

International conference of edible oils & fats

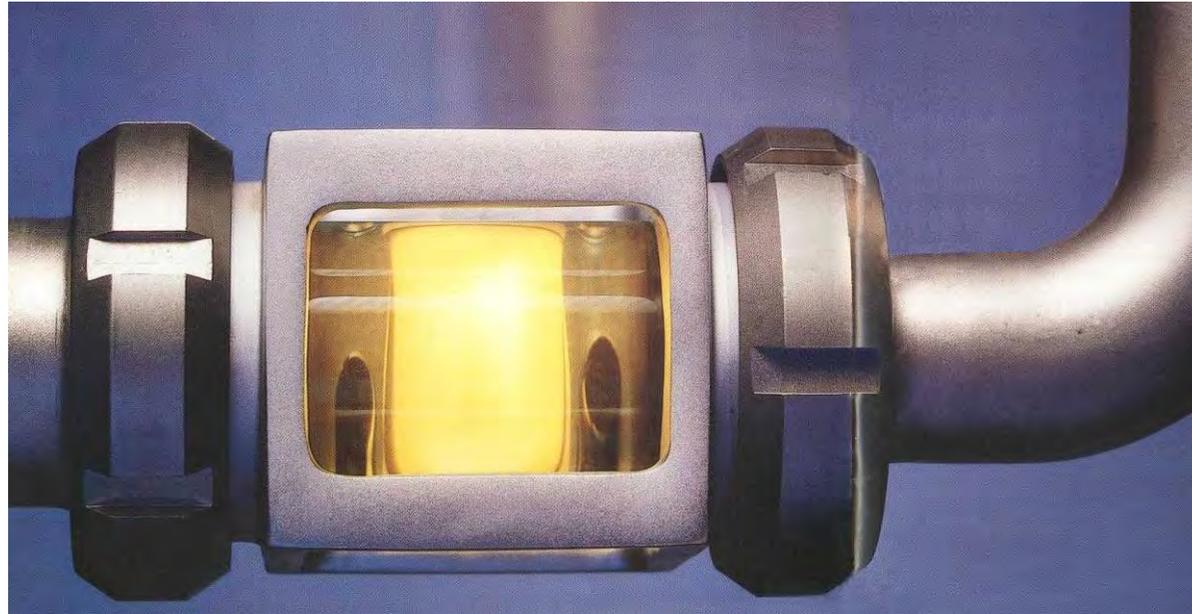
“from fundamentals to the future: processing applications & health”



April 15-16, 2008
Abu Dhabi (أبو ظبي)

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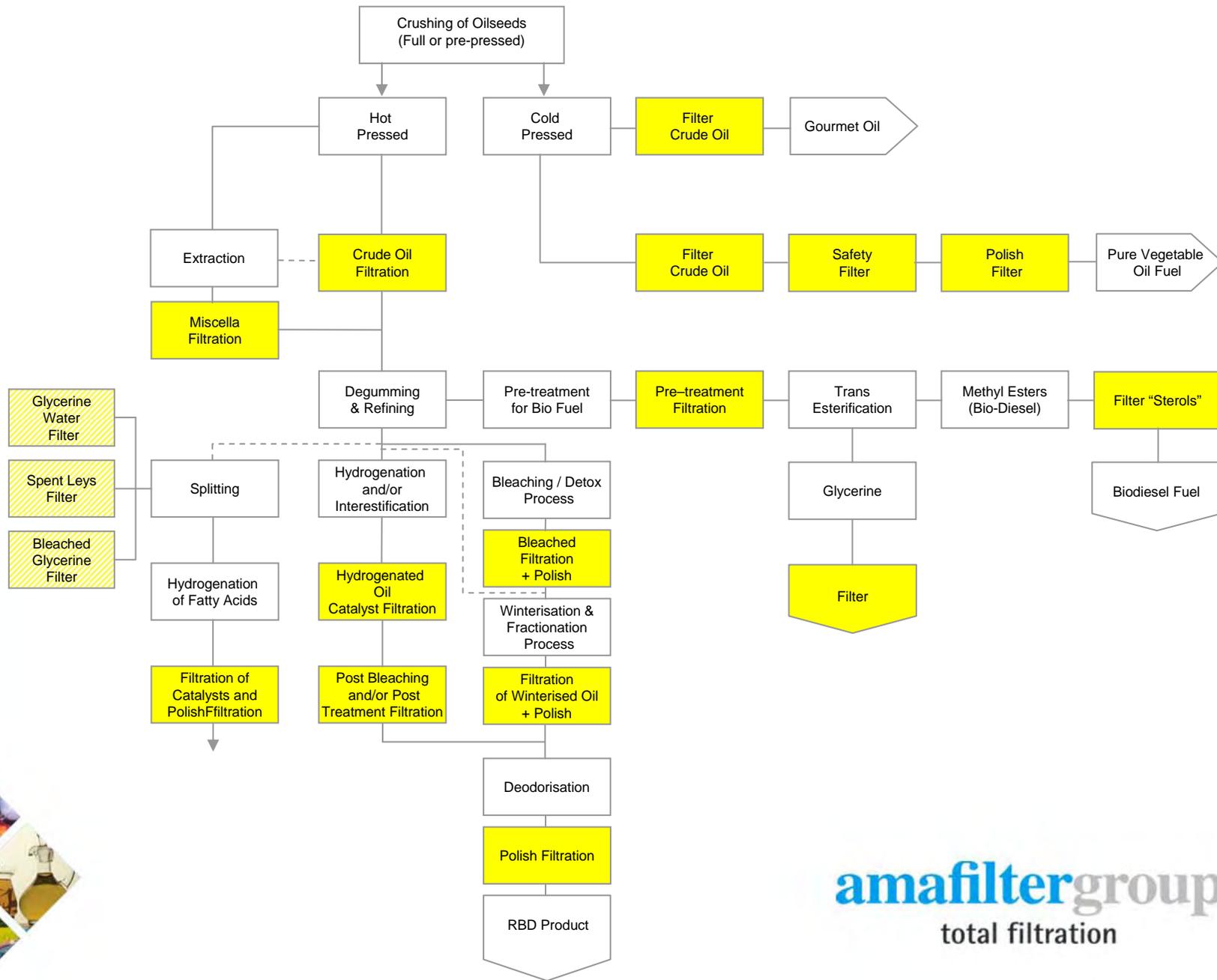
Development in filtration systems applied to oils & fats processing



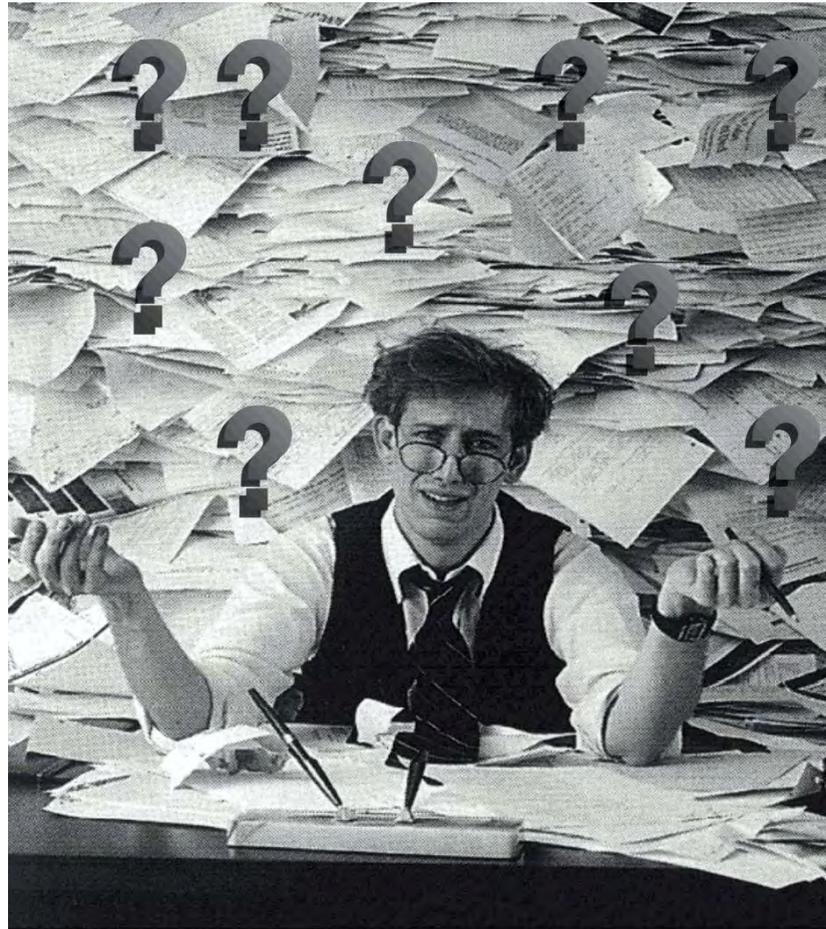
By Frank Veldkamp

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What is Filtration?





Preliminary analysis:

- Define overall problems
- Establish process conditions
- Data on solids
 - silica, crystals, hydroxides, fibers, chemical, other
- Data on liquids
 - acids, bases, hydro carbons, oils, food grade, pharmaceuticals, viscosity, etc.
- Process analysis
 - flow rate, temperature, pressure, solid content, particle size distribution, required filtrate residual solids level, etc.
- Filter cake discharge
 - wet, slurry or dry, disposal or re-use requirements, cake wash requirements, etc.



Continuous filters and separators such as:

- Centrifuges and decanters
- Vacuum belt filters
- Vacuum drum filters
- Continuous settlers
- Hydro cyclones
- Belt presses



Discontinuous filter such as:

- Sand and media filters
- Plate and frame / recessed plate filter presses
- Cartridge, bag and other disposable element filters
- Pressure leaf / tube type filters
- Single plate nutsch filters



SIZING & SELECTING

” ART SCIENCE ”



1 Darcy =

Permeability of 1 ml per second
per cm² of a liquid of 1 centipoise
viscosity through a cake of 1 mm
thickness at a pressure of 1 ATM



The most common equation that is the basis for filtration, is:

$$Q = \frac{A \cdot \Delta P}{R \cdot \pi}$$

Q = Flow in m^3 / sec

A = Filter area (sqm)

ΔP = Delta pressure (Pa)

R = Resistance 1/m

π = Dynamic viscosity (Pa)



Two main factors for sizing pressure leaf filters

- Flow in M^3 / hr or Mt / hr .
- Amount of solids in the feed versus or in combination with cycle length



Sizing on flow

$$\frac{\text{Flow required through filters}}{\text{Filtration rate}} = \text{Filter area}$$



Sizing on cake

$$\frac{\text{Total cake volume in M}^3/\text{cycle}}{\text{Cake thickness in M}} = \text{Filter area in M}^2$$

$$\frac{\text{Total cake weight in MT/cycle}}{\text{possible cake weight in Mt/M}^2/\text{cycle}} = \text{Filter area in M}^2$$



Selection of the right filter type, based on:

- Available space and space requirements
- Solids content
- Dry or wet cake discharge
- Cake discharge properties
- Filter unit size versus plant capacity
- Existing filtration equipment
- Batch or continuous system
- Required level of automation
- Investment costs
- Experience



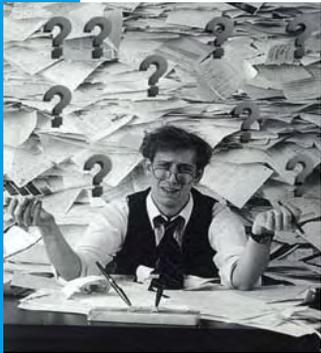
Principle models

- Process Filters
 - Model “Vertical” with a vertical tank
 - Model “Horizontal” with a horizontal tank
- Polishing Filters
 - Disposable Bag type filters
 - Disposable Cartridge filters
 - Disposable Paper / Pads filters



Process filter

Typical for leaf – or tube type filters:



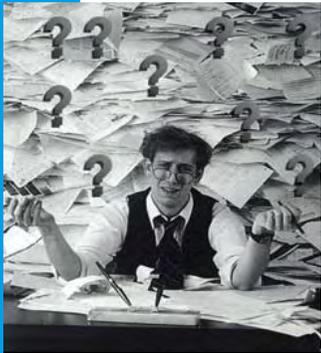
- Application with 0.001 – 5% solids (maximum up to 15%)
- 0.3% solids and higher can be filtered directly on screen or cloth
- Below 0.3% solids often precoat / body feed required
- Flowrate ranges 0.02 – 2.5 m³/m²/h



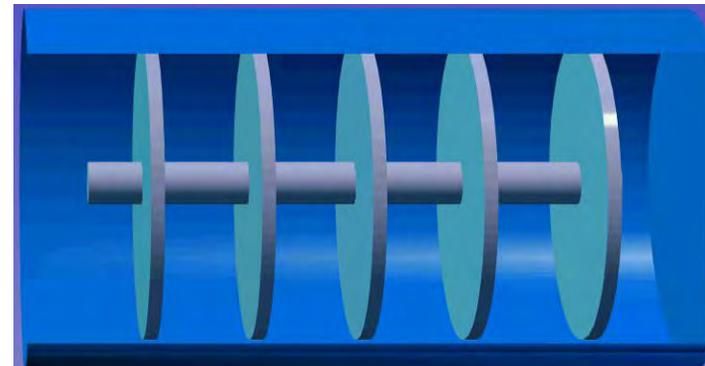
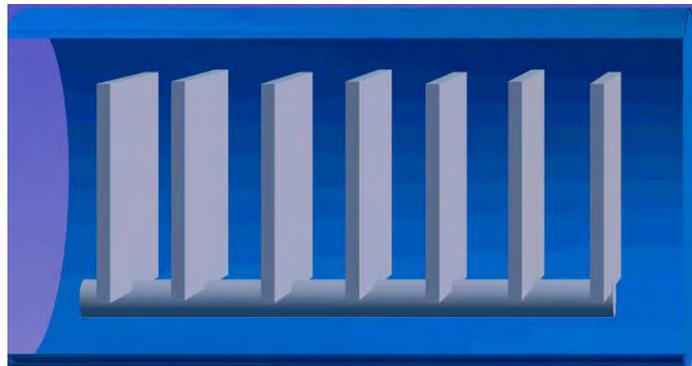
Polish filter

Typical for polish type filters:

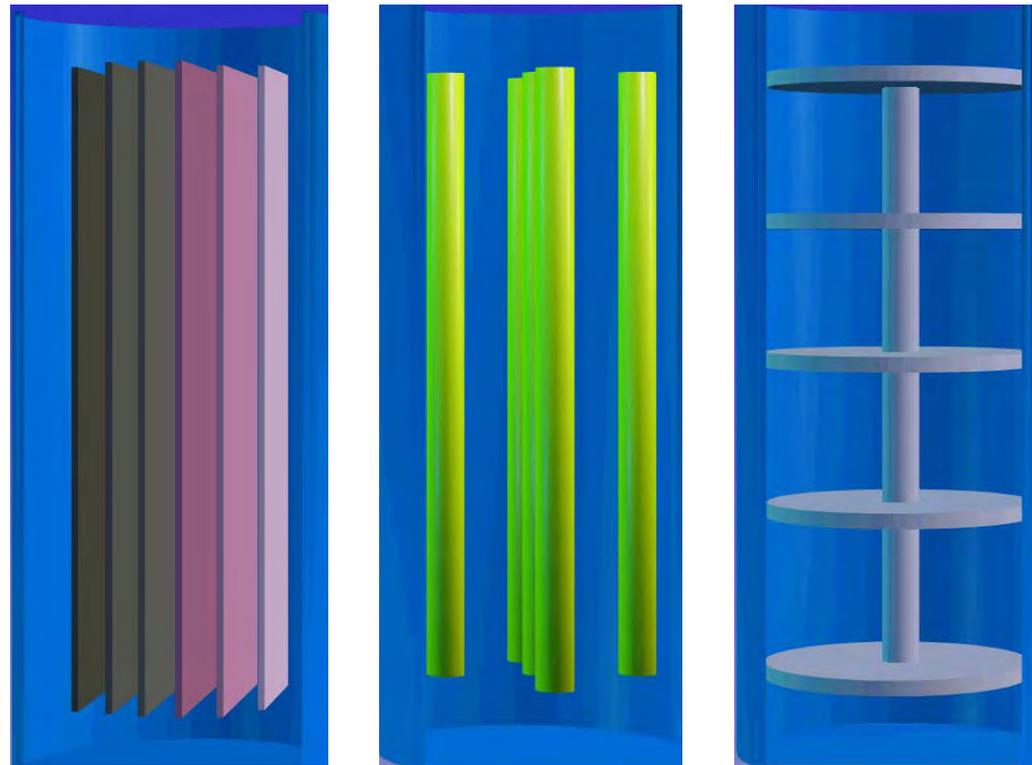
- Polish filters with disposable elements are used for application with approximately 1-100 ppm solids



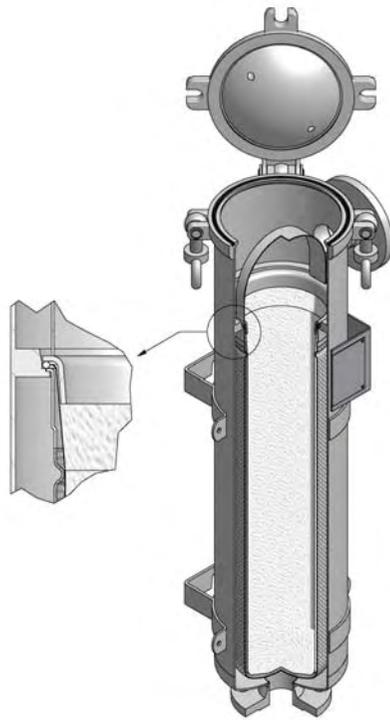
Process Filter Model “Horizontal”



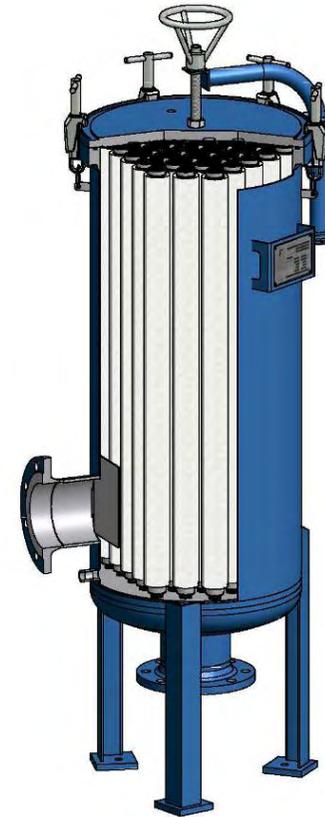
Process Filter Model “Vertical”



Polishing / Safety Filter



Model disposable
“Bag” Filter



Model disposable
“Cartridge” Filter

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Process leaf filters used in Edible oil and methyl ester applications (1)

- **Crude Oil:**
 - Vertical tank or horizontal tank type filters
- **Bleached Oil or Pre-Treatment filters:**
 - Up to 118 M² vertical tank
 - > 100 to 250 M² horizontal tank
- **Detox or Activated Carbon treatment filter:**
 - Vertical tank or pulse tube / cricket type filter
- **Hydrogenated Oil, Catalyst filter:**
 - Vertical tank or pulse tube / cricket type filter

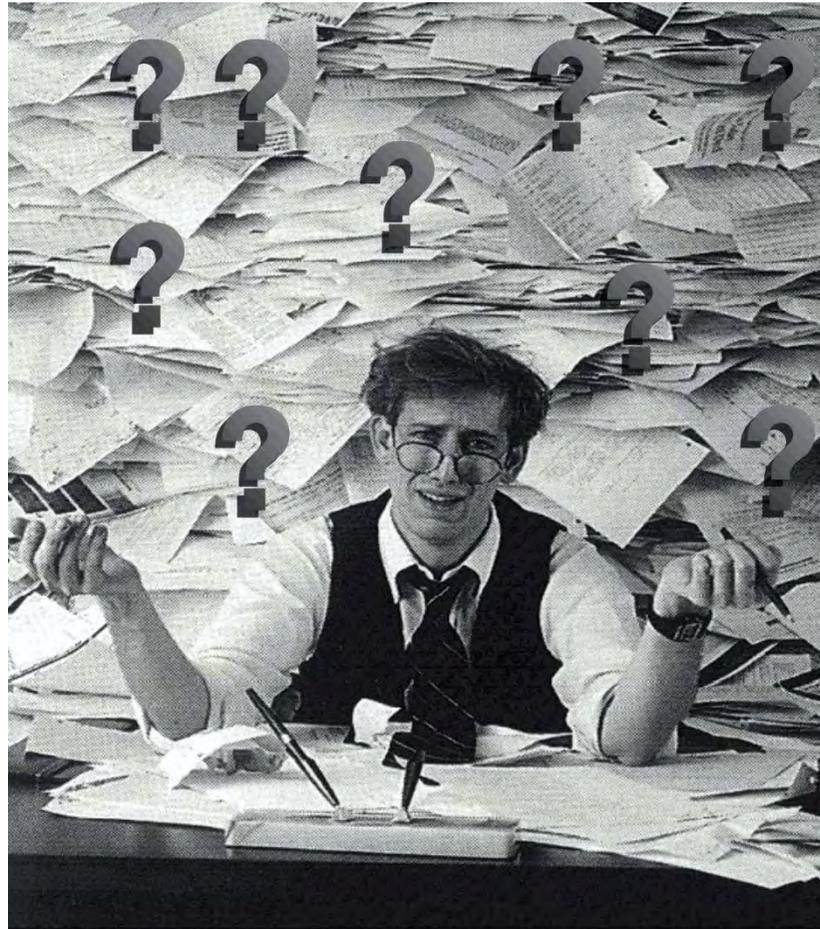


Process leaf filters used in Edible oil and methyl ester applications (2)

- Post bleaching / Post treatment:
 - Vertical tank or pulse tube / cricket type filter
- Winterised Oil filter:
 - Horizontal type filter
- Bio-Diesel / Sterol filter:
 - Vertical tank or horizontal tank type filters

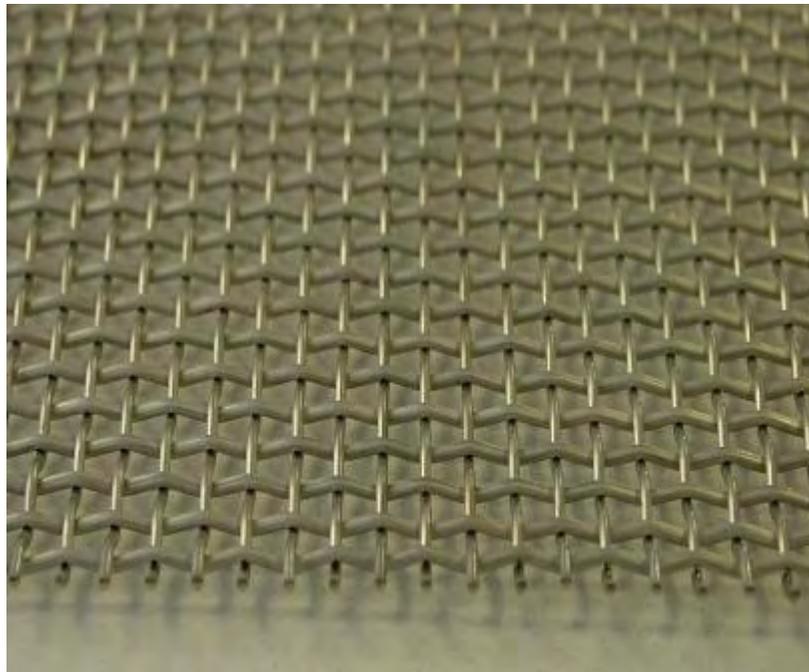


How to select the right type of filtermesh?



Crude oil & winterised oil

- **60 Mesh Plain Weave Filter Screen**
Wire thickness 0.19 or 0.26 mm
Retention approx. 200-240 microns nominal

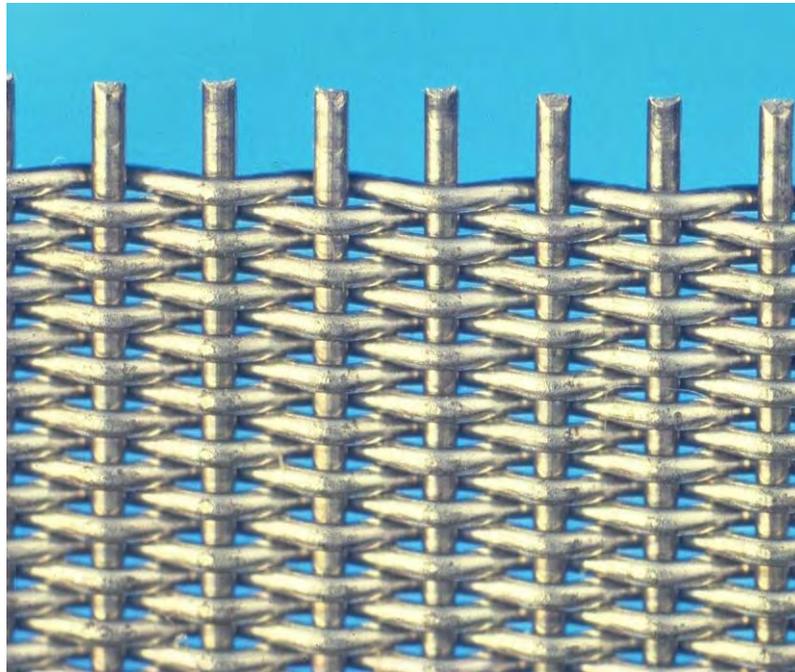


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Bleached, winterised and pre-coated applications

- **24 x 110 Dutch Weave Filter Screen**
Wire thickness 0.36 – 0.26 mm
Retention approx. 120 microns nominal

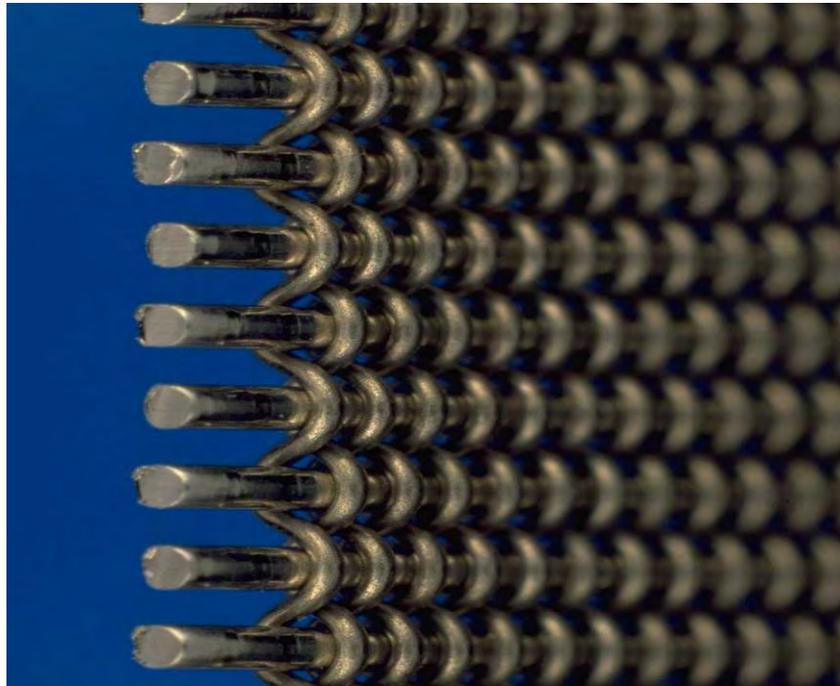


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Bleached with activated carbon or fine clays, hydrogenated, pre-treated with silica and pre-coated applications

- **PZ80S** (Strong) Panzer Weave
Wire thickness 0.2 – 0.4 mm, 3.1 kg / m²
Retention 80 microns nominal



Precoat Filtration

(with separate pre-coat / body feed
or with solids in feed)

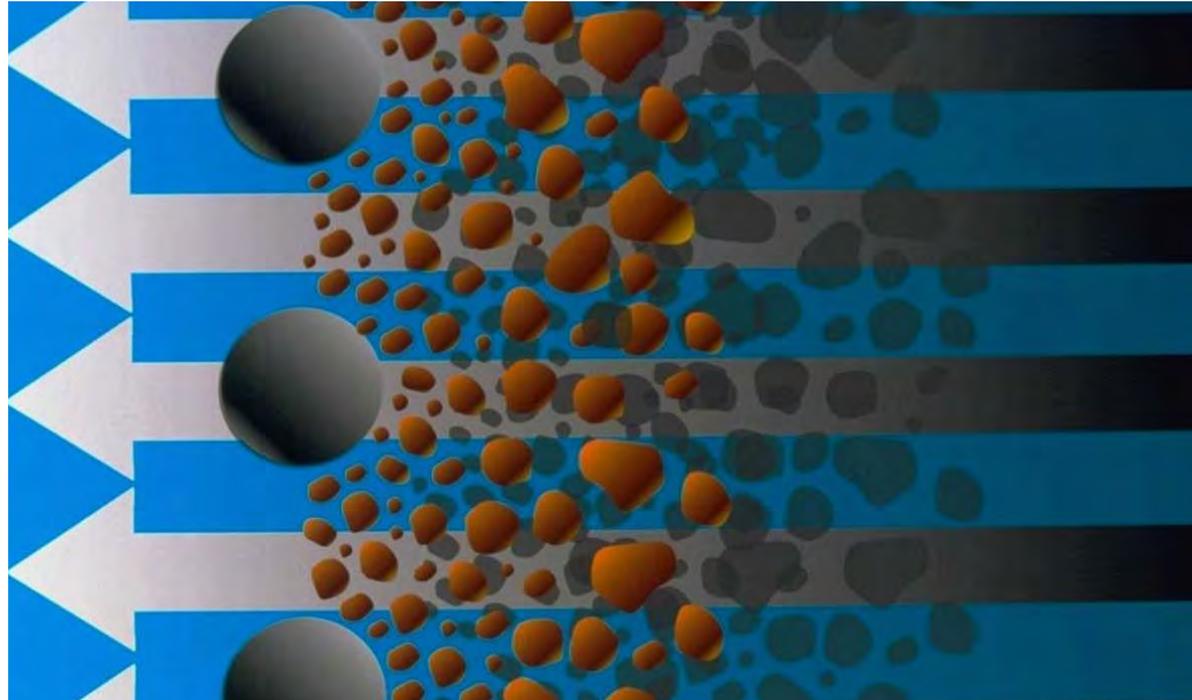
Our main objectives are:

- To provide a septum or precoat layer which is “tight” enough to retain all the suspended solids from the liquid to be filtered
- In addition to provide this same septum with maximum porosity so that the maximum quantity of suspended solids can be retained before the septum becomes blocked, when the septum is blocked cleaning becomes necessary which in turn causes an interruption in flow. Obviously when the suspended solids are smaller in size than the pores of the cake, the solids will pass through. Fortunately filter aid is commercially available in many materials and grades which allow various particle sizes to be retained.

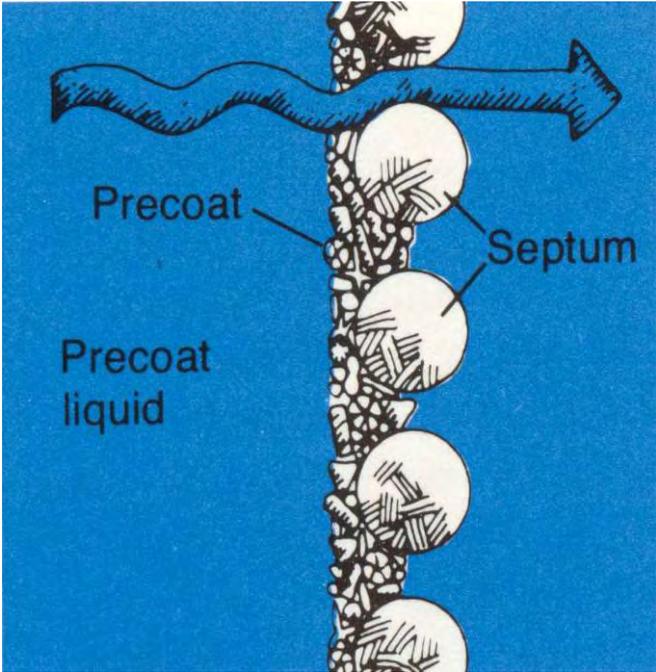




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Pre-coat principle



Typical filtration cycle Edible Oil

Stand-by

Filling

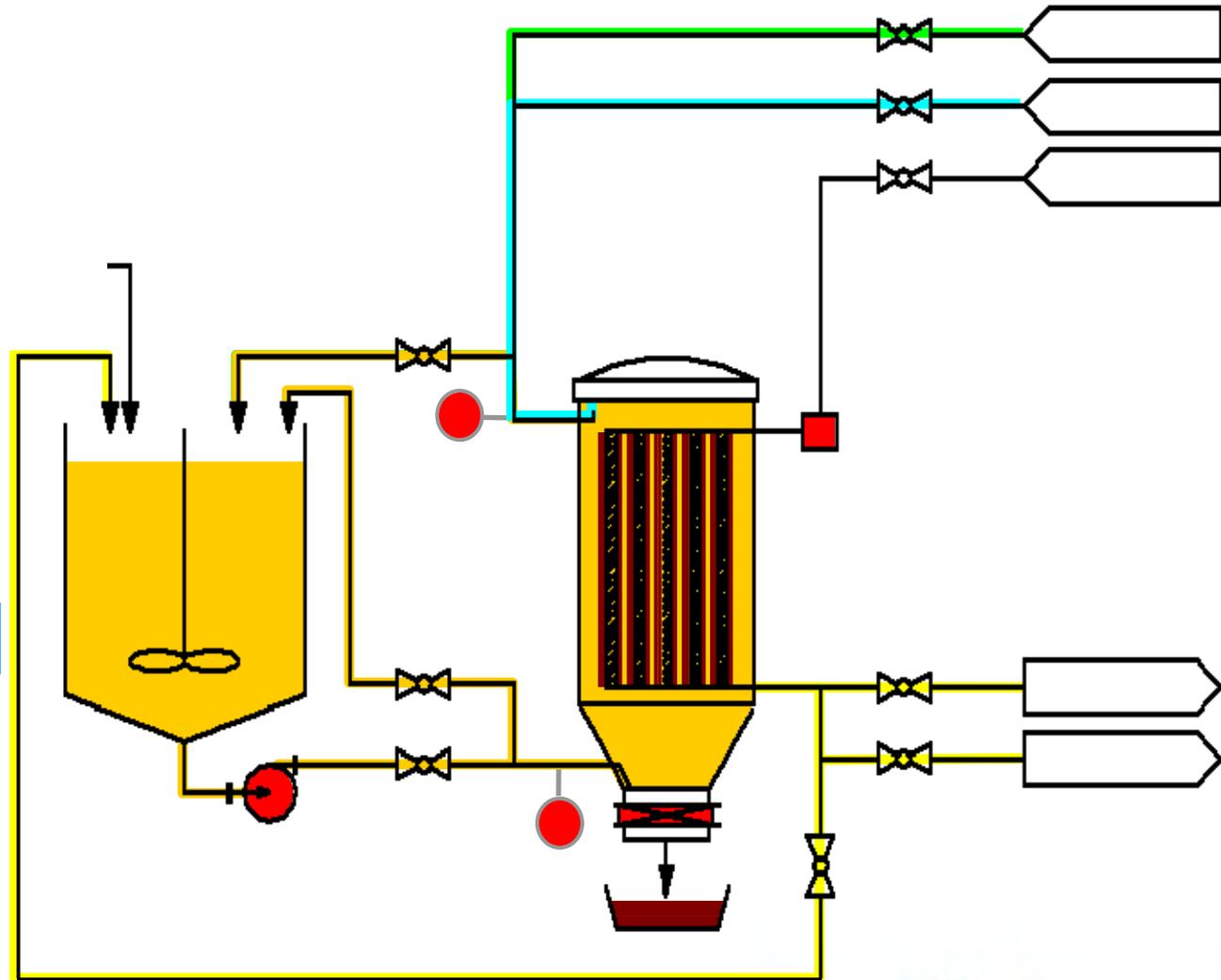
Clarification

Filtration

Draining

Cake drying

Cake discharge

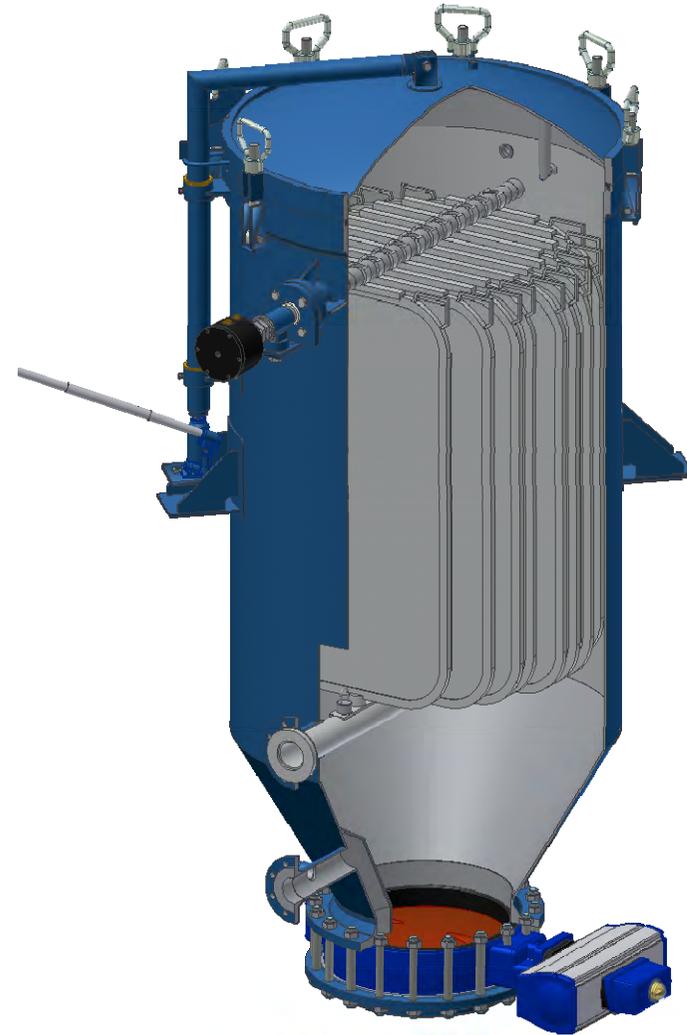
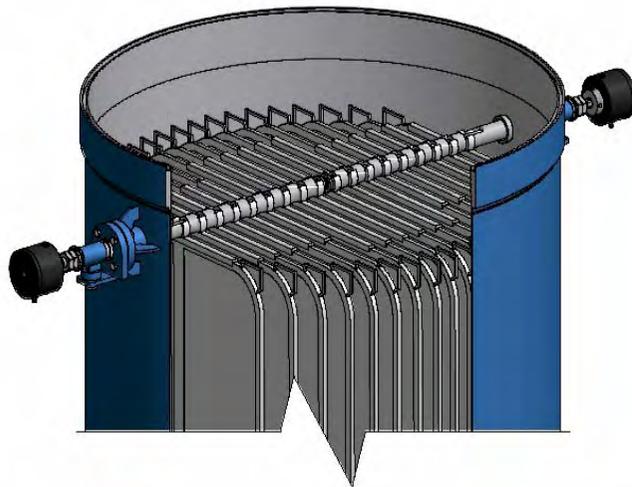


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Vertical Tank Filter

Model Vertical Filter
5 – 118 m²



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Horizontal Tank Filter

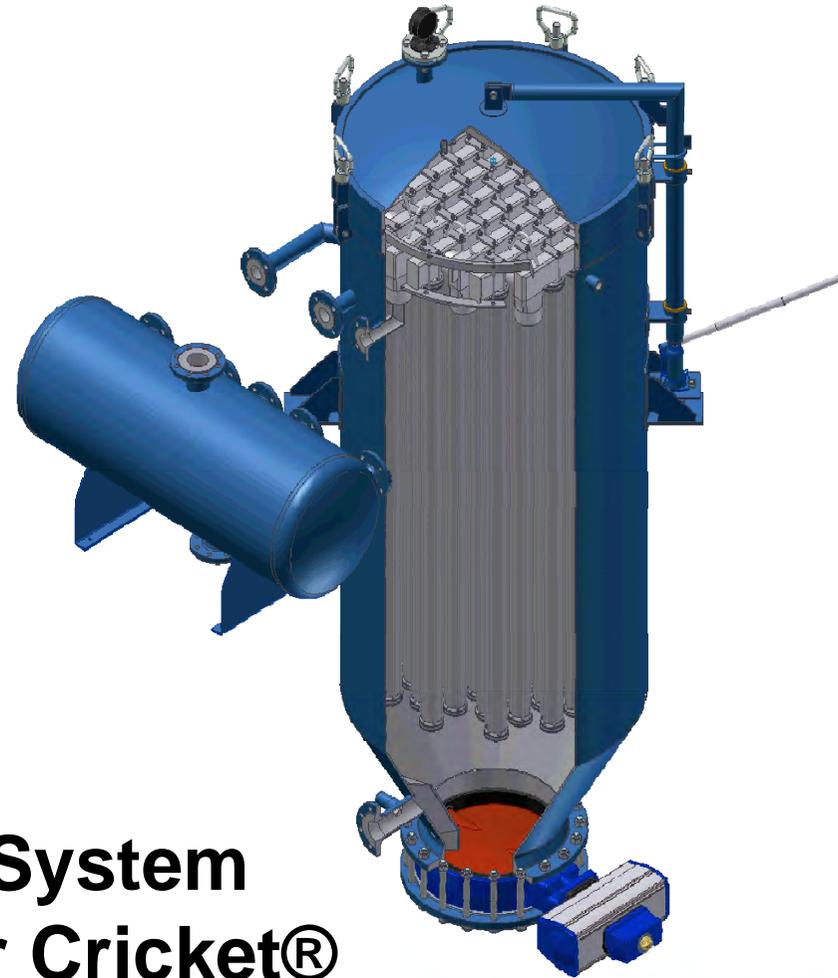


Retractable Bundle Filter
10 – 250 m²

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Tube Tank Back Pulse Filter



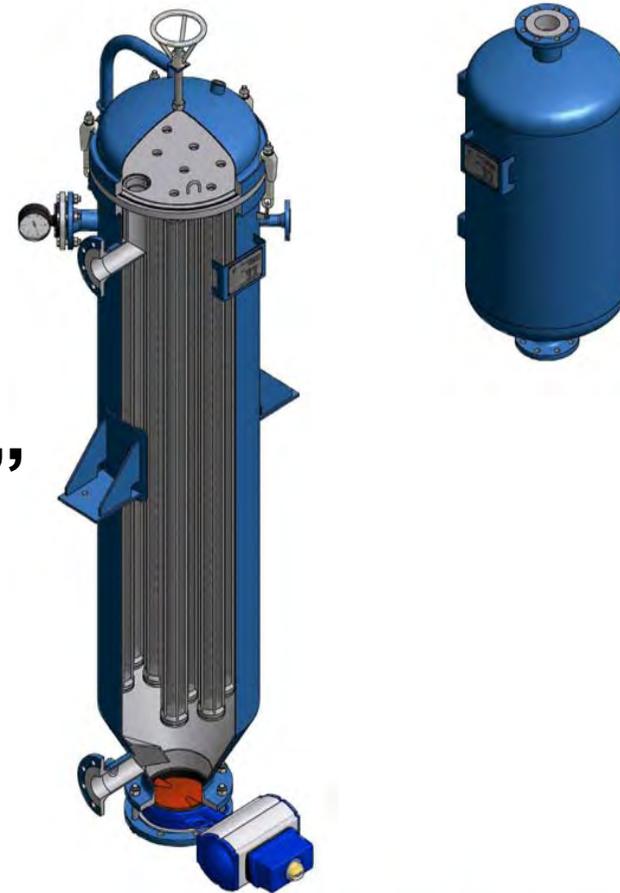
**Pulse Tube System
PTS Filter or Cricket®
2.5 – 100 m²**

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Tube Type Back Pulse Filter

**Model PTSDCD “Heel”
for heel filtration**

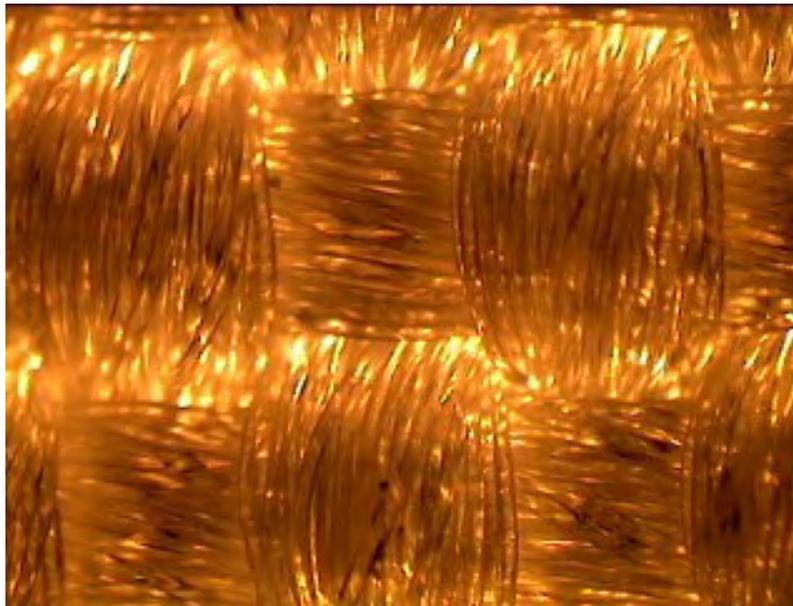


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Filter Media

- Mono filament
- Mono-Multi filament
- Multi filament
- Needle felt



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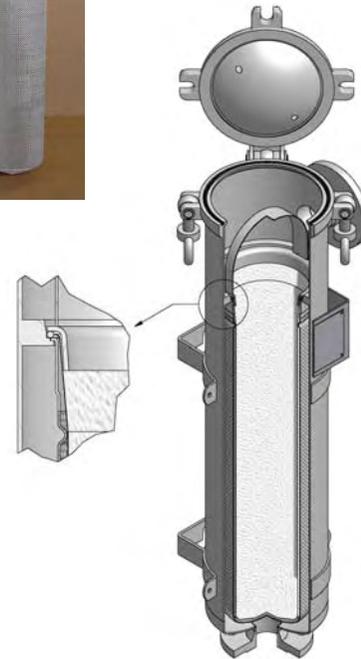
Polishing Filtration



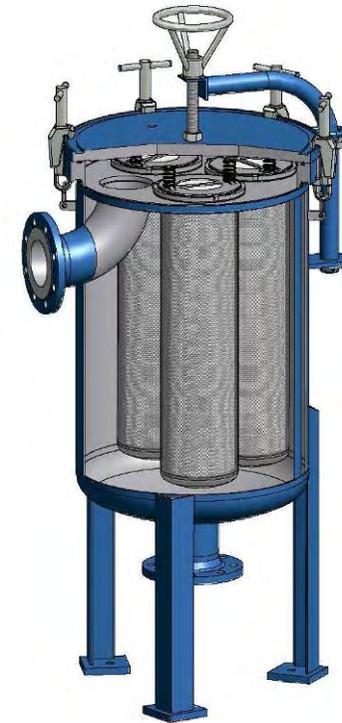
Model Bag type Polishing



Replacement Filterbags /
consumables



Single Bag

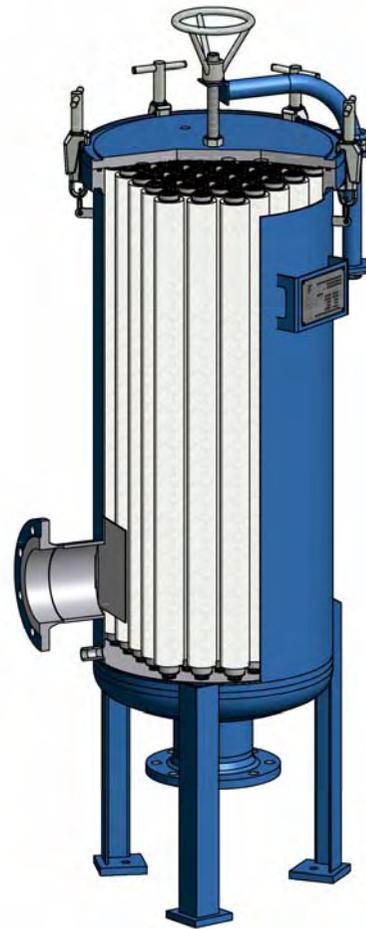


Multi Bag

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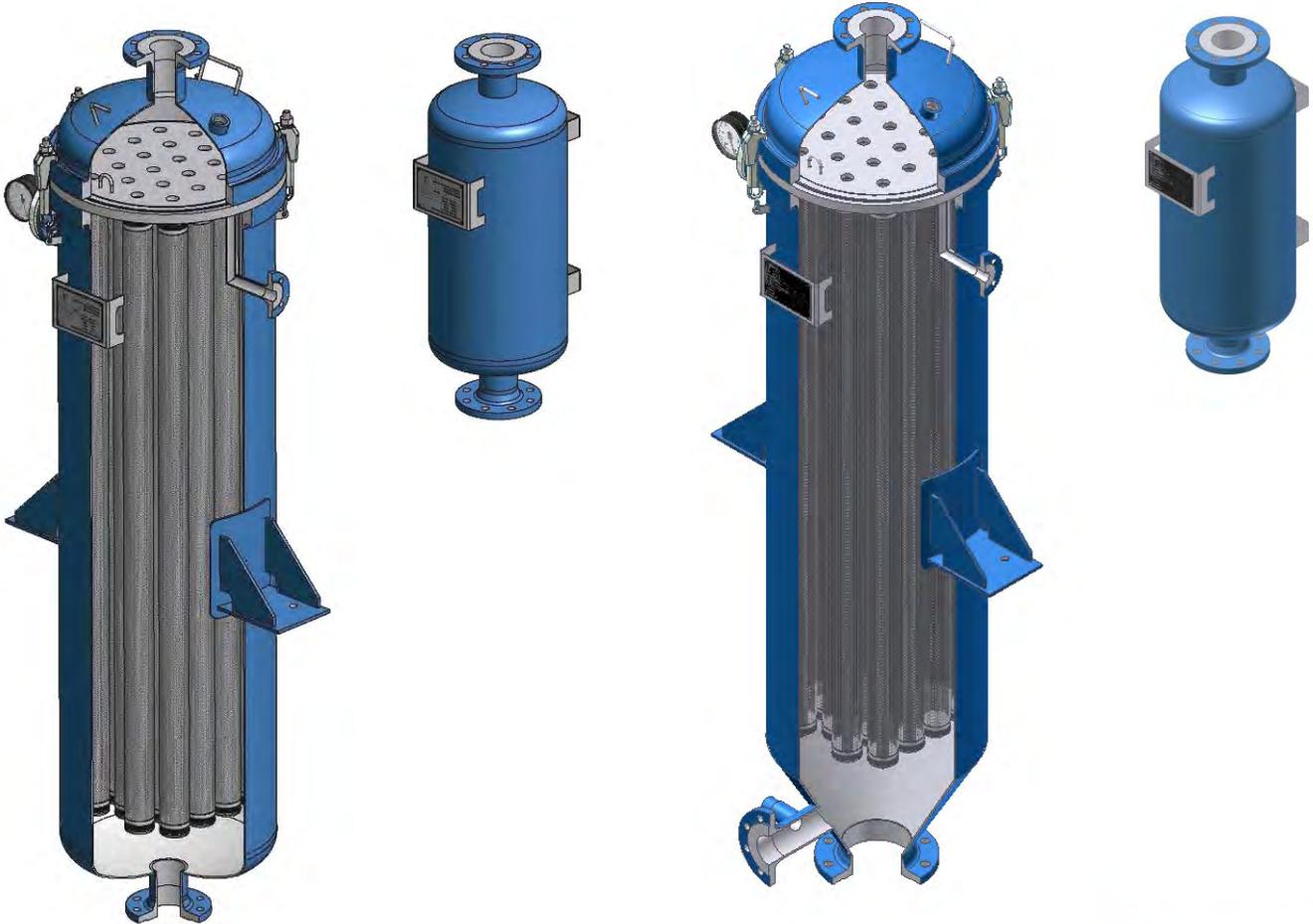
Model Cartridge Polishing Filters



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Model Pulse Tube / Cricket Polishing Filters



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Summary

- Pressure leaf- and tube type filters have become std. equipment in most oil, fat and oleo-chemical plants since they separate with a closed (hermetic) vessel.
- Pressure leaf- and tube type filters can be an integrated part of the automated production process and housekeeping is greatly improved.
- Pressure leaf and tube type filters give clear filtrate with “zero” solids and after proper drying low residual oil content in spent cake.
- Pulse type polishing filter will avoid or minimize expensive consumables used in bag or cartridge type filters.



Filtration tests (1)

- For unknown applications filtration tests should be conducted. This can be either on lab scale or with bigger units on site if required.



Filtration tests (2)



Filtration tests (3)

Available
Nutsch filters
cover large
V/A ratio!

Area = 20 cm²
Volume = 400 ml



Area = 5, 10, 25 cm²
Volume = 5000 ml



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Filtration tests (4)



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For the Best Result in Oil & Fat Filtration

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