MODERN FILTRATION METHOD FOR SUGAR JUICE

Sugar industry already has a long tradition with Separation and Filtration.
Filtration is that important in only a few industries, so the engineers in the sugar mills have a very practical experience and much knowledge in this field.
Most of the filtering systems in sugar mills are designed for low capacities and pressures and usually filter-aids are used to build up a filter-cake to reach the necessary filtration-level.

Disadvantages of these filtration systeeed of a very large floor area, heavy constructions, usage and disposal of filteraids and much attention of the operators. This results in high exploitation-costs.

Holland Filter started in sugar industry with delivery of selfcleaning filter systems for beetwash water and for condensers (raw juice and carbonatation). In a later stadium the engineers of a sugar mill asked to develop a system for the filtration of sugar juice (thick juice) just before crystallization. In 1986 Holland Filter developed the first **fully automatic selfcleaning filter system** for a sugar mill of the largest sugar company in the Netherlands, "Suiker Unie".

Such a system, called a "**thick juice sugar installation**", is a design of several ABF^{7} selfcleaning filters, which are connected parallel and build together.
This system is controlled by a PLC according to the latest modern standards. Because thick juice is a rather viscous and expensive product for the sugar factory, thin juice or hot water is used as back washing medium. This thin juice will be carried back to an earlier stage in the process flow.

There will be no loss of expensive thick juice during this filtration step.

GENERAL INFORMATION ABF FILTERS

Holland Filter bv was founded in 1983 and started in the Netherlands with the introduction of selfcleaning liquid filters. Nowadays Holland Filter is specialized in liquid and air filtration and has become a modern company with many international contacts in the sugar industry, as well as in many other branches of industry.

ABF^7 filters are automatically self cleaning and have been developed to provide a trouble free way to remove suspended solids from liquids.

By using modern production and design techniques, ABF^7 is a flexible product that can be used in a variety of applications. Thanks to the specific qualities of the filter, ***high efficiency, high reliability, easy handling and little maintenance***, ABF^7 filters have found their use in many industries: Chemical, Food and Beverage, Plastic, Steel, Agricultural, Municipalities, etc.

A worldwide network of sales and service personnel backs the ABF^7 filters. All dealers are specialists in the field of filtration; they will be pleased to utilize their experience to help you select the best filtration system for your application. Furthermore, they will provide an excellent after-sales service, to guarantee trouble free use for many years.

ECONOMIC REASONS FOR ABF^7 FILTERS IN SUGAR INDUSTRY

Sugar factories use ABF^7 filters in various applications for the following reasons:

a) To **improve** sugar quality by removing all visual dirt by absolute filtration.

b) To **reduce** production and energy **costs** by very low maintenance and labour costs using these ABF^7 **Thick Juice Filter Installation**.

c) Because of the fully automatic filtration, **no loss of production** caused by standstill and **no loss of expensive thick juice** will occure.

d) Very **easy handling** and **simple operation**.

e) **Less floor space** and **no extra foundation** needed compared to conventional filtration methods.

ABF^7 filters offer a total solution to save maintenance and energy costs. It is a fully automatic selfcleaning system. These "**HOLLAND FILTER Thick Juice Filter Installation**" have an automatic back flush by using its own liquid or an external liquid such as thin juice or hot water.

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SPECIFIC ADVANTAGES OF THE ABF^7 FILTER INSTALLATION

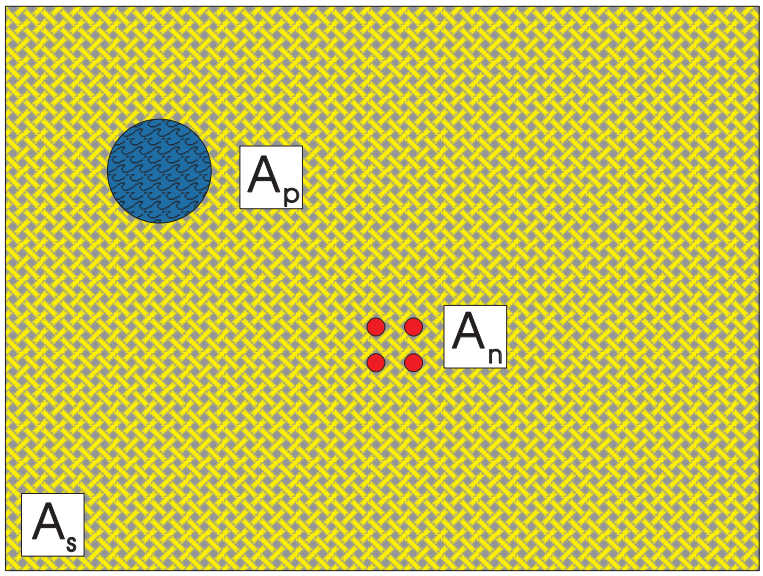
* The self cleaning process starts first at a pre-set pressure differential over the "**Thick Juice Filter Installation.**

* The installation uses thin-juice for backwashing;

  - First it is a cheaper medium for back washing and it goes back into the process, so that there are no sugar losses

  - Second the viscosity is lower, so back washing is more easy and efficient

* The flow velocity over the fine screen is low because of the large filter area A_s compared to the pipe area A_p. There is only a small pressure loss over the filter; this ***reduces*** your ***energy costs***



* Back washing takes place through small nozzles (A_n), which describe a circular and spiral-downward movement across the fine screen. The fine screen is cleaned in only one spot at a time with a very high back flush velocity. This gives a **100 %** optimal cleaning effect.

* While flushing one filter, thick juice remains flowing through the other filters. So there is a continuous filtration without any interruptions.

* **High capacity**, and **compact units.** This simplifies installation and makes a foundation superfluous. ***Less installation costs*** .

* ***Little maintenance and high reliability***. The ABF^7 **Thick Juice Filter Installations** have proven this for more than 10 years in practice.

* A very smooth movement of the dirt collector by using a special designed piston, guarantees a ***100 %***

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cleaning off the complete fine screen area.

* Reed switches on the piston end the back flushing. This means the flushing does not take any longer than absolutely necessary, so ***less usage of thin juice*** and ***less wear of the internal parts*** in the filter itself will occur.

* Fine screens are specially designed for viscous media like sugar juice, bringing the following advantages:

  - ***high flow meshwire*** for little flow resistance and high capacity.
  - ***pleated screen***, giving more filtering area for large dirt accumulation.
  - ***longer life time*** of the screen while rounded pleats are being used.
  - ***mesh wire consists of three layers*** (2 support layers + actual filtering layer), ensuring absolute filtration and maximum strength of the filter element.
  - ***easy changeability of the filter elements*** afterwards to another micron size, to adapt to different process conditions.

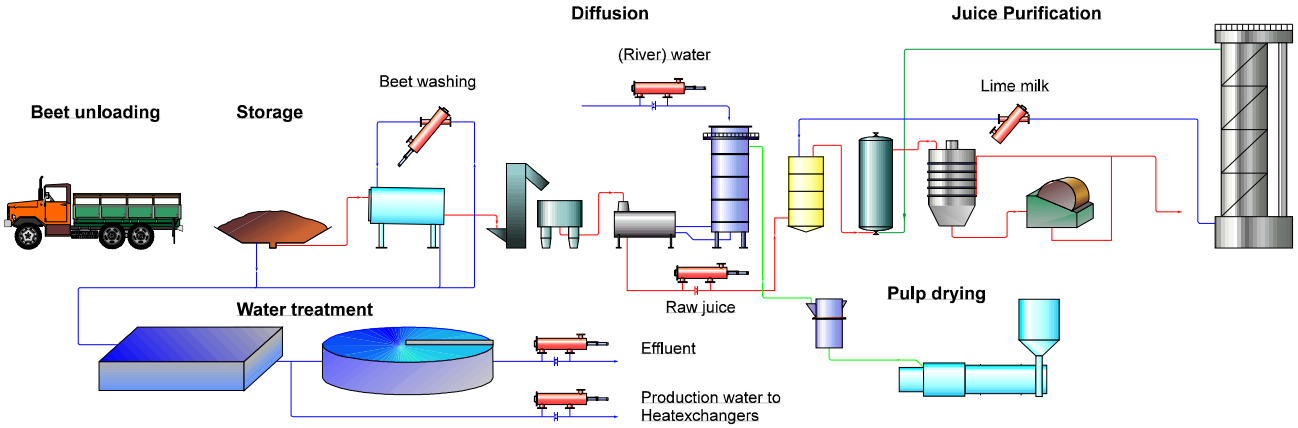
* Very sophisticated PLC control with the following features:

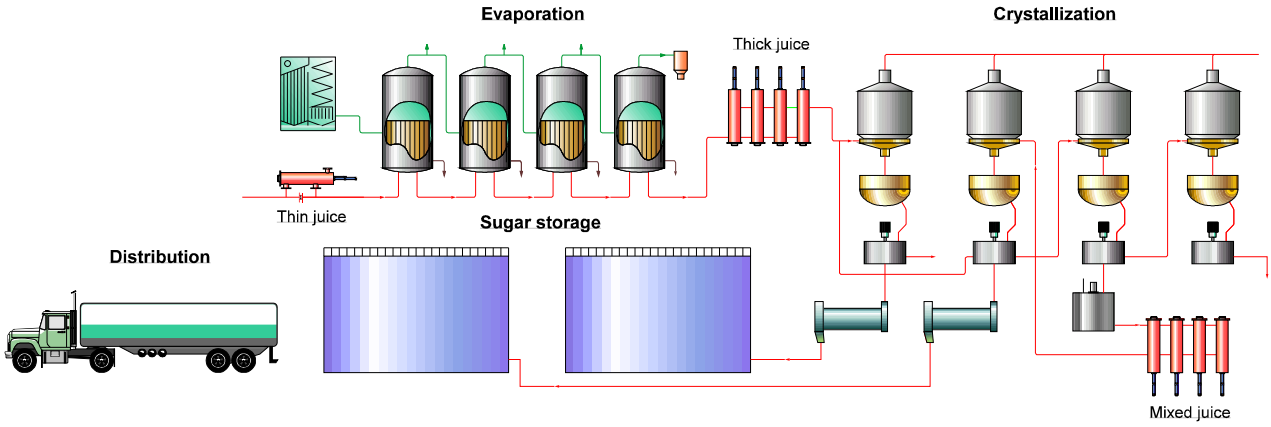
  - ***fully automatic back washing*** process started by ΔP.
  - ***protection*** of the installation ***against too high ΔP.***
  - ***blind scheme*** showing all valve and piston positions in the front of the control box, giving a clear view of the actual status of the installation.
  - push buttons to initiate manual flush, manual operation of the filters, lamptest, alarm reset and emergency shut-down of the complete installation.
  - ***alarms*** for too high flushing frequency, too high ΔP and too low air pressure for actuators.
  - the valves will be controlled in such a way ***that standard liquor/mixed juice and thin juice <u>can not</u> mix*** and that the risk of water-hammer will be reduced to a minimum.
  - ***the PLC program is designed for maximum protection of the installation, highest reliability and easiest maintenance.***
  - three potential free contacts for “installation in service”, “flushing cycle” and “general alarm” are available to signalize these situations in the central control room.

The above mentioned features are the results of over **10 years experience** in sugar juice filtration. During this time Holland Filter has made a lot of improvements and adaptions resulting in a very reliable, trouble free and maintenance friendly install
ation.

APPLICATIONS IN SUGAR INDUSTRY

Holland Filter delivered its selfcleaning filters successfully for the following applications:





Application	Micron rate	Process data	Purpose of filtration
Beetwashing	200 µ	400 m³/h-10 Bar	Preventing clogging of nozzles by filtering the recirculation water
Raw juice heat exchangers	6 mm	250 m³/h- 5 Bar	Removing beet particles to prevent clogging of
Cooling water system	120 µ	80 m³/h- 4 Bar	Protection of CO_2 Vacuum pumps in cooling
Lime milk	400 µ	40 m³/h- 2 Bar	Protection of water for calcium dosing
Cooling water	200 µ	200 m³/h-22 Bar	Protection of turbine cooling system
Malaxeur	200 µ	80 m³/h-2 Bar	Filtering surface water, to protect heat exchangers
Influent/effluent from anaerobe treatment	200 µ	200 m³/h-22 Bar	Protection of plate heatexchangers
Thin juice	50 µ	40 m³/h-4 Bar	Removal of dirt before mixing
Standard liquor	50 F	350 m³/h - 4 Bar	Removal of visible particles
Thick juice	50 F	40-180 m³/h - 3-5 Bar	Removal of visible particles

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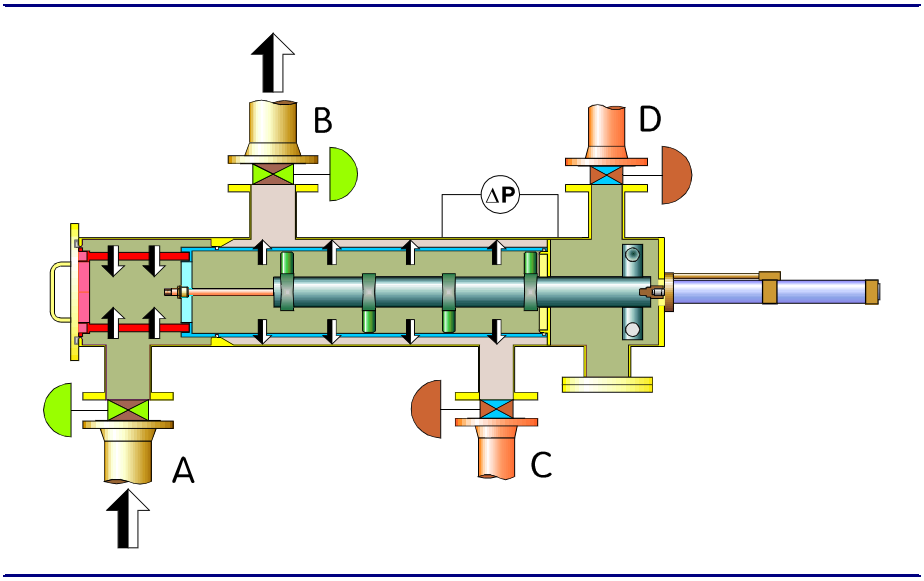
WORKING PRINCIPLE
HOLLAND FILTER SUGAR JUICE FILTER INSTALLATION

The Holland Filter Thick Juice Filter Installation consists of several ABF^7 selfcleaning liquid filters, mounted parallel on a connecting pipe frame, controlled by a modern PLC control box.
Because thick juice or standard liquor is an expensive product for the sugar factory, thin juice or hot water is used as a back wash medium. This thin juice also has the advantage of a lower viscosity.

The sugar juice enters the main inlet header and flows through the filters into the main outlet header. Back washing starts at a signal of the ΔP-monitor, which has been set at a predetermined level.

The ABF^7 filter consists of 3 compartments: the coarse screen compartment, the fine screen compartment and the lower compartment. On this side of the filter also the hydraulic motor is located.



Sugar juice enters through the inlet (A) into the coarse screen compartment and flows through the coarse screen from the outside to the inside.
From the coarse screen, the sugar juice enters the fine screen, through which it is flowing from the inside to the outside of the fine screen. The contaminated liquid is separated from the clean liquid by a partition and O-ring seals. The clean liquid leaves the filter through the outlet (B) and the dirt remains at the inner side of the fine screen.

The coarse screen traps the large particles (like bolts, nuts, little stones etc.) and protects the fine screen and inner parts against damage; it has to be cleaned manually at certain time intervals, depending on the quantity of large particles becoming accumulated at the screen.

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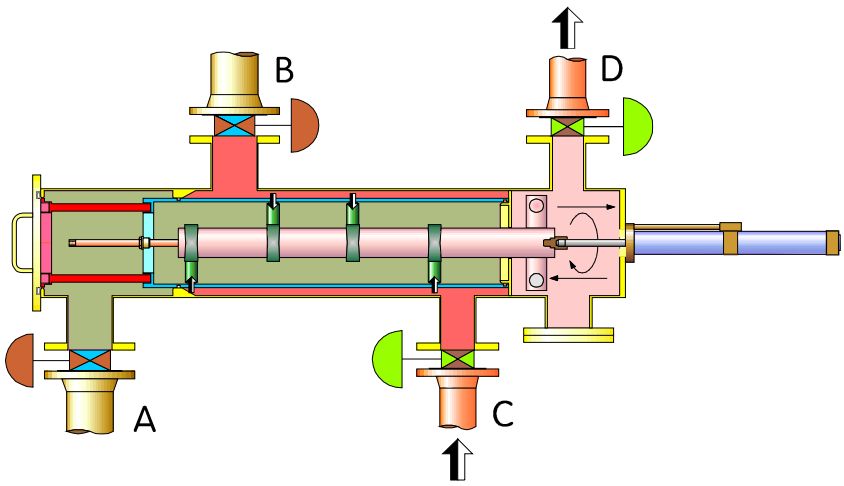
The fine screen consists of two strong supports on the inside and outside with three layers off Stainless Steel 316 woven meshwire in between. Sugar juice is flowing through the fine screen from the inside to the outside, leaving behind particulate matter on the woven meshwire.
Particles trapped by the fine screen start forming a filter cake. The filter cake gradually causes a pressure differential between the inlet and outlet of the filter. The differential pressure will be the same for all filters, because all the inlets and outlets off the filters are connected to one another.

When this differential pressure reaches its preset value, the back wash cycle will start.
The main inlet (A) and outlet (B) from the first filter close and also its piston will be brought to its starting position by air pressure. After both valves have closed, the flush inlet (C) and flush outlet (D) open.



Thin juice is flowing through inlet (C), and passes the coarse screen to the inside of the fine screen. From here it is flowing through the fine screen to its outside.
Since the flush outlet (D) is connected to the drain at atmospheric pressure, a low pressure path is created through the dirt collector and lower compartment. The debris that is "vacuumed-off" the inside off the fine screen travels through the dirt collector and lower compartment to the drain. This action causes the hydraulic motor to rotate the dirt collector with the nozzles.
The filters of the **ABF^7 Thick Juice Filter Installation** have a piston at the bottom which also gives the dirt collector an axial movement; in this way the nozzles clean the filter area for **100 %** in spiral-downward motion.
The cleaning of the fine screen takes 10 - 15 seconds per filter.

Now the piston reaches its resting position again, the flush outlet (D) and flush inlet (C) close. As soon as both valves are closed the main inlet (A) and outlet (B) open again. All valves are provided with limit switches, and the PLC-controls prevents that the flushing valves and main valves can be open at the same time, thus to prevent that filtered product will mix with thin juice.

Now the filter is clean again and this procedure repeats for each following filter until all filters have been cleaned. Now the installation will wait for the next ΔP signal.

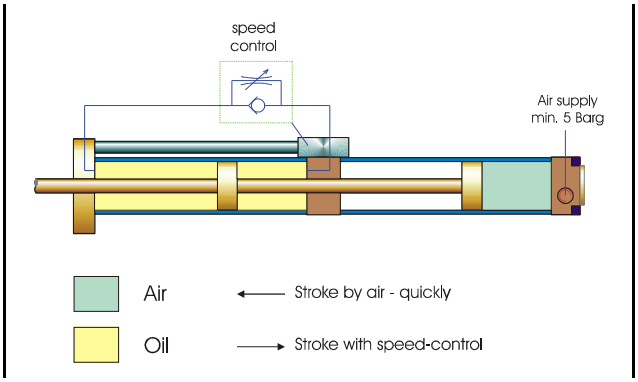
At the main outlet header of the **ABF^{7} Thick Juice Filter installation**, a manual valve is mounted to regulate the juice flow.

Because of the simplicity of our design it is very easy to install an automatic by-pass into the pipe frame. When the differential pressure (over the fine screens) will be too high, the automatic by-pass will open and guard the fine screens for damaging.

Piston

Usually pneumatic controlled pistons are provided with an oil-brake for speed-control.
Because air is compressible, stick-slip may occur in the piston, resulting in an irregular movement. As a result of this, the fine screen may not be cleaned evenly and completely. To prevent this we developed a special piston with oil-brake; this has a built-in speed control and gives a maximum control over the speed of the piston.

At the beginning of the flushing process the piston shaft moves up; there is no speed control on this stroke, so it takes place quickly in only a few seconds. The dirt collector is moving downward during rinsing by the pressure differential between the fine screen compartment and the lower compartment.



The movement of the piston in the cylinder forces oil to flow through a by-pass to the other side of the piston. The by-pass includes a speed-control valve, which makes it possible to control the velocity of the axial stroke of the dirt collector.

The complete stroke has to be made within the adjusted rinsing time. If the piston moves too fast, the fine screen will not be cleaned sufficiently. The speed of the piston can be checked by means of the red/white flags on the magnetic strip; these move because there is a magnetic ring in the piston on the piston shaft.

Back flush requirements:

The filters need a minimum flow of thin juice of : 50 m³/h and a pressure of 3 - 5 Barg during the back flush process, to guarantee a 100 % effective cleaning.

Normally thin juice is used for back washing; this will be lead back to an earlier stage in the process, so no losses occur

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REFERENCES SUGAR INDUSTRY
Designed and delivered by Holland Filter b.v.

Factory **City** **Country**	**Capacity** **Delivered** **Microns**
Pfeiffer & Langen Lage Germany	100 m^3/h 4 x 4"L filters 50 Microns
Diamant Zucker Konnern Germany	100 m^3/h 4 x 4"L filters 50 Microns
Agrokombinat Zobor Sturova Czecho-Slovakia	35 m^3/h 1 x 4"L filter 50 Microns
Finnish Sugar Satamatie Finland	60 m^3/h 3 x 4"L filters 50 Microns
Suiker Unie Groningen The Netherlands	125 m^3/h 5 x 4"L filters 50 Microns
Suiker Unie Dinteloord The Netherlands	125 m^3/h 5 x 4"L filters 50 Microns
Sucr. de Berneuil-sur-Aisne Berneuil-sur-Aisne France	100 m^3/h 4 x 4"L filters 50 Microns
Suiker Unie Roosendaal Netherlands	40 m^3/h 2 x 4"L filters 50 Microns
Tienen Sugar Refinery Tienen Belgium	30 m^3/h 1 x 4"L filters 50 Microns
Suiker Unie Puttershoek The Netherlands Agrana Tulln	350 m^3/h 8 x 4"L filters 50 Microns 120 m^3/h 10 x 4"L filters
Austria	80 Microns
C.S.M. Breda The Netherlands	100 m^3/h 4 x 4"L filters 50 Microns
Kaposvar Cukorgyar Kaposvar Hungary	70 m^3/h 3 x 4"L filters 50 Microns
Szernecsi Cukorgyar Szerencs Hungary	70 m^3/h 3 x 4"L filters 50 Microns
Irish Sugar Carlow Ireland	150 m^3/h 6 x 4"L filters 50 Microns
Sarkadi Cukorgyar Sarkad Hungary	70 m^3/h 3 x 4"L filters 50 Microns
Sucrerie de Bourdon Bourdon France	50 m^3/h 3 x 4"L filters 50 Microns
Ternopil Ternopil Ukraine	80 m^3/h 4 x 4"L filters 80 Microns
Tschortkiw Tschortkiw Ukraine	150 m^3/h 6 x 4"L filters 80 Microns
Chorostkiw Chorostkiw Ukraine	150 m^3/h 6 x 4"L filters 80 Microns
Butschatsch Butschatsch Ukraine Agrana Hohenau Austria	80 m^3/h 4 x 4"L filters 80 Microns 120 m^3/h 12 x 4"L filters 80 Micron

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