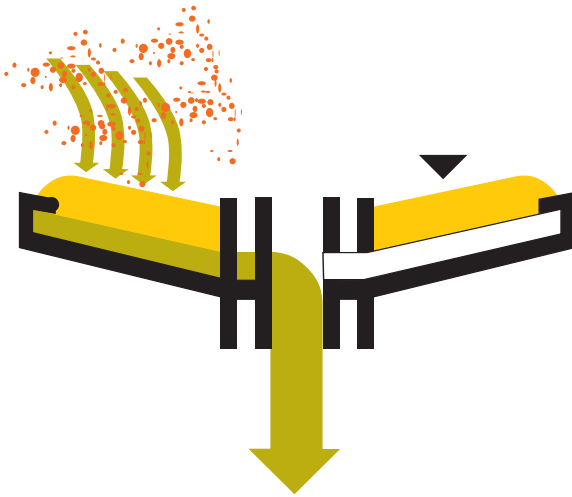
What kind of measures can be taken to counteract this?

Now in order to be able to guarantee the transport of the solid matter phase to the upper plate with low specific filter performance, the rate of ascent must be greater than the speed of the sedimentation of the solid phase in the upper part of the filter too.

In order to increase this rate of ascent, a so-called 'overflow' into the feed tank is necessary. This, of course, must be taken into consideration in the calculation of the filter pump.

The feed into the filter must be higher by the amount which can escape via the overflow.

Cake filtration



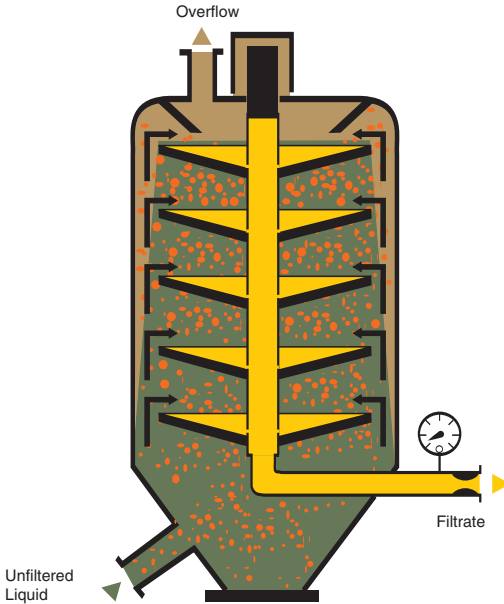
Filtration in relatively impermeable cakes, meaning with low specific filter performance, can be optimised through the addition of filter aids.

Filter aids maintain the permeability of the cake, considerably increasing their lifetime.

What sort of quality should be used?

Usually, filter aid is added in the same amount as solid matter is filtered out. In order to be able to optimise this amount, tests are obviously again necessary, whereby the pressure progression provides the indications.

Sedimentation



A vital requirement for a filter system is a 100%-full filter shaft.

Only through this can it be guaranteed that the same pressure difference is being exerted on all filter elements. The pressure at the filter outlet must be greater than the height of the vessel, multiplied by the specific weight of the fluid to be filtered.

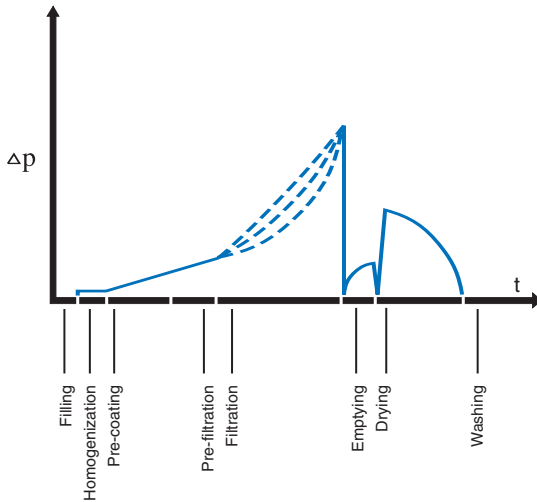
This can be achieved either through flow restriction at the outlet or through an appropriate rearrangement of the piping, whereby a through-pipe (communicating vessels) is added.

Should the Δp increase in this phase with each further filtration, it can safely be assumed that the filter screen is becoming increasingly clogged. Of course, this must be remedied straight away, otherwise damage to the filter can't be avoided.

The flow pattern with horizontal plate filters shows that the speed of the sedimentation of the solid matter in the liquid phase plays an important role.

Only with sufficiently-high levels of filter performance is the transport of solid matter particles guaranteed on the uppermost plates. The respective required filtration capacity can be calculated.

Pressure



During the entire filtration process, the Δp progression indicates the separate phases.

The function of the filter can be analysed by means of the recorded curve.

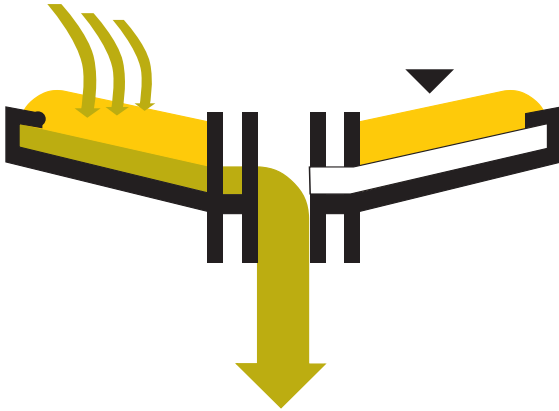
Any possible damages or discrepancies are easily identifiable through this.

This more or less typical record of pressure or pressure difference over the course of the entire filtration process provides information about the process and the state of the filter. As a result, filter screen blockages can be discovered during the pre-coating phase, for example.

With a fully-automatic system, the exceeding of a defined pressure threshold can even trigger an 'alarm'.

In the pre-filtration phase, the quality of the pre-coating layer can be determined. The actual filtration curve shows whether it is a question of a linear or an exponential process. The optimal filtration duration can be determined by following the progression of this curve.

Outflow into the sleeve shaft



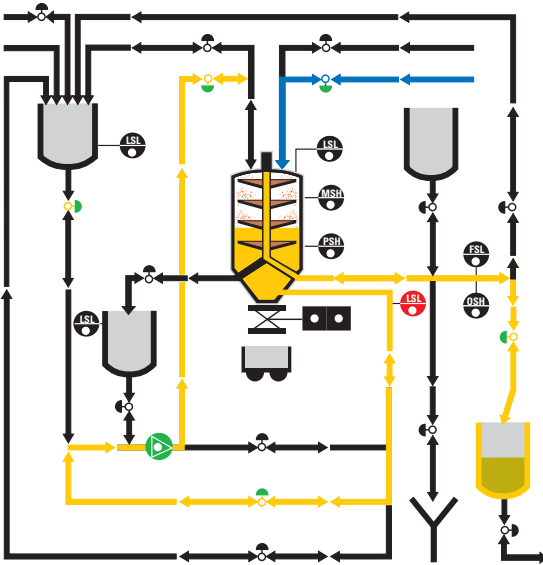
The geometric form of the filter element is a deciding factor in the ability to guarantee a complete discharge.

Not only the conicity but also the “buckle” in the plates, which serve as supports for the filter screen, allow free flowing of fluids in the sleeve shaft.

Discharge may not be carried out at too high a speed, a factor which can be controlled by the amount of pressure gas added, and not by the reduction of the pressure gas.

- Only through the right proportioning of this amount can blowouts through the filter cake be avoided.
- After each discharge, the space underneath the plates and in the sleeve shaft should be completely free of fluid.

Chemap® residual volume filtration

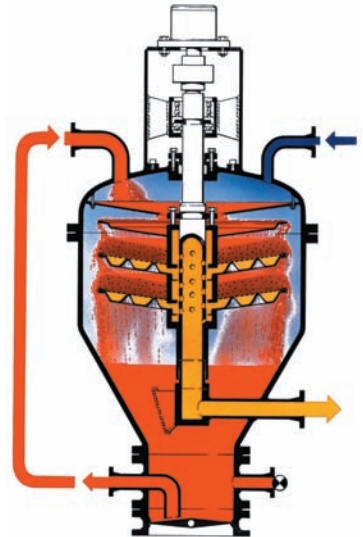


Should the dead volume be available as clarified filtrate, then the Chemap® residual volume filtration technique can be applied. The conicity of the filter element is also very important here.

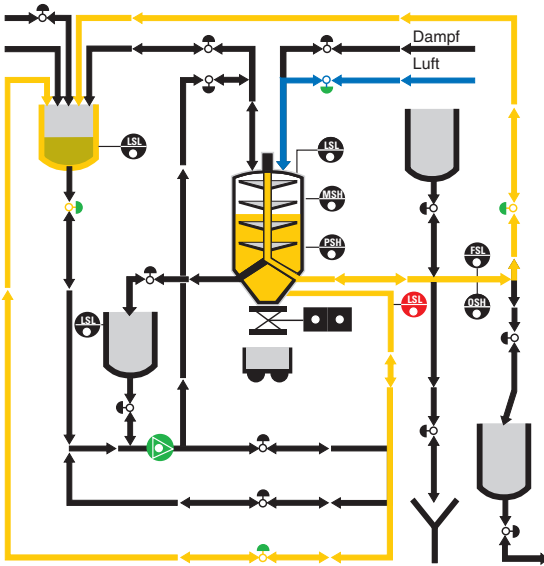
In this phase, a so-called “fluid lake” is formed on each individual plate.

- Pressure filtration – similar to siphon filtration – is only possible if the cake remains constantly moistened. The feed of the prefiltrate is carried out in a cascade form from the top. The filter pump now has a completely new task. It no longer needs to generate filter pressure, but rather only induce the transport of the fluid from the cone towards the top. As already explained, the filter pressure required now originates from an added gas feed.

The residual volume technique depends on the precise setting of the relationship between the amount of circulation and the amount of gas. With a correct set-up, filtration is possible up until “the last drop”.



Discharging the filter



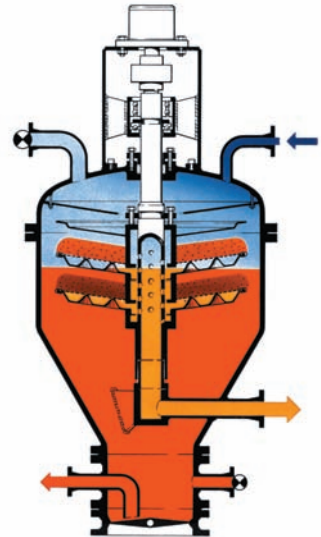
After the filtration has been carried out, the dead volume must be removed from the filter in order to be able to start the regeneration.

Depending on the method, it is sufficient to feed the unfiltered suspension back into the feed tank.

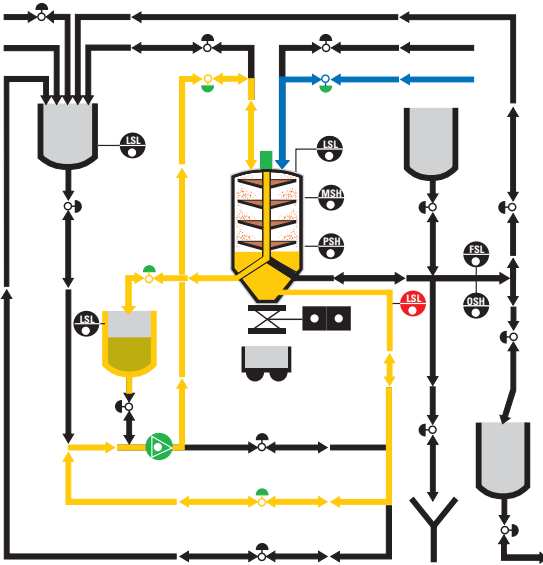
This simple process step should still be carried out with the upmost care.

All subsequent process steps are dependent on this simple step, because essentially it concerns preserving the filter cake on the filter plate with as little damage as possible. Particularly important is that the discharging is carried out on both the filtrate and feed sides.

Therefore both valves must be opened so that the cake can be pressed onto the filter elements.



Efficient extraction



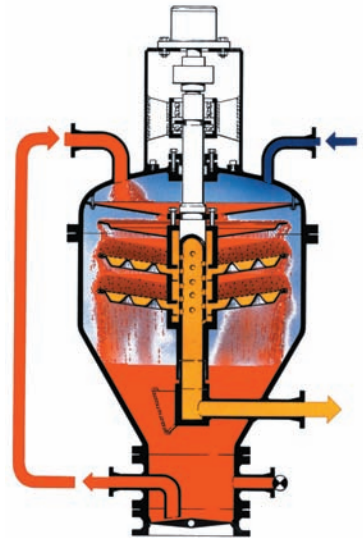
With most horizontal plate filters, the dead volume to filter surface area relationship is unfavourable.

Therefore we have developed a technique to be able to carry out cake extraction with the smallest amounts of wash medium.

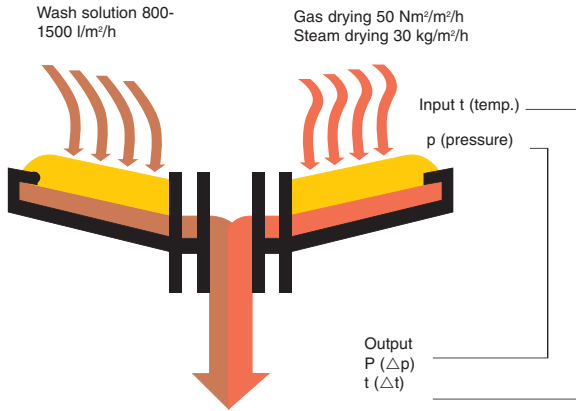
We also refer back to the aforementioned residual volume filtration for cake extraction.

Normally, at least one vessel volume + around 30% is required for one cycle wash, so that a closed cycle can exist.

By means of residual volume filtration, extraction with only a small amount is possible which of course improves efficiency a great deal. Environmental pollution can also be avoided through this.



Cake drying



As already explained on several occasions, complete discharge is an important pre-requirement before each drying.

Likewise for many drying processes, a prior extraction can be necessary as it is well-known that thixotropic cakes are extremely difficult to dry.

With purely dynamic drying (“blowing”), a relatively high level of specific flow performance is necessary. In order to reach a certain effective level of velocity inside the cake, around 40 to 50 Nm³/h must be added per m³.

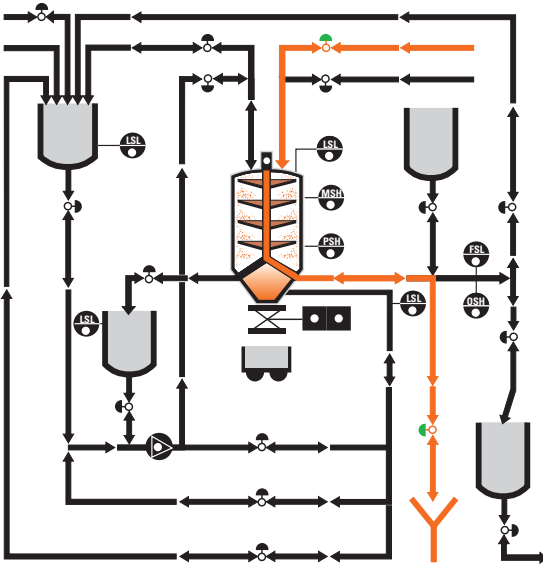
With steam drying, there are further effects. So as a result, the addition of calories plays an important role in the evaporation of the residual fluids.

After the cake extraction the cake drying follows. In principle, two different types of drying can be decided between:

1. Purely dynamic drying using pressure gas
2. Thermodynamic drying using steam

The dished form of the filter plates is here again especially important since it prevents residual fluid from remaining beneath the filter screen.

Optimal drying level



Drying must be of an optimal duration for efficiency reasons, because this phase results in relatively high energy costs.

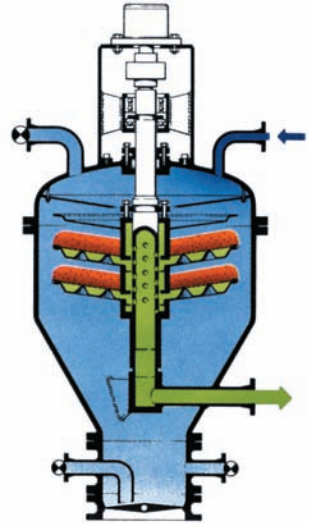
How can the optimal drying level be identified?

1. With gas drying, using Δp
2. With steam drying, using Δt .

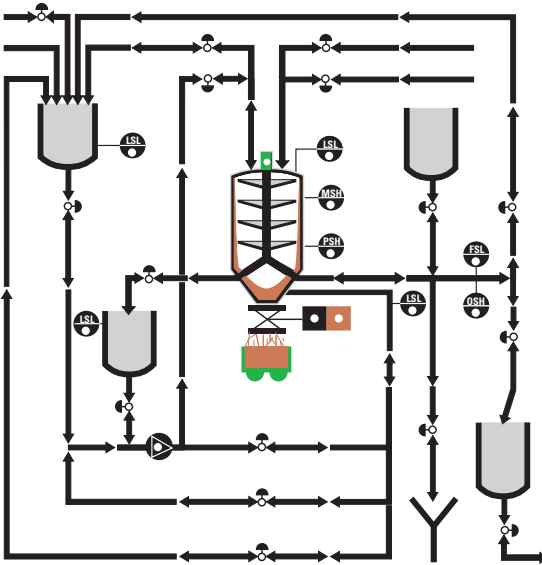
Should a drying phase last longer than around 30 minutes, it must be assumed that a blowout has taken place. In this case continuing the drying phase makes less sense. The pressure curve progression provides very good information on this.

With gas drying, the expansion of the pressure gas after the filter is extremely important. This must be taken into account in great detail regarding the choice and design of the pipeline system. Should a blockage occur in the outflow, then drying can be compromised.

With steam drying, the drying efficiency can be considerably increased if the filter is placed under a vacuum several times, which of course considerably reduces the evaporation temperature. The pressure release after each drying phase should always be carried out firstly on the filtrate side and then on the feed side. Likewise it must be ensured that the sump is also discharged.



Dry cake discharge



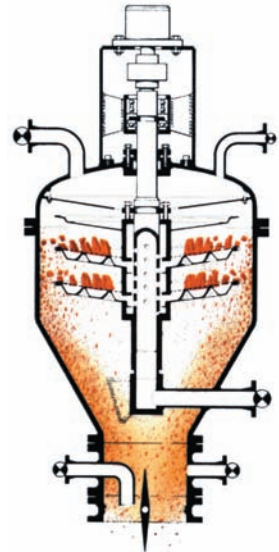
All previous phases have been carried out purely statically with regard to the filter mechanics. Only now does the filter unit need to be moved, in the unpressurised vessel.

The hydro drive as a “supportive unit” possesses all necessary technical advantages for this process.

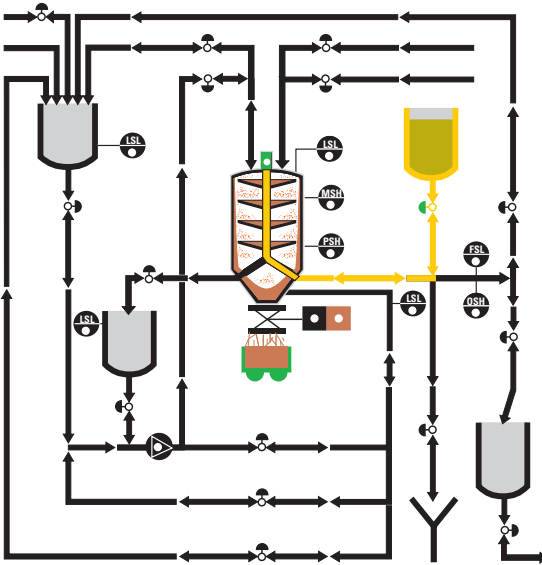
With clarification filtration processes, purely dry cake discharge represents an optimal solution with regards to dry residues and loss of fluid products remaining inside the residues.

The discharge of the filter cake in dry form is, in many cases and for many different reasons, an important requirement for a filter system.

As discharge in closed systems is possible without manual intervention, requirements regarding hygiene have been completely fulfilled in the Chemap®-filter.



Slurry discharge



The slurry discharge variation then comes into application in clarification filtration processes if the residue must be suitable for pumping.

The thinning of the suspension is possible in two ways:

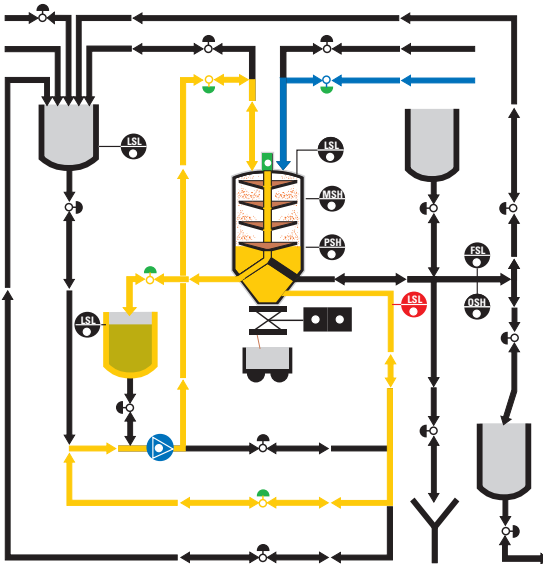
1. through backwashing
- or
2. through moistening from above, in the form of a cascade.

Should the filter screen or filter cloth type not allow backwashing, then the only possibility is the addition of thinning agents from above in cascade form.

However, should backwashing be implemented, very precisely-defined laws must be taken into consideration.

Above all, blocked filter screens cannot ever be backwashed, rather they must be cleaned beforehand in the direction of the filtration. Then they should be backwashed with as little pressure as possible applied in a controlled manner, whereby 4 – 6 mWS should not be exceeded. This can be done ideally with a deep tank. Pumps should not be used for this purpose. Moreover, the deep tank has the advantage that it can act as a reservoir, because there needs to be a whole volume of the vessel available in 2 – 3 minutes.

Filter screen cleaning



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The possibility of preventative filter screen cleaning in a closed system should not be missing from any project!

Periodic cleaning protects your filter from being damaged and definitely pays off!

How can this washing be made easier?

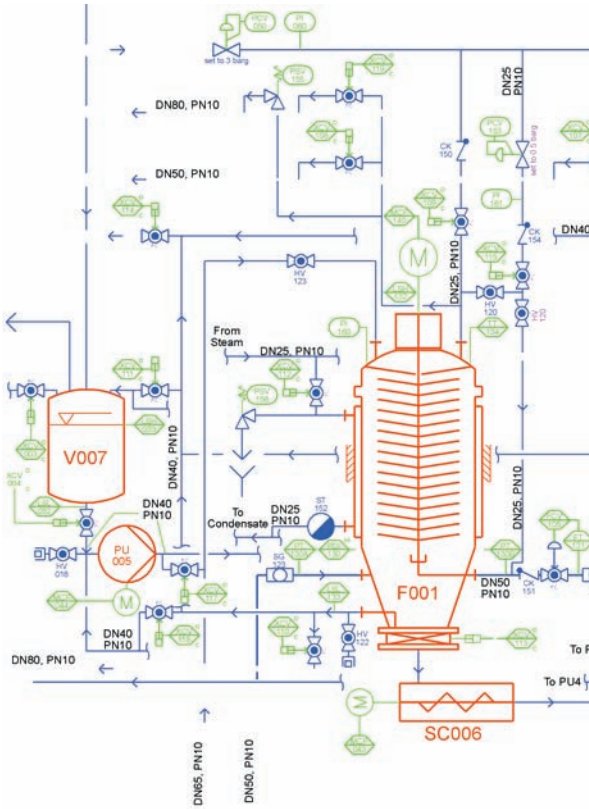
We refer back to the “residual volume filtration principle” for this phase too.

The fully-discharged filter is partially filled with a washing fluid. This washing medium is then pumped in and then the unit rotates alternately.

Through this, you obtain a reciprocal effect in the direction of filtration through gas pressure, and against the direction of filtration through centrifugal force.

This washing should be carried out periodically, depending on the state of the gauze. Another good opportunity for the cleaning of the gauze can also be blowing steam through in or against the direction of filtration. Chemicals can be added to the steam - via an injector valve - whereby of course it must be ensured that the filter's construction materials are not attacked.

Filter control system



Filtration processes can be automated with industrial controls, or integrated into the process control system. You can get more information about this at:

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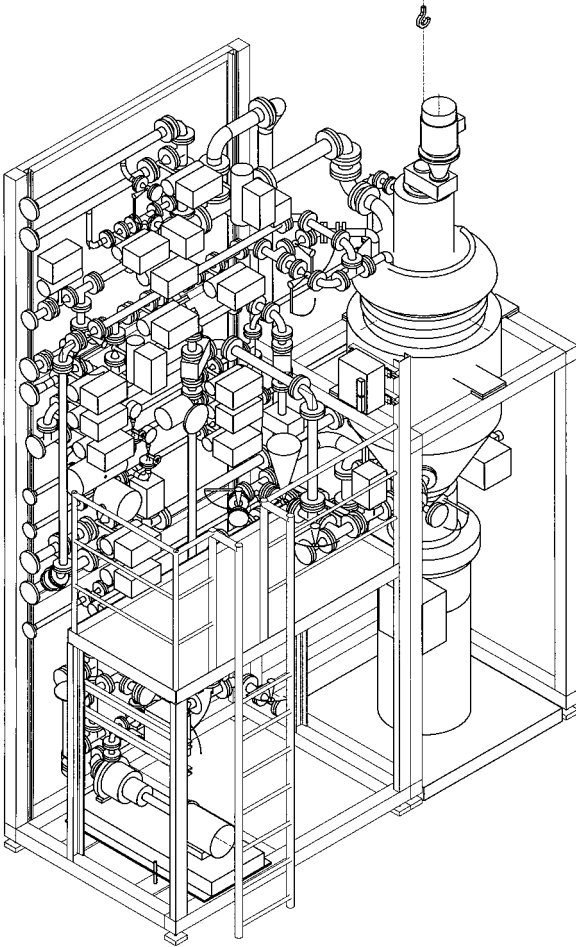
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Compact systems



Alongside individual filters, INFOLABEL AG also builds complete systems with pumps, pipelines, valves, fittings, measurement devices, controls etc.

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