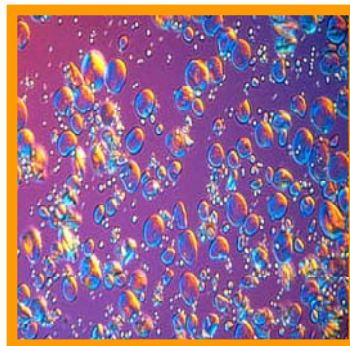
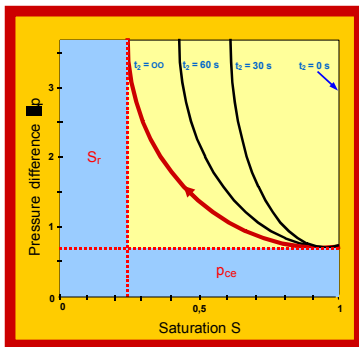


# Starch Dewatering by Hi-Bar Filtration

Dewatering of Starch Suspensions by Continuous Pressure Filtration



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# BOKELA Hi-Bar Oyster Filter

## Continuous Pressure Filtration



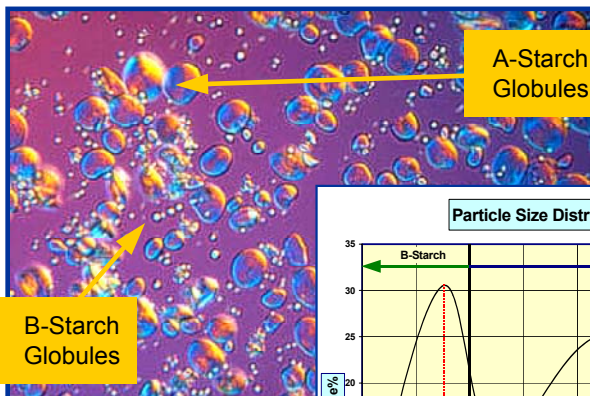
**The Oyster Filter –  
a continuous pressure filter ...**

... especially designed for the **chemical, pharmaceutical, food and life science industry.**

The Oyster Filter is made for applications with:

- valuable products
- fine and difficult to filter particles
- toxic products
- low-boiling suspensions
- frequent product changing
- high quality standards
- extreme process conditions

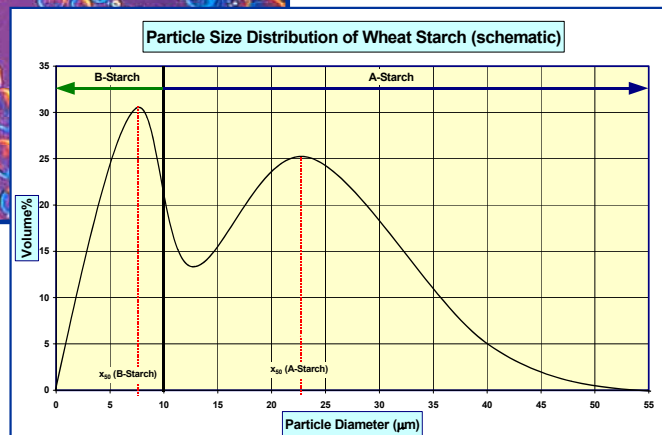
## Basics – The Product



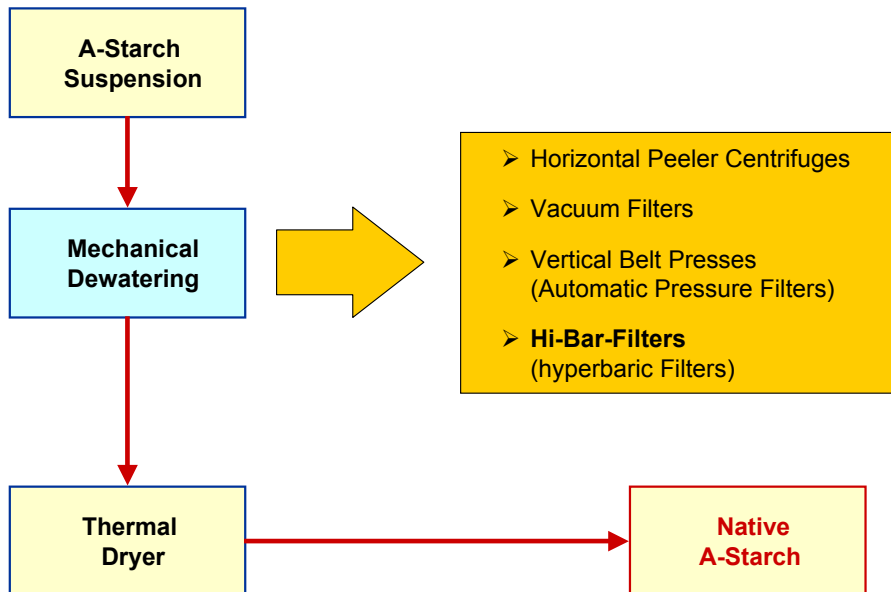
A-Starch Globules

B-Starch Globules

The smaller the particles, the more difficult the solid liquid separation



## Basics – The Process



## Basics – The Objectives



### Good Dewatering (low residual moisture content)

- Energy saving in the succeeding dryer
- Investment saving for new plants (smaller thermal dryer)
- Capacity improvement for existing plants

### High Starch Throughput

- Small apparatus sizes

### Continuous Operation

- Investment saving for peripheral equipment (smaller storage tanks etc.)

Mechanical Dewatering

## Basics – The Equipment



Equipment	Driving force	Dewatering	Throughput	Size	Operation
Horizontal Peeler Centrifuge	800 x g-force (& $\Delta p$ up to 0.9 bar)	38-40% (37-38%)	400-500 kg/m <sup>2</sup> /h	up to 1800 mm diameter	dis-continuous
Vacuum Filter	$\Delta p$ up to 0.7 bar	40-42%	100-200 kg/m <sup>2</sup> /h	up to 100 m <sup>2</sup>	continuous
Vertical Belt Press	$\Delta p$ up to 6 bar	34-36%	50-150 kg/m <sup>2</sup> /h	up to 144 m <sup>2</sup>	dis-continuous
Hi-Bar Filter	$\Delta p$ up to 6 bar	34-36%	600 – 800 kg/m <sup>2</sup> /h	up to 24 m <sup>2</sup>	continuous

## Basics – The Equipment



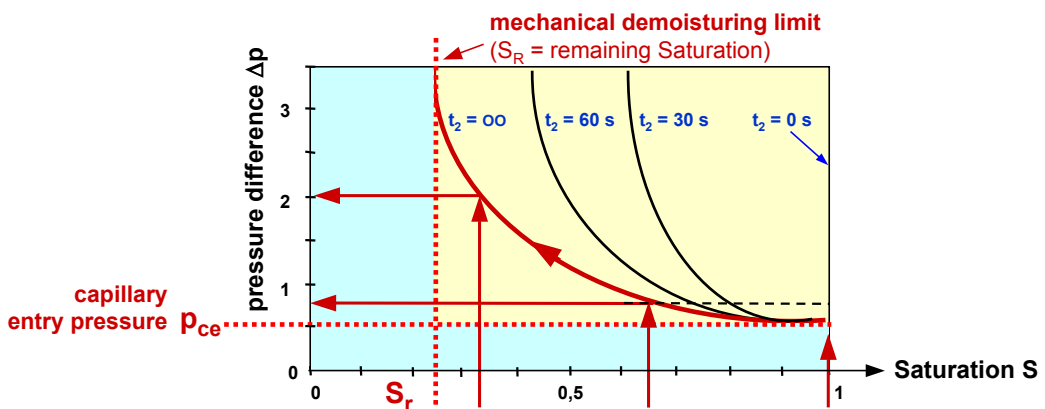
Equipment	Invest cost for Equipment	Invest cost for periphery	Energy cost / Invest cost for thermal dryer
Horizontal Peeler Centrifuge	--	-	-
Vacuum Filter	+	-	--
Vertical Belt Press	-	-	+
Hi-Bar Filter	0	+	+

# Basics – The Equipment

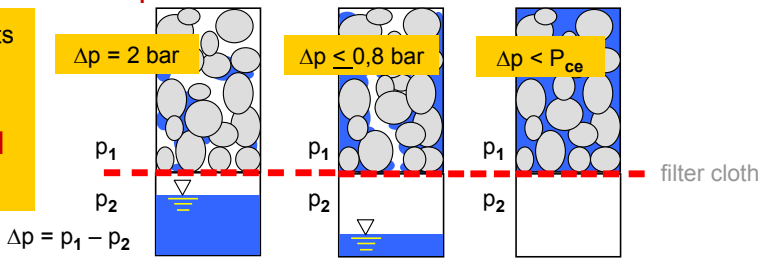


Equipment	Advantages	Disadvantages
Horizontal Peeler Centrifuge	<ul style="list-style-type: none"> <li>➤ Good flexibility to changing products</li> </ul>	<ul style="list-style-type: none"> <li>➤ Residual moisture high</li> <li>➤ Discontinuous operation</li> <li>➤ CIP only limited</li> <li>➤ Throughput limited</li> </ul>
Vacuum Filter	<ul style="list-style-type: none"> <li>➤ Good accessibility</li> <li>➤ Continuous operation</li> </ul>	<ul style="list-style-type: none"> <li>➤ Residual moisture high</li> <li>➤ Large units required</li> </ul>
Vertical Belt Press	<ul style="list-style-type: none"> <li>➤ Residual moisture low</li> <li>➤ High throughput</li> <li>➤ Filtration of modified starches possible</li> </ul>	<ul style="list-style-type: none"> <li>➤ Discontinuous operation</li> <li>➤ Difficult belt alignment</li> <li>➤ CIP only limited</li> <li>➤ Accessibility limited</li> </ul>
Hi-Bar Filter	<ul style="list-style-type: none"> <li>➤ Residual moisture low</li> <li>➤ High throughput</li> <li>➤ Continuous operation</li> <li>➤ Good accessibility</li> <li>➤ CIP</li> <li>➤ Filtration of modified starches possible</li> </ul>	<ul style="list-style-type: none"> <li>➤ Only two operational units installed (but working successfully)</li> </ul>

## Why Pressure Filtration: Low Residual Moisture Content





reduced moisture contents  
(overcoming of capillary forces)  
 $S = f [ (\Delta p - p_{ce}), t_2, \dots ]$



# Why Pressure Filtration: Low Residual Moisture Content



<b>Vacuum Filtration</b>		<b>filter cake: wet and sticky</b>
		<b>mc = 41 %</b>
<b>Hi-Bar Filtration</b>		<b>filter cake: dry (powder like)</b>
		<b>mc = 35 %</b>

# Why Pressure Filtration: High Solids Throughput



$$\dot{M}_s = \dot{m}_s \cdot A_F = \rho_s (1 - \varepsilon) \cdot \sqrt{\frac{2}{\eta_L r_c}} \cdot \sqrt{\kappa} \cdot \sqrt{\Delta p} \cdot \sqrt{\frac{n}{60}} \cdot \sqrt{\frac{\alpha_1}{360^\circ}} \cdot A_F \cdot 3,600$$

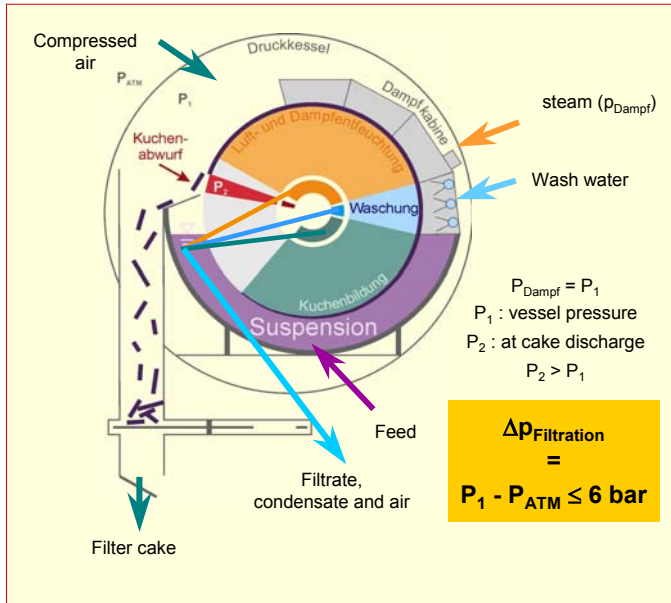
	product parameters	process parameters	machine parameters
<b>product parameters</b>	$m_s$ [kg/m <sup>2</sup> s] $\eta_L$ [kg/ms] $\kappa$ [-] $r_c$ [1/m] $\varepsilon$ [-]	<b>specific solids throughput</b> <b>filtrate viscosity</b> <b>solids concentration coefficient</b> <b>cake resistance</b> <b>porosity</b>	
<b>process parameters</b>	$n$ [1/min] $\Delta p$ [N/m <sup>2</sup> ]	<b>filter speed</b> <b>pressure difference in form zone</b>	
<b>machine parameters</b>	$\alpha_1$ [°] $A$ [m <sup>2</sup> ]	<b>cake forming angle</b> <b>filter area</b>	

# BOKELA Hi-Bar Filtration

## Process and Plant Design



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**Standard design** (large units) with horizontal pressure vessel for bulk materials



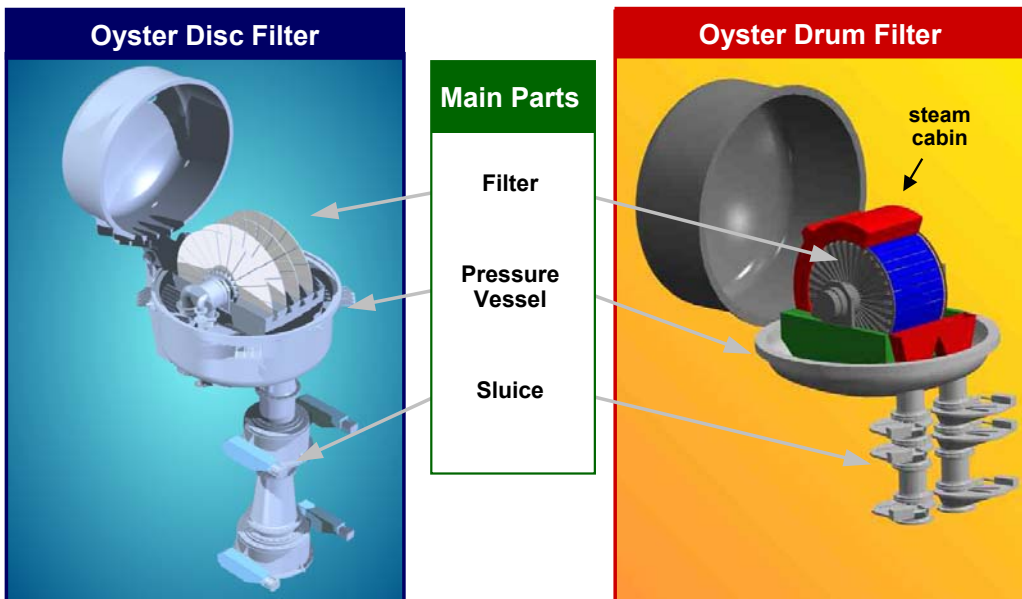
**OYSTER-Design** (smaller units) with vertical pressure vessel for sophisticated applications (chemical, pharmaceutical and food industry)

# BOKELA Hi-Bar Oyster Filter

## Disc and Drum Filter



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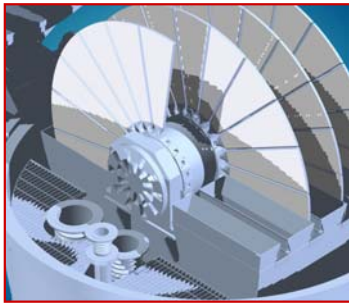


# BOKELA Hi-Bar Oyster Filter

## Exchangeable Filter Cells / Segments



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Disc filter segments prepared for fitting



Drum filter cells

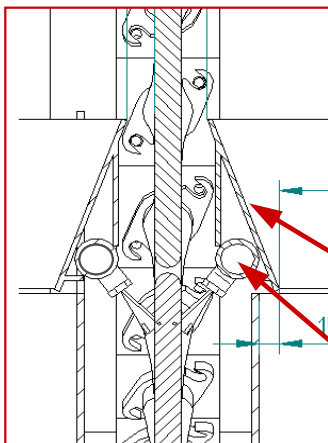
Simple and quick cloth change due to exchangeable filter segments

# BOKELA Hi-Bar Oyster Filter

## Cleaning in Place



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### Enclosed system:

- No emissions to atmosphere or surrounding
- No pollution of product
- Cleaning in Place of complete system possible

deflector plates

Cloth wash bar with nozzle



Several Rotating CIP-Nozzles installed inside the vessel

# BOKELA Hi-Bar Oyster Filter

## Excellent Accessibility - Easy Maintenance



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excellent accessibility for maintenance work by completely hinged pressure vessel – no "release of vessel" inspection required



### Pressure Vessel

- Vertical pressure vessel for optimum accessibility
- Opens and closes automatically
- MOC: stainless steel possible



Hydraulic locking device (Scholz)

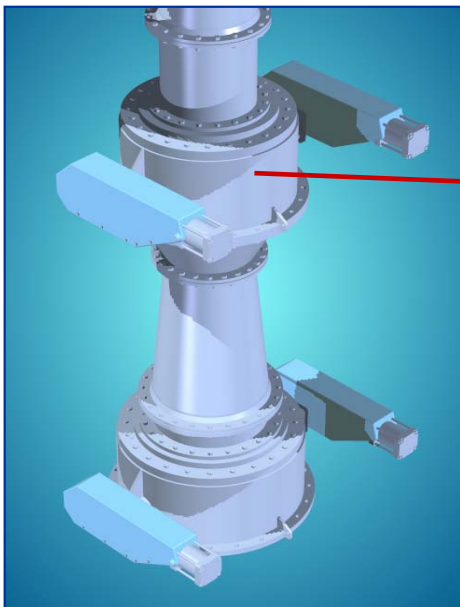
-15-

# BOKELA Hi-Bar Oyster Filter

## Discharge Sluice



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- Sluice with proven and well established valves
- Conical intermediate chamber to avoid bulk bridging
- MOC: Stainless steel
- Heating of intermediate chamber possible
- CIP

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# BOKELA Hi-Bar Oyster Filter

## Sizing



	Type	Diameter	Filter Area	Floor Space
<b>Drum Filter</b>	XS1	0.9 m	1.0 m <sup>2</sup>	2.,2 x 2.4 m
	XS2	0.9 m	2.0 m <sup>2</sup>	2.2 x 2.4 m
	S4	1.4 m	3.6 m <sup>2</sup>	2,8 x 2,8 m
	S5	1.4 m	5.0 m <sup>2</sup>	2.8 x 2.8 m
	M7	1.9 m	6.8 m <sup>2</sup>	3.5 x 3.5 m
	M9*	1.9 m	8.8 m <sup>2</sup>	3.5 x 3.5 m
	M11*	1.9 m	10.8 m <sup>2</sup>	4,5 x 4.5 m
	M12*	1.9 m	12.8 m <sup>2</sup>	4.5 x 4.,5 m

\* no single cell design

	Type	Diameter	Discs	Filter Area	Floor Space
<b>Disc Filter</b>	XS1	2.2 m	1	6.0 m <sup>2</sup>	3.5 x 3.5 m
	XS2	2.2 m	2	12.0 m <sup>2</sup>	3.5 x 3.5 m
	XS3	2.2 m	3	18.0 m <sup>2</sup>	3.5 x 3.5 m
	XS4	2.2 m	4	24.0 m <sup>2</sup>	3.5 x 3.5 m

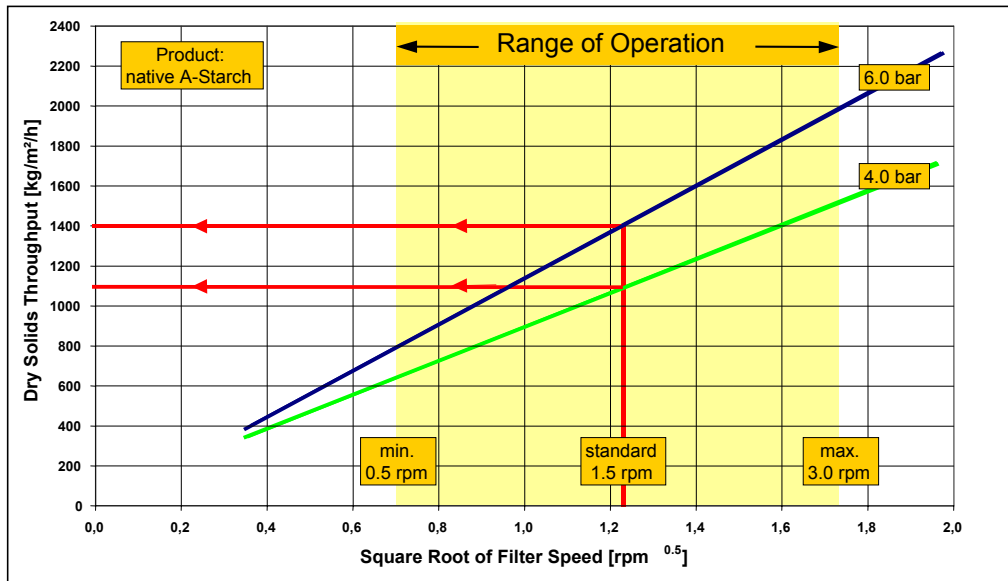
# BOKELA Hi-Bar Filtration

## Performance Data



	$\Delta p$	Specific troughput		Cake moisture	Filter speed	Filter area for 200 to/d	Filter type
		[bar]	[kg/m <sup>2</sup> /h] min				
Native A-Starch	4	650	1550	35.8	0.5 – 3.0	6.8	Oyster disc XS2
Native A-Starch	6	800	1980	34.8	0.5 – 3.0	5.3	Oyster disc XS1 or Oyster drum M7
modified A-Starch	6	380	690	34.7	1.0 – 3.0	15.6	Oyster disc XS3

# BOKELA Hi-Bar Filtration Performance Diagram



# BOKELA Hi-Bar Oyster Filter In Brief



- Low residual moisture
- High specific throughput
- Continuous filtration process with disc- or drum filters, installed inside a pressure vessel
- High filtration pressure difference of up to  $\Delta p = 6$  bar
- Complete cake discharge by air-blow-back with snap-blow valve (blow-off air serves for the filtration process)
- Enclosed system
- Good accessibility
- Simple maintenance
- Simple and quick filter cloth change due to filter segments / cells
- High flexibility at fluctuating product properties by
  - Variable cake formation angle (adaptation during operation)
  - Variable cake thickness from 5 to 50 mm
  - different pressures in single process zones possible
- Available in a wide range of filtration area and throughput



[www.bokela.com](http://www.bokela.com)

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