Sep 9, 2025

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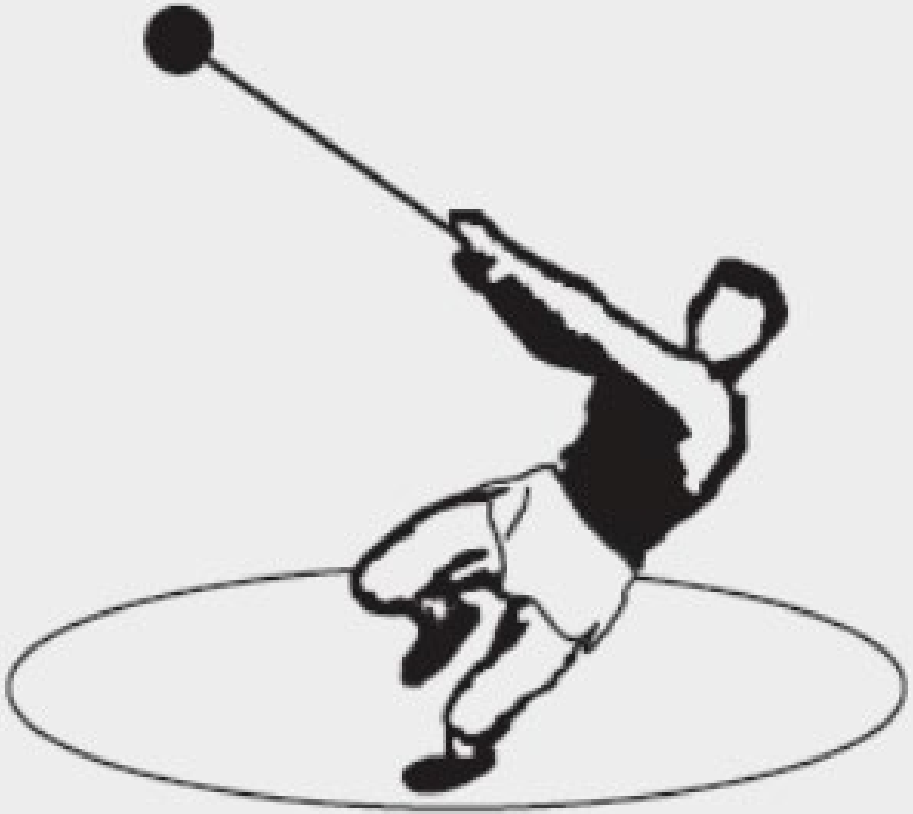
Separation for Life

Biotech separation seminar in Taiwan

09 September 2025

Classified by Alfa Laval as: Business

Content

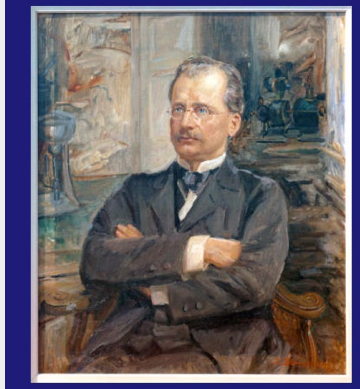


Seminar for separation challenge in biotech applications

- Alfa Laval company brief
- Alfa Laval involvement and perspective for Biotech market trend
- General separator applications
- Separation challenges in Biotech application
- Alfa Laval solutions and products
- Q/A

Who are we?
What can we do?

Gustaf de Laval (1845-1913)
Founder of Alfa Laval company



"The man of high speed"

- 200 projects and inventions
- 92 patents, including the milk separator (1878) and the steam turbine (1883)

Genentech
A Member of the Roche Group
AMGEN
sanofi
janssen
Lonza
Pfizer
Boehringer Ingelheim
mAbxience
From lab to life
Takeda
sinovac
Daiichi-Sankyo
ABZENA
Enabling better biopharmaceuticals
teva
ADM
leidos
WuXi Biologics
Global Solution Provider
3PBIOVIAN
abbvie
KYOWA KIRIN
SYNBIO TECH.
Better Probiotic Better Life
cytiva
AVID BIOSERVICES
CHR HANSEN
FirGenix
AstraZeneca

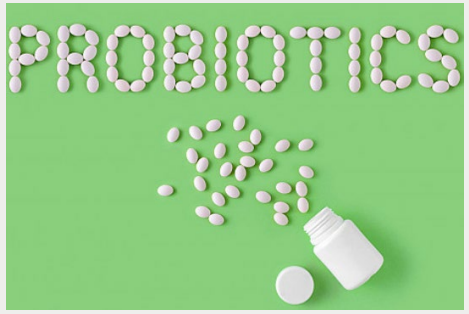
Market we are working for

Biotech market

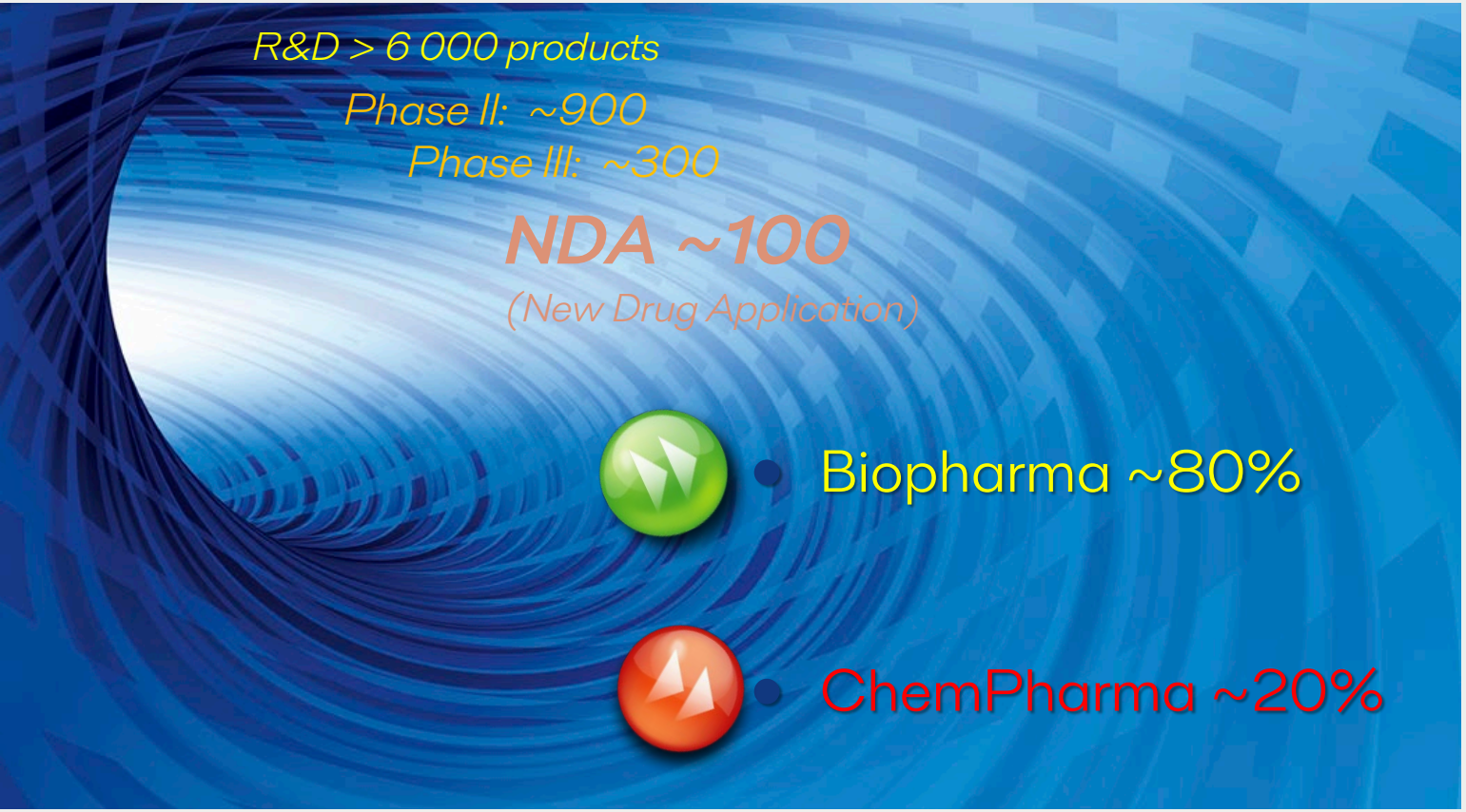
Biopharma & pharma
- Antibiotic
- Insulin, GLP-1
- Human vaccine
- Animal vaccine
- Interferons
- Growth factor
- Therapeutic enzymes
- Antisera

Starter and probiotics
- Starter culture
- Probiotic for human
- Probiotic for animal

Cultivated meat and cosmetic
- Beef
- Chicken
- Fish
- Collagen



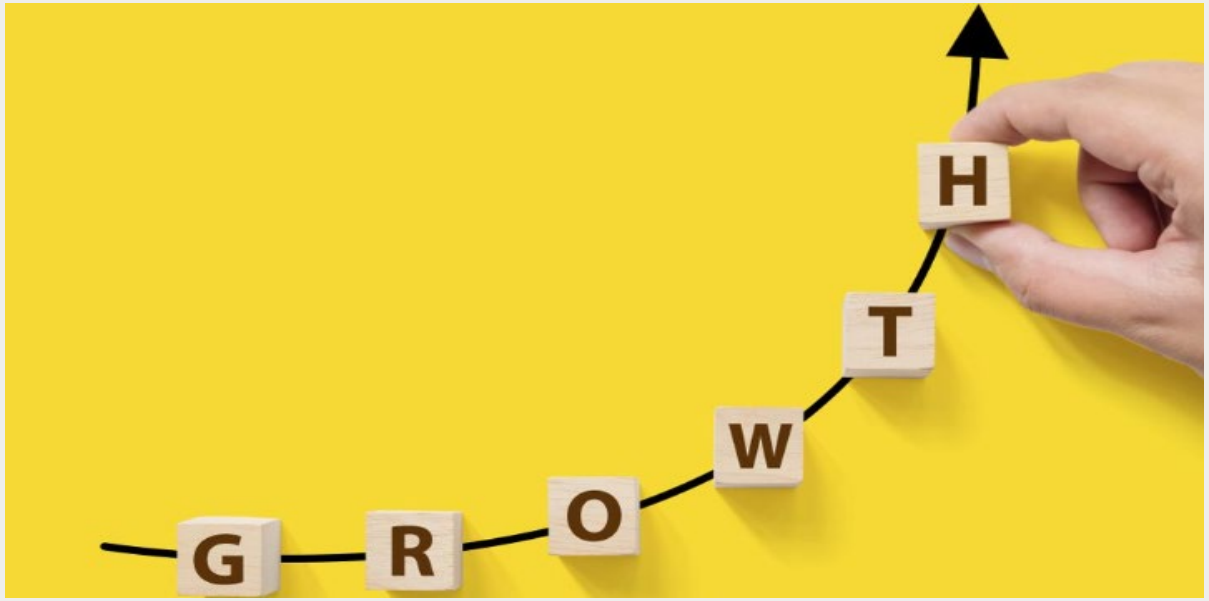
Our view of Technical trend



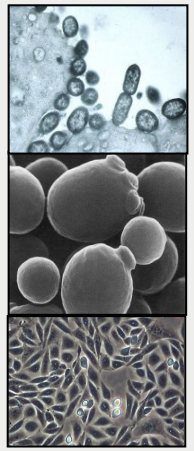
Our view of Market driver

A very essential, fast and profitable market

- Market driver by improving of awareness of healthcare and people become rich to improve the healthcare awareness.
- Higher demands to the animal product (egg, milk and meats)
- Food safety
- Aging population
- Higher profits
- Compound Annual Grow Rate (CAGR) >10% during 2025-2030.



General biotech Process

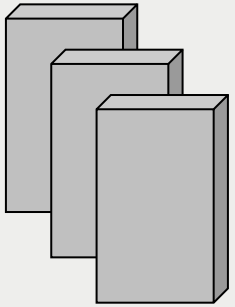


E-Coli
Yeast
Mammalian cell

Fermentation

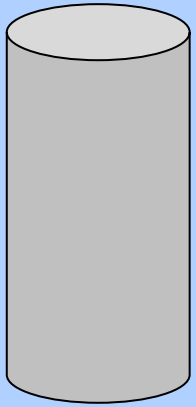
Separation
-harvest cell
-clarify broth

Extraction
-Lysis
-Sedimentation
-Precipitate



Purification and Concentration
-Chromatography
-Crystallization

Starter & Probiotics



dry
Spray dry
Fluid bed dry
Freeze dry

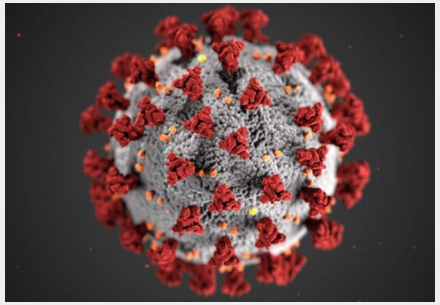
Freezing
Deep frozen (-40 °C)
Ultra low temp (liq N_2, -196 °C)

Immobilization
Ca-alginate beads
(Lc Lactis, cont fermentation)

Expression system

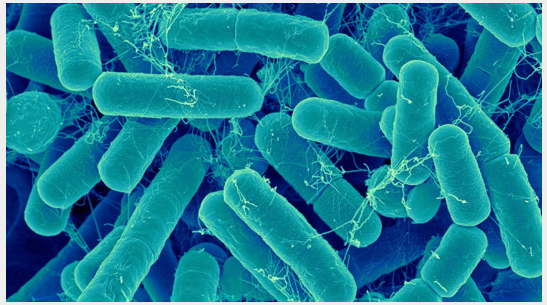
Virus

vaccine



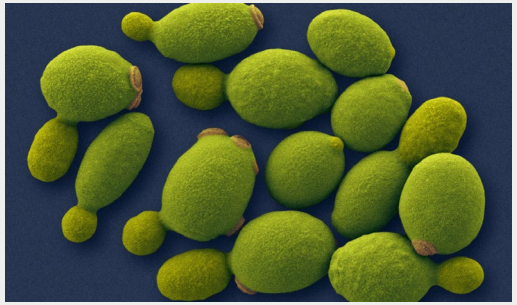
Bacteria

Vaccine, growth factor

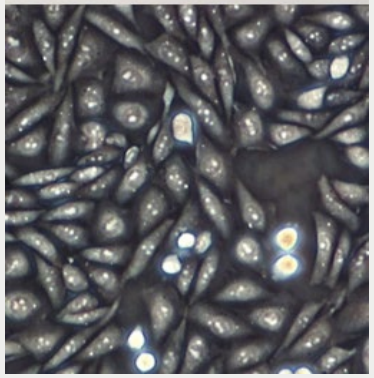


Yeast

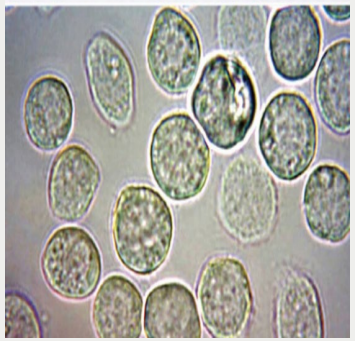
insulin



Mammalian cell culture
mAB



Insect cell culture
vaccine



Expression ways

Extra cellular

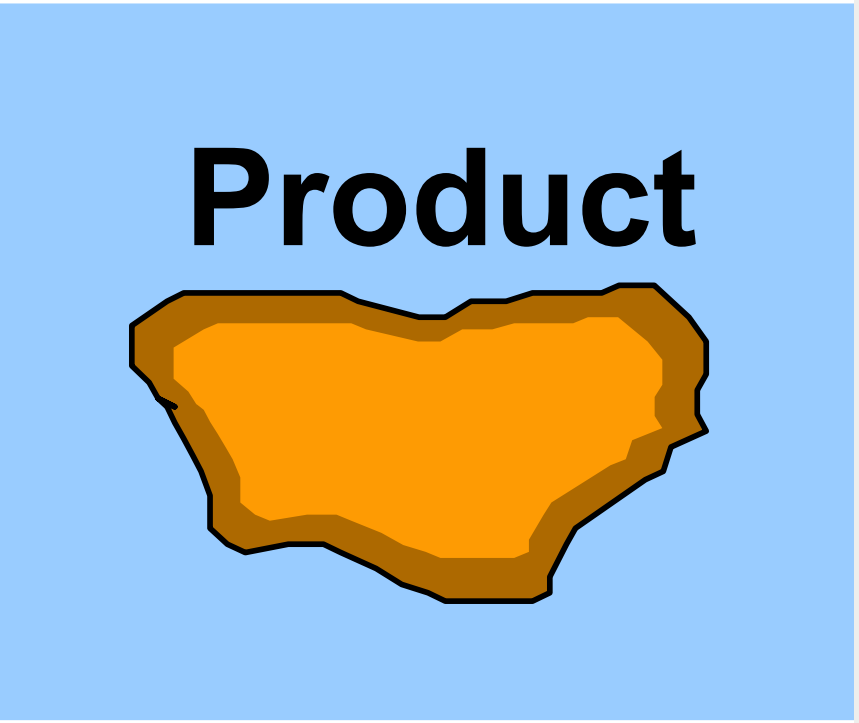
Product is in outside of cell

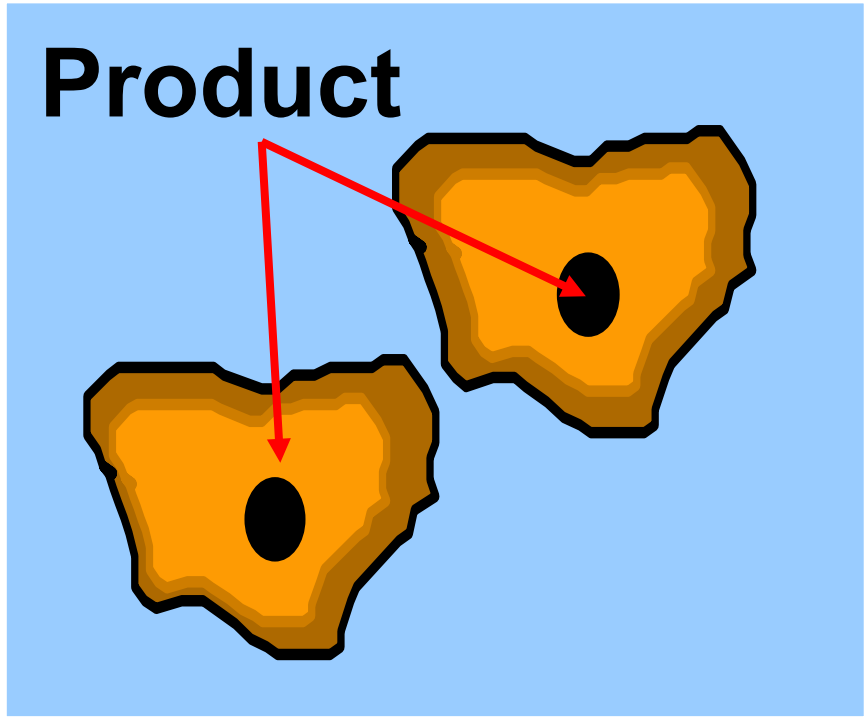
Intra cellular

Product is inside of cell

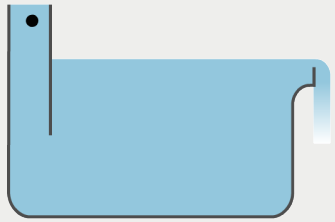
Inclusion body

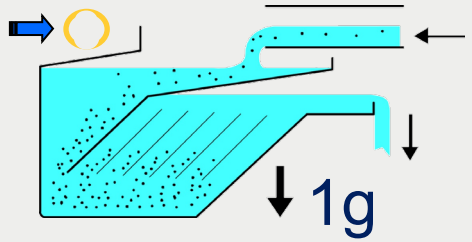
Product is inside of cell but it’s particle





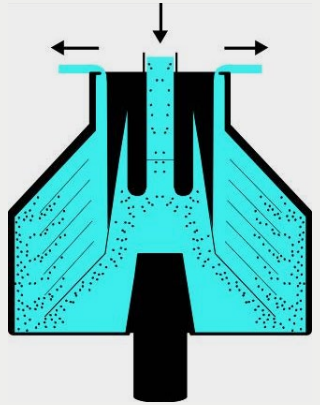
Separation in biotech





Classic and sustainable

- Disc stack separator is **efficient separation technology, big in capacity, and low in operation cost**
- High speed disc stack separator is a centrifuge for liquid-solid, liquid-liquid, liquid-liquid-solid **mechanical separation**
- It's a unique separation equipment based on settlement theory. It's often to see other technologies in biotech factories -
    - Filtration. Like hollow fiber filter, membrane filter
    - Tubular centrifuge
    - Chromatography



>5000g

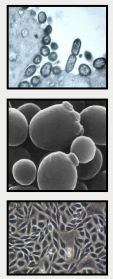
Alfa Laval

Extracellular

Target product (protein) is in outside of cell

Typical for:

mAB,
antibiotic,
amino-acids

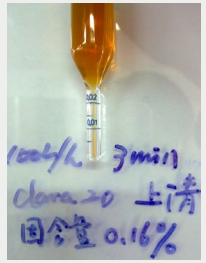


Fermentation

Fermentation broth

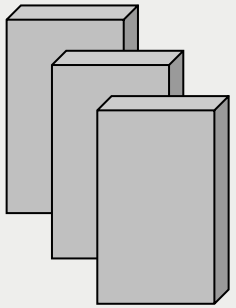
Product

Clarification



Supernatant

Purification

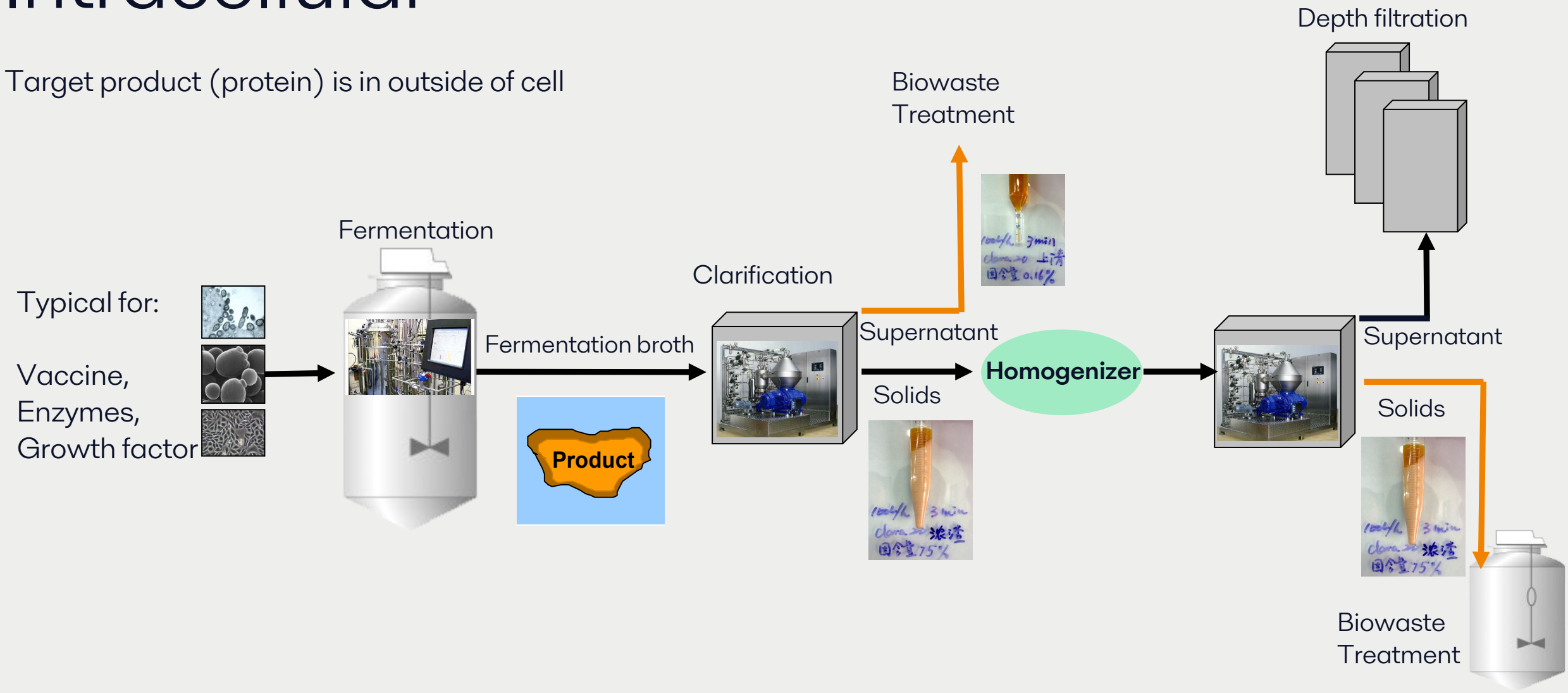


Solids

Biowaste
Treatment

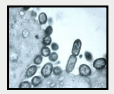
Intracellular

Target product (protein) is in outside of cell



Inclusion Body

Target product (protein) is in outside of cell

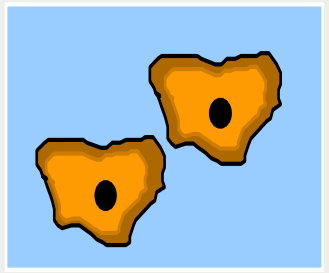


Typical for:

Insulin
GLP-1
Bioplastic

Fermentation

Fermentation broth



Clarification

Supernatant

Solids

Homogenizer

Lysate

Supernatant

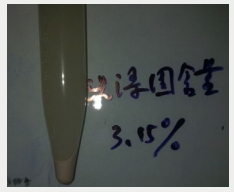
Solids

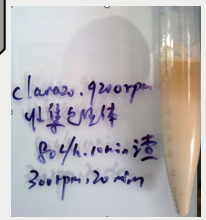
Buffer
Washing

Biowaste
Treatment

Solids

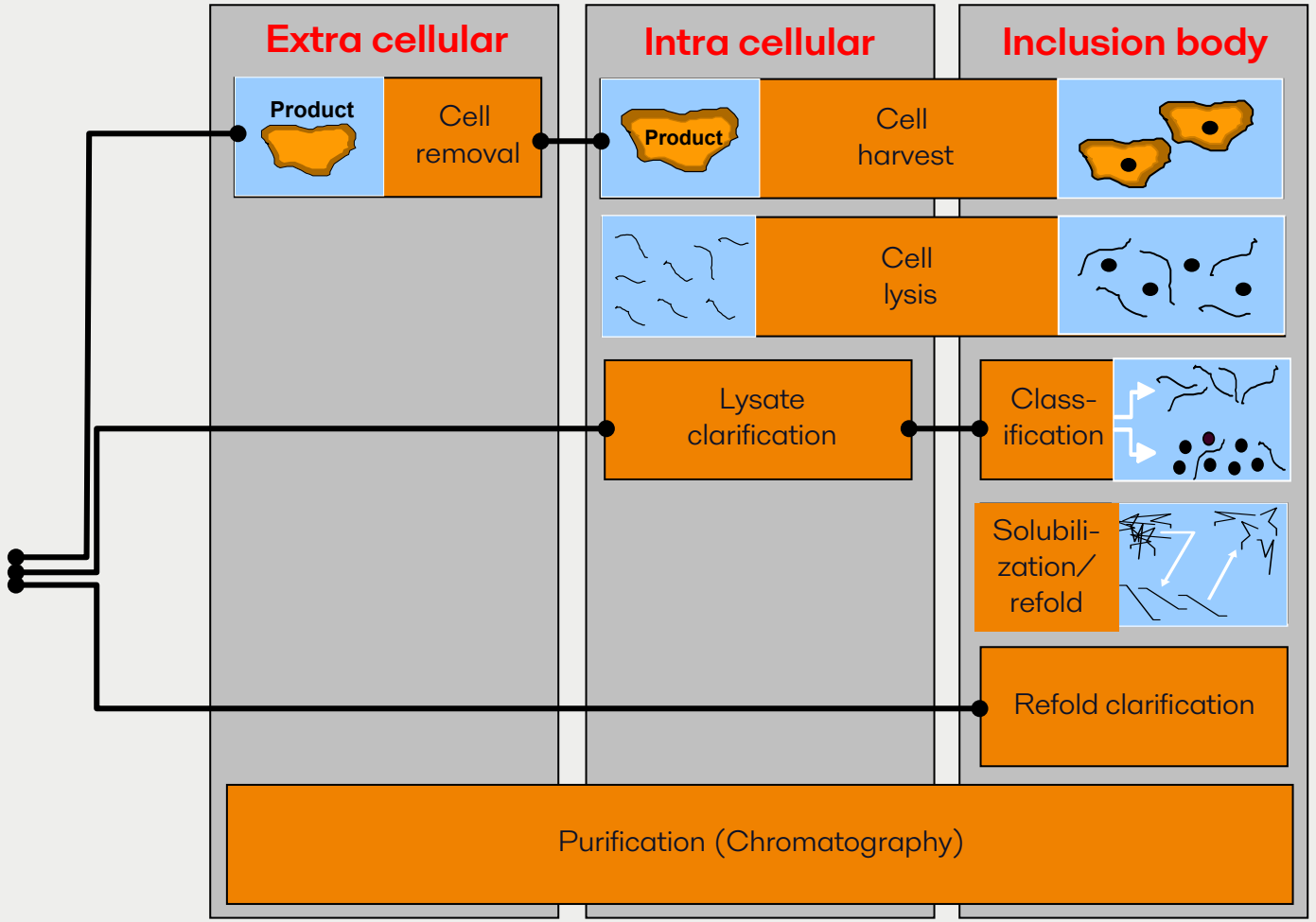
Inclusion Body To Purification





Summary of separation duty

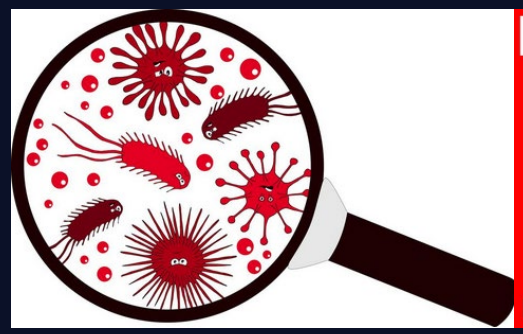
Only for liquid and solid separation

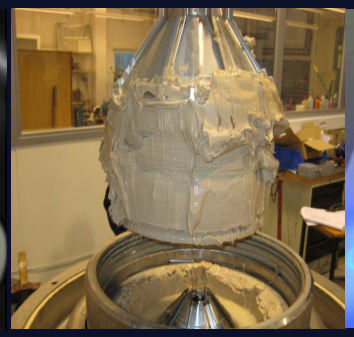


Challenges

Challenges to disc stack separation

1. Separation efficiency
2. Shearing force sensitive separation
3. Keeping viability
4. Multi-products share one equipment
5. High fermentation density tender
6. Clean and validation to separation system





Alfa Laval contribution

09 September 2025

Alfa Laval contribution

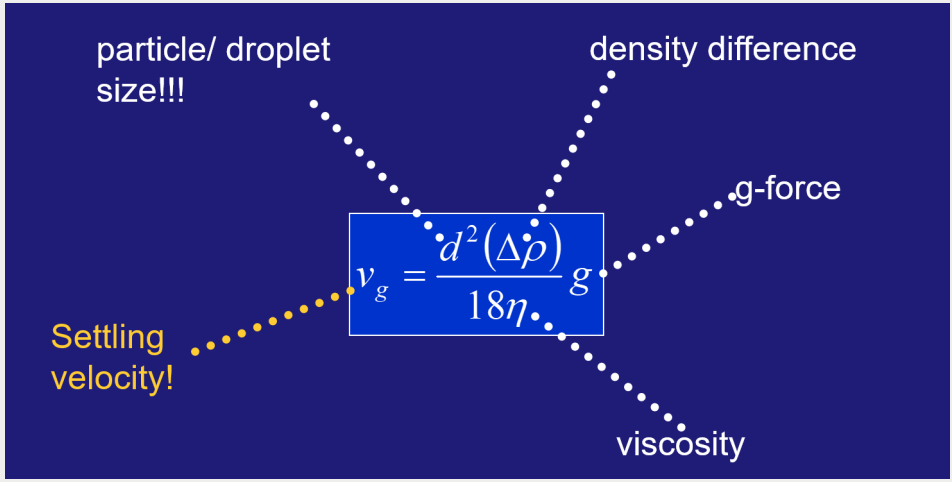
Alfa Laval can provide unique solution to help customer to optimize the performance.

Alfa Laval solution focus on:

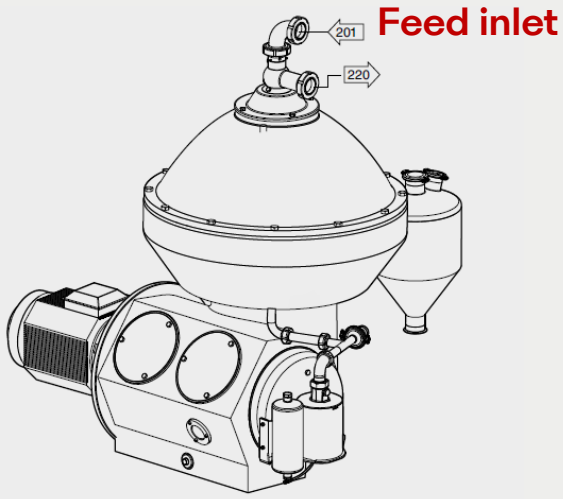
- improve the separation efficiency
- reduce shearing force to keep whole cell separation
- Less power consumption and friendly to use
- more aseptic operation

Different product (1)

Different feed structure
higher separation efficiency in bottom feed machine due to lower shearing force to keep intact cell separation.



Top feed

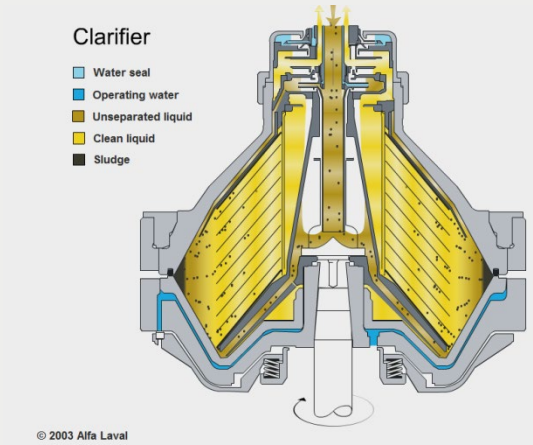


Bottom feed

Different product (2)

Different of solid discharge system

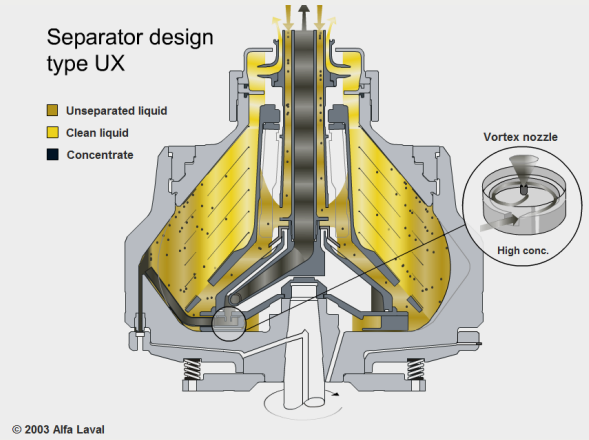
PX



Intermittent solid discharge

Typical apply for low fermentation bacteria separation

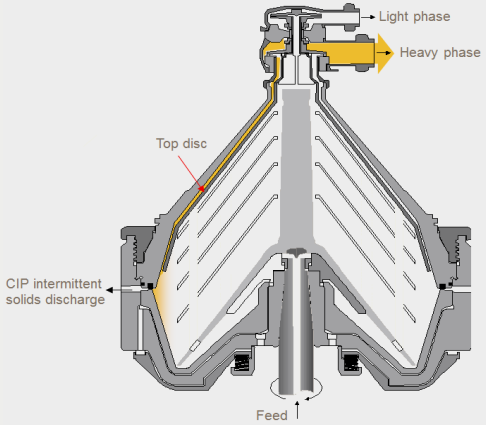
UX



Continuous solid discharge

Typical apply for Pichia yeast, probiotics separation and high feed PCV duty

Bactofuge



Continuous solid discharge

Typical for mammalian cell culture, higher fermentation bacteria, probiotics separation

Different product (3)

The difference investment level

Clara series

CLARA 200 (VNPX 810)

Investment level x 1

MB series

MBPX 810

x 5

BT series, 121dC SIP-able

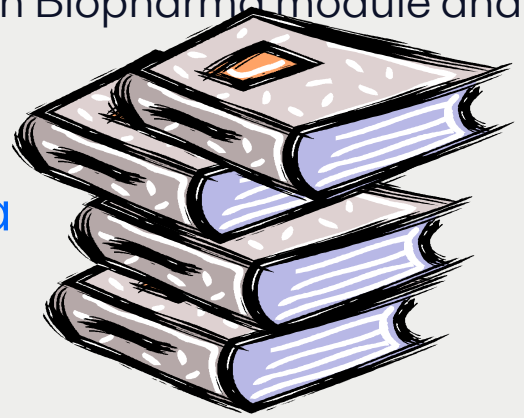
BTPX 810H

x 10

Documentation/validation

Difference between Biopharma module and food module

Biopharma



- **Separation system directive and instruction**
- **System manual**
- **Test report and validation**

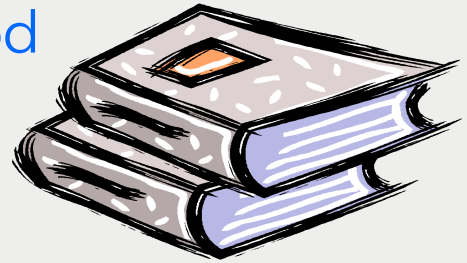
Certificate (GMP document package)

- **Separator/Module/components**
- **Electric and pneumatic element**
- **Software**
- **Welding**

Validation documents

- **FAT**
- **SAT**
- **CIP validation**
- **IQ/OQ**

Food



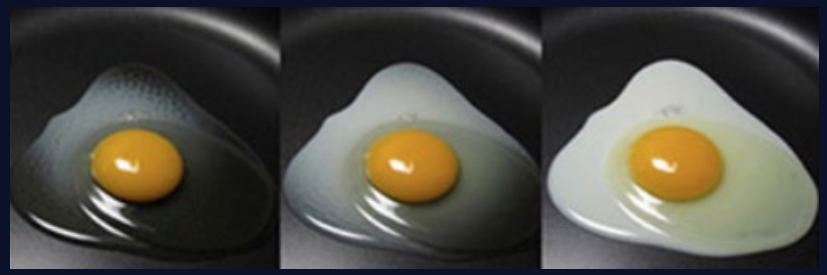
- **Installation and operation instruction**
- **Separator manual**
- **Module manual**
- **Electric drawing**
- **Test report and certificate**

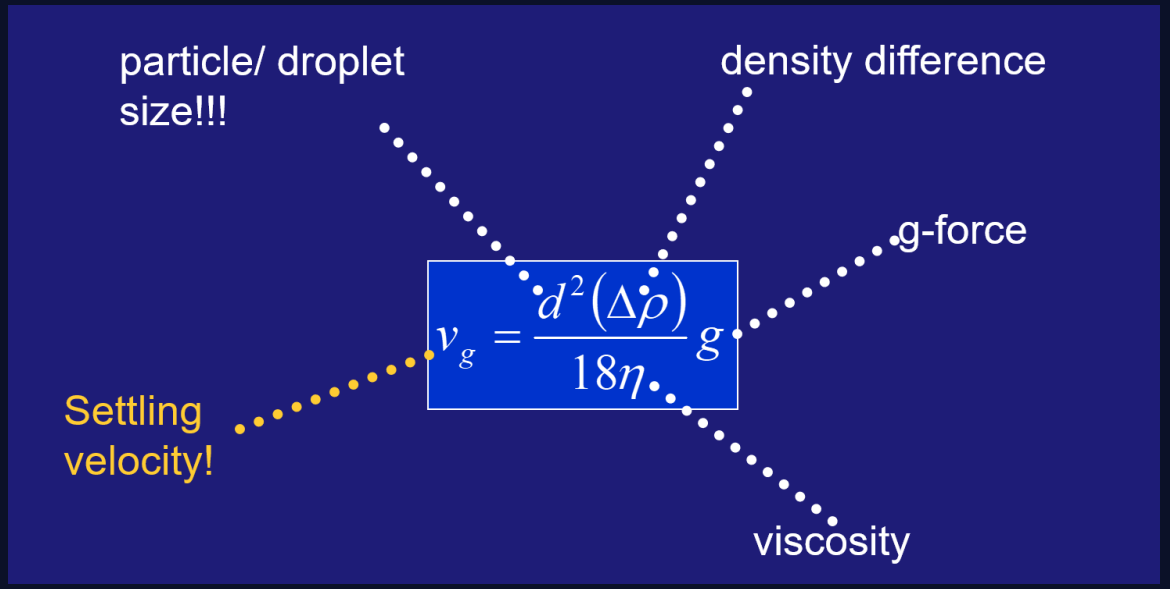
Higher cost for these documentation and validation protocols and longer lead time.

Challenges for intracellular

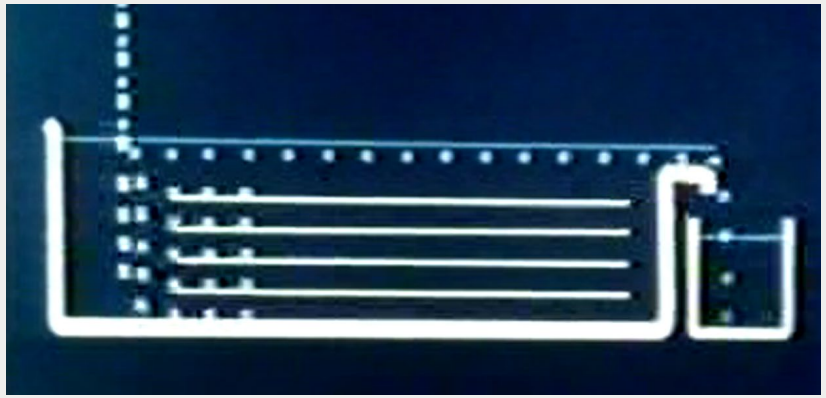
Separation efficiency and temperature

- Product is in liquid phase
- Cell debris is very small (<0.5um), it's very difficult for separation
- Low feed flow to generate high temperature up to denature the protein and clean issue



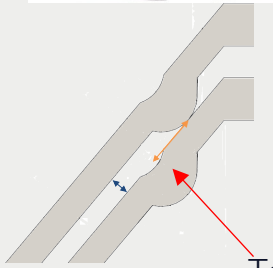


UniDisc™



Traditional disc

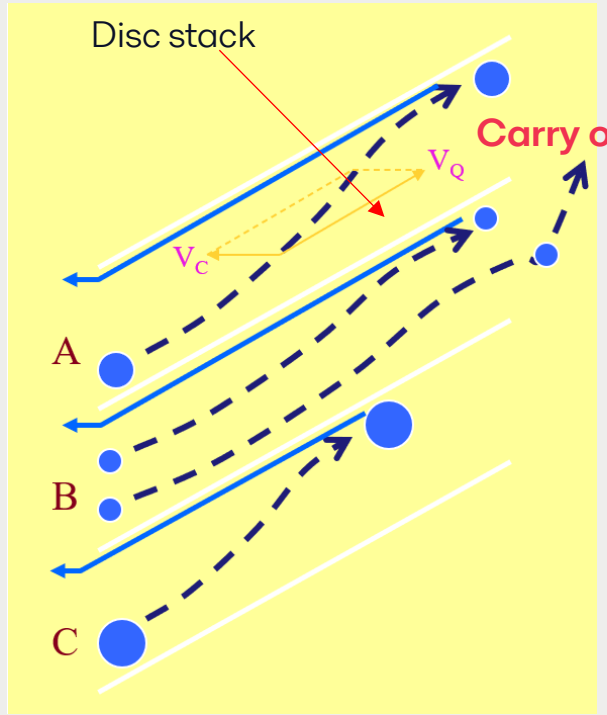
Alfa Laval Unidisc



Total ~1400 spots
on one disc surface

UniDisc™, a unique Alfa Laval design of separator disc stack

- New generation disc stack with patented integrated caulk design
- Enhance the small particles capture capability due to even short settlement distance
- Free gap between each disc become easier for CIP

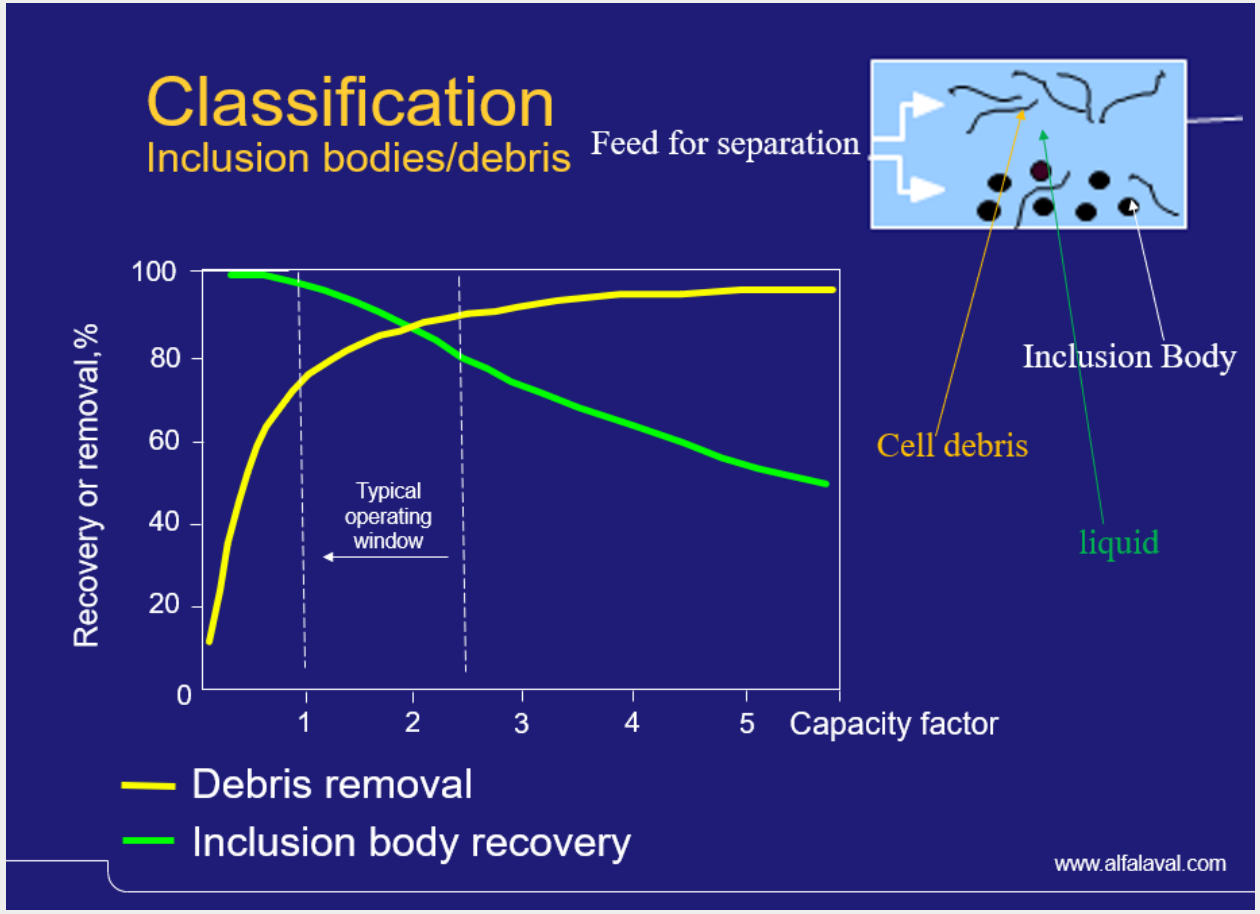


C-biggest size particle
B-smallest size particle
A-Cut size particle

Challenges for Inclusion body

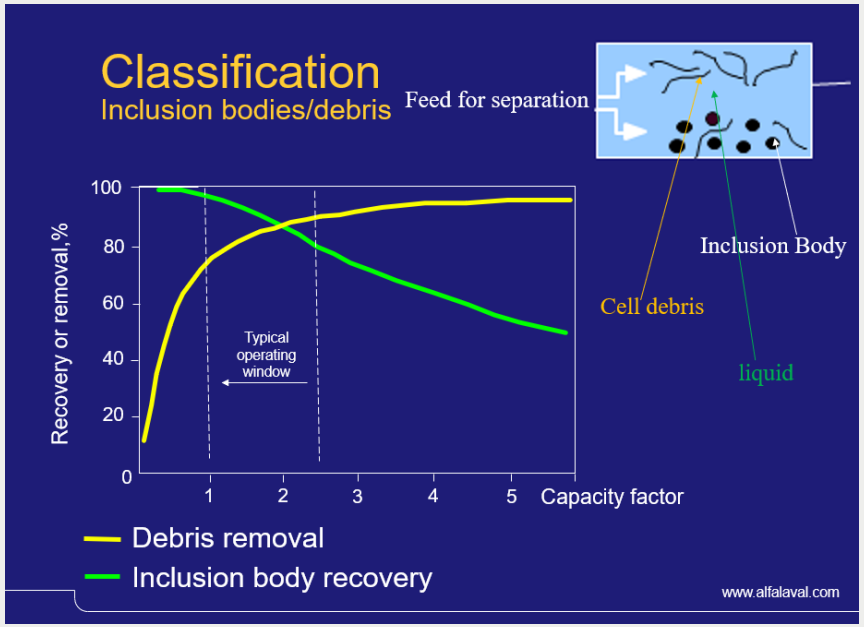
Separation between two different particles

- Target particle is Inclusion body.
- Need high purity IB or need to less content of cell debris in harvested IB
- Don’t expect the IB lose too much
- Narrow windows for operation

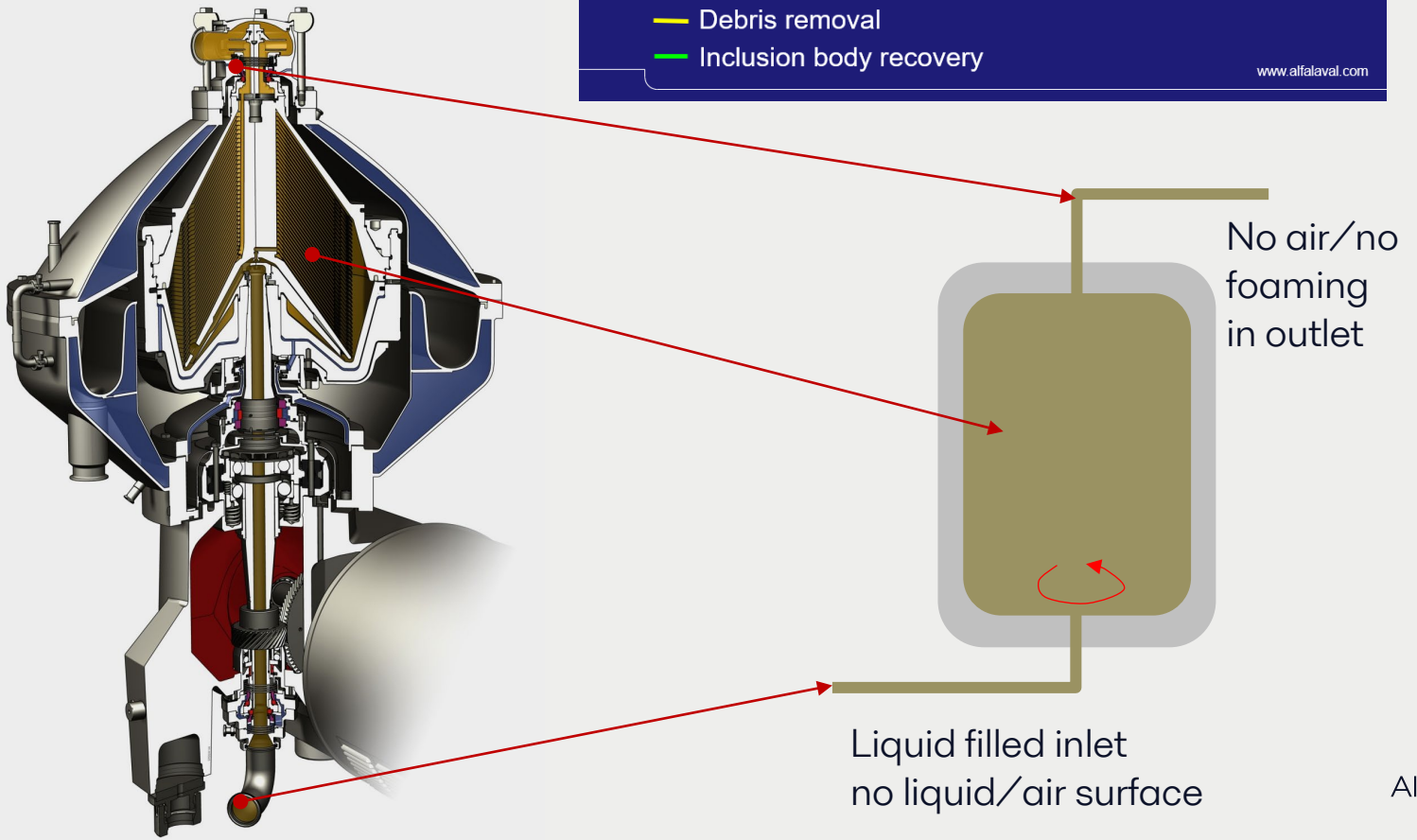


Challenges for Inclusion body

Alfa Laval full hermetic separator



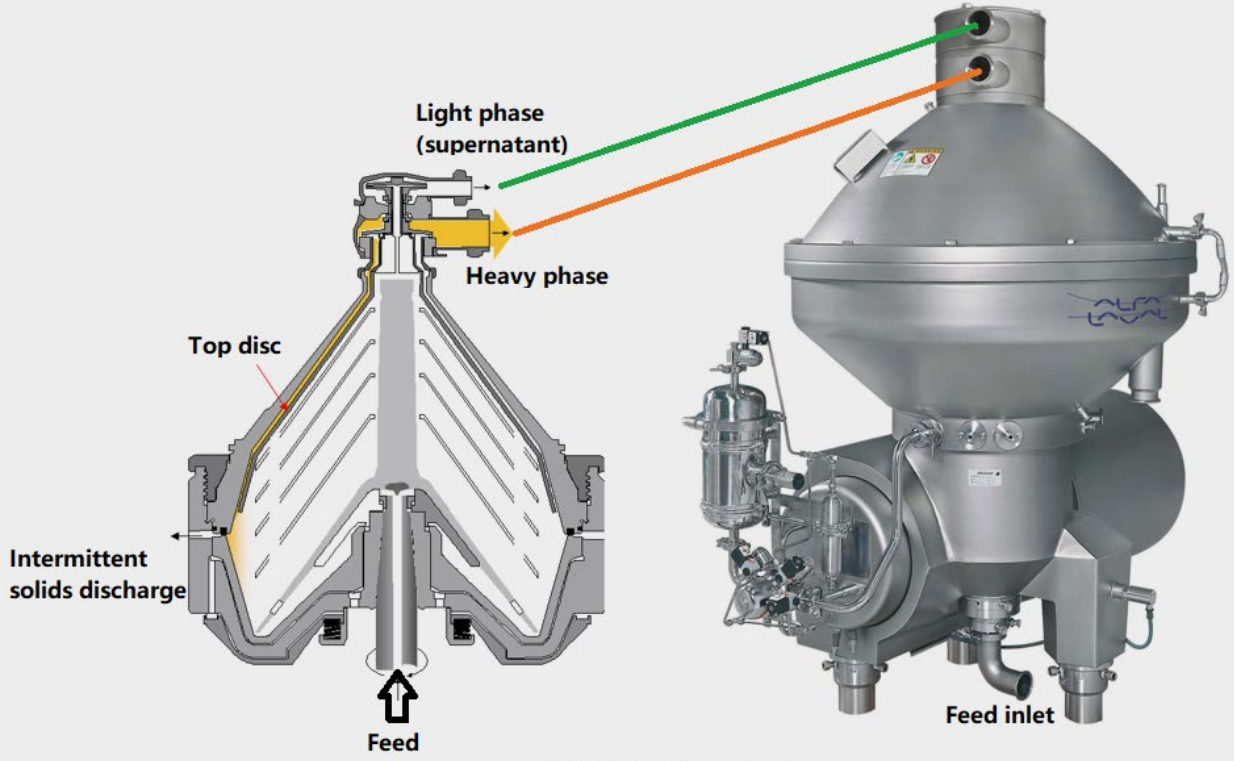
- No foaming
- No need to adjust backpressure to control the operation window
- Max separator feed capacity



Bactofuge

Flexible operation for muti-production

- Continuous solids output, over the top disc, through a second outlet on top – fully hermetic design. Fit for high density fermentation duty.
- Combined solid intermittent(traditional) and continuous discharge

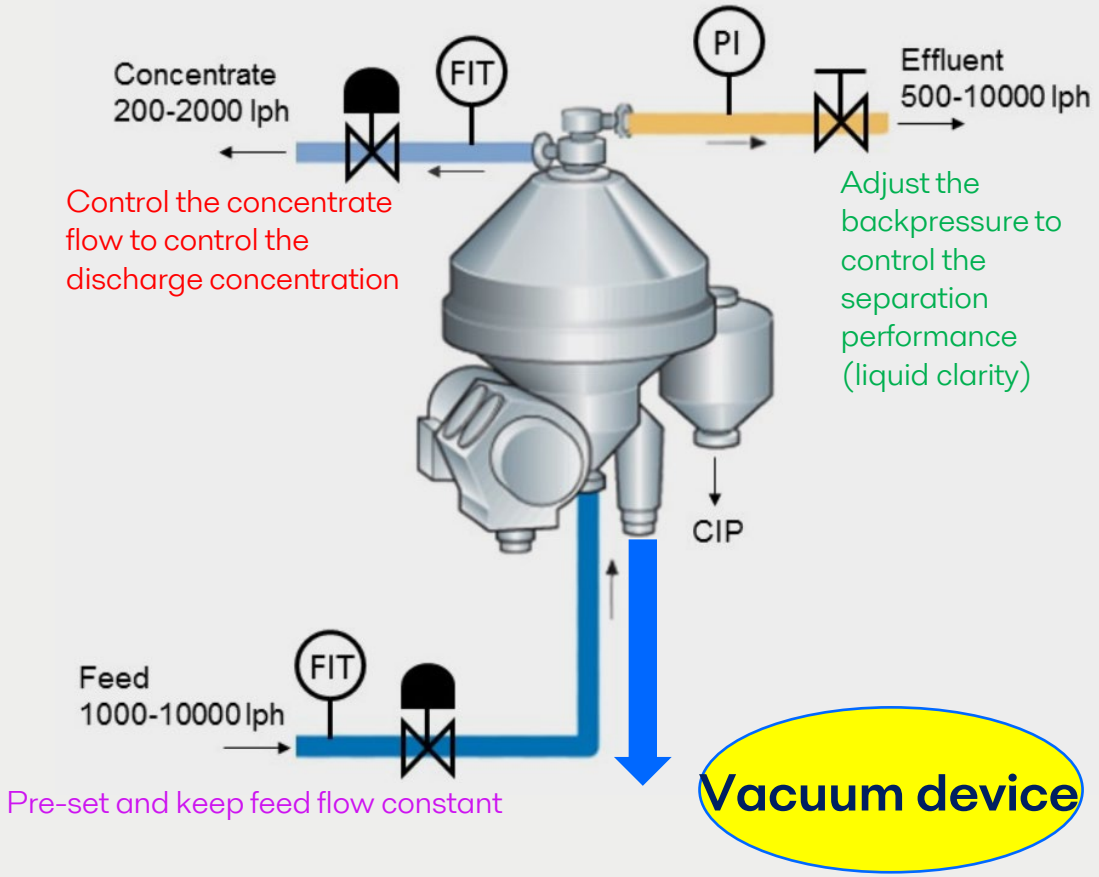


BBTPX 714H Bactofuge

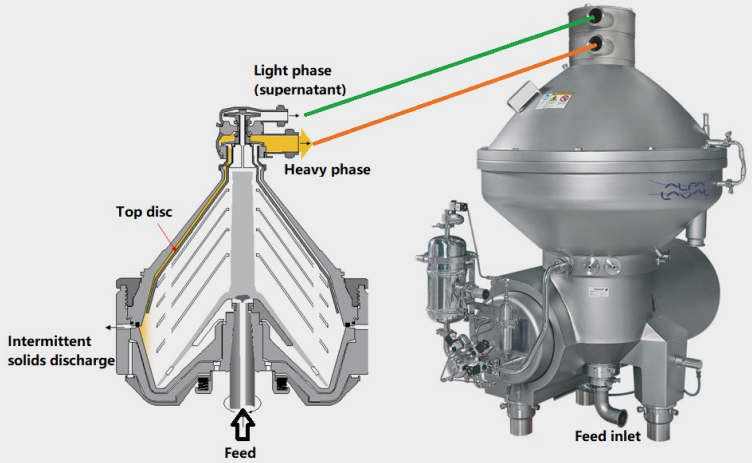
Bactofuge

With eMotion

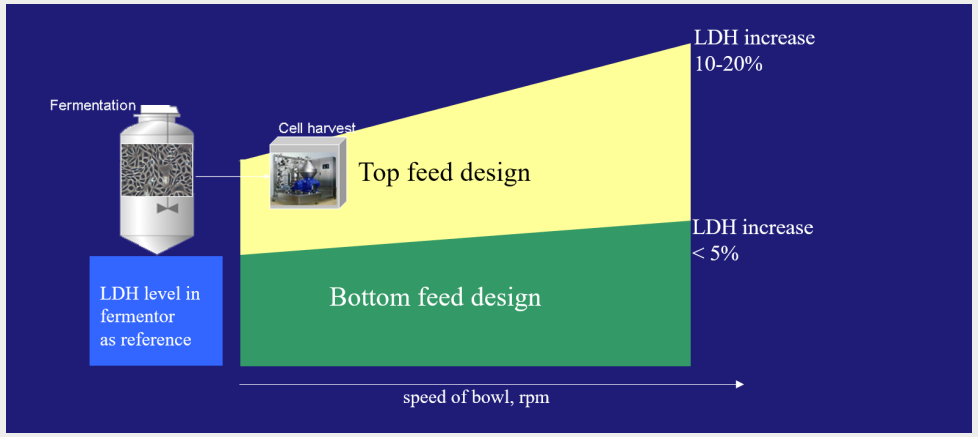
- Cooling water can be used to reduce the temperature
- eMotion function is under development to continue reduce the temperature pickup , reduce power consumption and ever lower noise



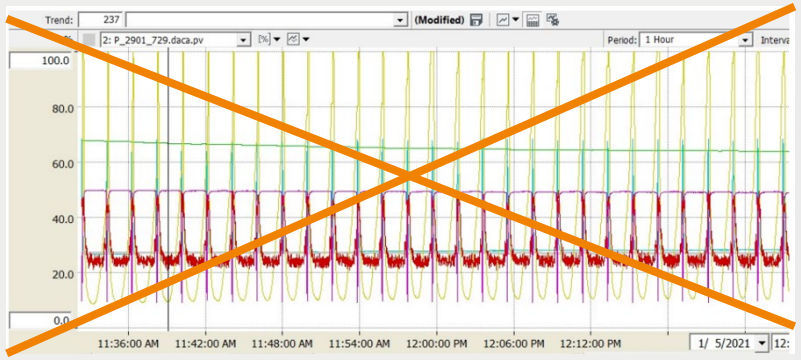
Bactofuge

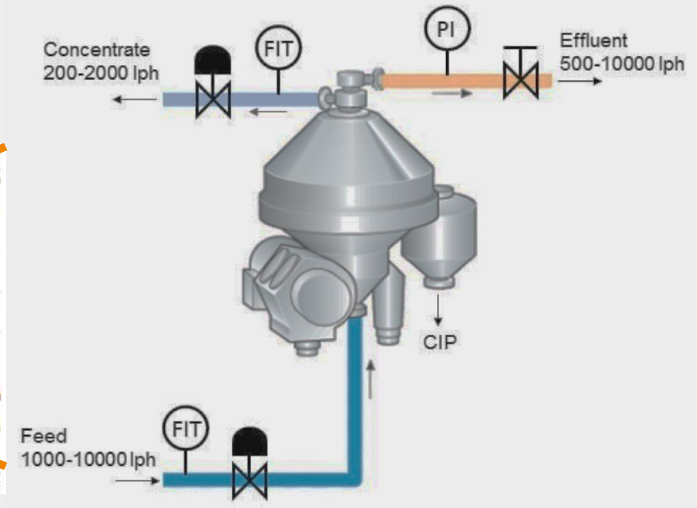


BBTPX 714H Bactofuge



- Full hermetic design with very gentle feed, low extra lysis
- Constant supernatant quality, constant solid discharge
- Traditional intermitte solid discharge available
- Easy for operation

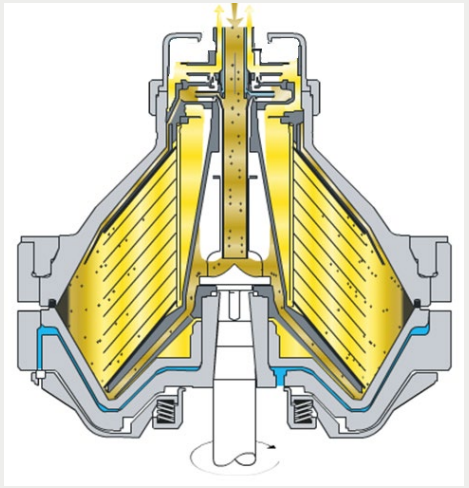




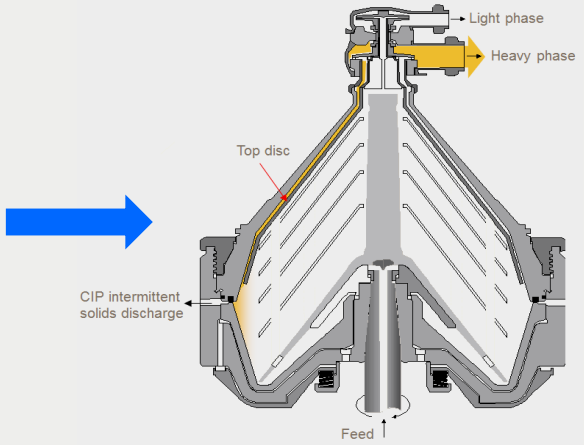
Importance to starter and probiotic

Keeping viability from continuous discharge

- Keep the micoorganism with viability after separation, To avoid to be hurted by temperature and high G-force
- Separator selection depends up acceptance of mortality and product value



Top feed PX separator



Bottom feed Bactofuge

PRODUCT	Starting batch in litres	Inlet Flowrate, l/h	T°C Separation	Total Concentr Kg for each 5000 l batch	Concentration Factor	Separation Yield % in cell	Mortality % in Liophilisation
Streptococcus thermophilus	5000	2500	4-6°C	310-290	15-17 times	70-90%	10-30%
Streptococcus thermophilus+ L.bulgaricus	5000	1500	4-6°C	550-510	8-10 times	25-50%	90%
Lactobacillus Plantarum	5000	2000	4-6°C	180-200	25-27 times	90-100%	20-40%
Lactobacillus Acidophilus	5000	2000	4-6°C	330-350	14-16 times	60-80%	20-40%
Lactobacillus Bulgaricus	5000	2500	4-6°C	260	19times	60-80%	60-80%
Mesofili Omo-Eterofermentanti	5000	2000	4-6°C	440-400	11-13 times	40-60%	20-40%

Mortality 20%

MB 20
MB 20B

09 September 2025

Alfa Laval

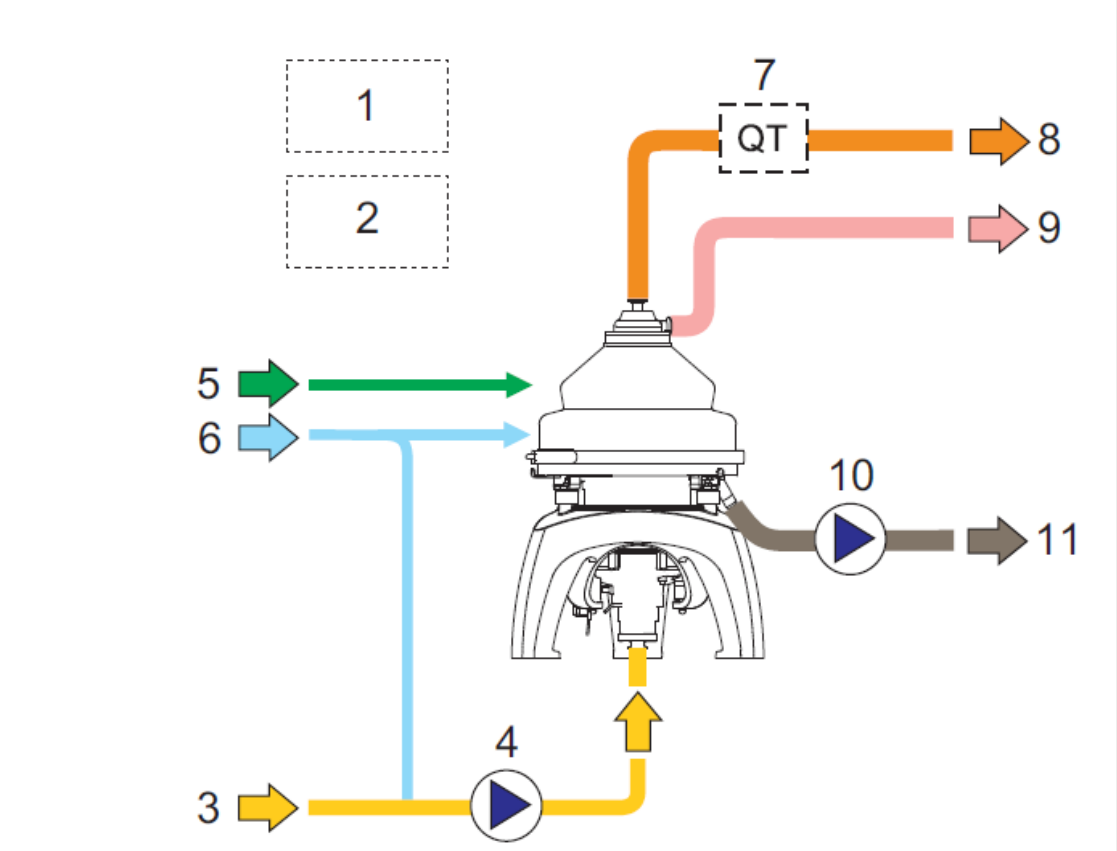
MB 20 / MB 20 Bactofuge

The first small fully hermetic disc stack centrifuge

The first small fully hermetic disc stack centrifuge with **continuous solid discharge**

Flow Chart

MB20



- Control cabinet
- Main motor starter cabinet and VFD
- Feed inlet
- Feed pump (optional)
- Utilities
- Standby water
- Turbidity meter for solids discharge (optional)
- Light phase outlet
- Heavy phase outlet
- Solids receiving unit (optional)
- Discharged solids outlet

MB 20 / MB 20 Bactofuge

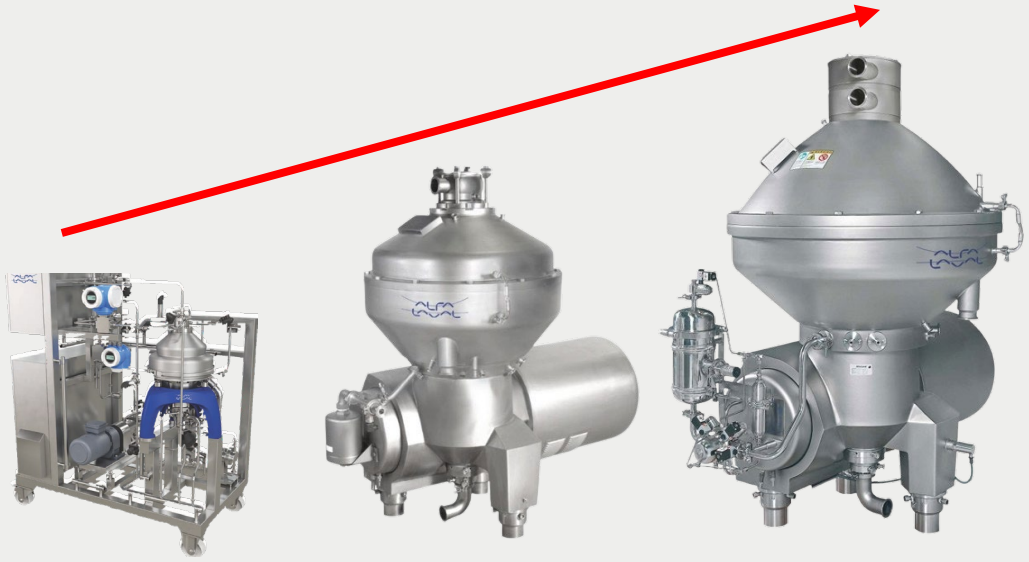
Separator	
Bowl speed	9500rpm
Motor	5KW
Free steaming	90-100°C

Feed type	Max feed capacity [l/h]
E coli	120-180
Cell debris	40-80
Lactobacillus	200
Saccharomyces yeast	600
Pichia yeast	350-450
CHO	200-250

Application and Scalability

From smallest to largest

- MB 20 offers the same bowl design as larger models from Alfa Laval
- Capacity can be scaled up with high reliability
- Cell return in continuous fermentation if free steaming is avaible



TopStream™ Hermetic Design™ UniDisc™

User benefits with MB 20 systems

Flexible in flow rate

- Hermetic design allows for 50-600 l/h without modifications

Handles feeds with low and high solids, above 30%

- Easy for customer to convert between clarifier with PX discharge and Bactofuge

High separation efficiency

- Hermetic inlet avoids cell disruption

No foaming

- No air present in outlet

Customer benefits

TopStream™

Hermetic Design™

UniDisc™

Alfa Laval advantages

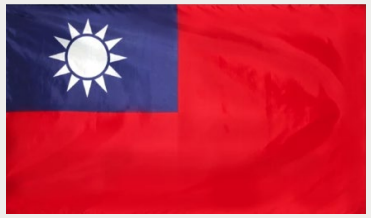
People, product and process understanding

To optimize the performance of our customers' processes Time and time again.

- High awareness of Biopharma processes, problems and difficulties.
- Focus on the separation solution rather than a mechanical equipment
- Good adaptation with customer process, and high bio-safe design
- Local resource, competence and experience even if the lessons

Your contact

Taiwan



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Your question?

Thanks for your time!