



DANISH
TECHNOLOGICAL
INSTITUTE

FOODS
MATERIALS
ENERGY

...FOR A BETTER FUTURE





Equipment and expertise specifications - fermentation



Our fermentation equipment



Laboratory
0.01-2 L



Pilot scale
15 – 100 L



Pilot production scale
0.1 – 2 m³

- 4 x 1L laboratory reactors
 - 2 x 20 L pilot reactor (Q3 2023)
 - 1 x 200 L pilot reactor (Q4 2023)
 - 1 x 2000 L pilot reactor (Q2 2025)
 - Downstream processing equipment to be purchased during 2023 (homogenizer, membrane filtration, centrifuge ... etc.)
- Complete process line
 - Multiple process units available at one spot
 - All units are adaptable to fit customized process
 - Certified for food grade production
 - Process development and adapted to every biomass
 - Minimal waste

DTI offers the following services and fermentation equipment



For more information contact:
Lise-Lotte Schmidt-Kallesøe
lisc@teknologisk.dk



Fermenters

Homogenizer

Centrifuge

Hydrocyclone

Filtration

Evaporater

Spray dryer

Fermenters

Seven fermenters with varying capacity from working volume 0,4 - 2000

Automated fermentation, sterilization, heating and cooling processes possible.

Gas available: Air, O₂, N₂, CO₂ and H₂

Aerobic and anaerobic cultivation with following microorganisms:

- Fungi
- Bacteria
- Microalgae
- Yeast

Precision and biomass fermentation

- 5-135 °C operating temperature (1 L only 60 °C)
- 40-600 RPM Mixer rotation speed (2000 L up to 2000 rpm)
- Air supply 2 VVM, additional gas supply (CO₂, N₂, O₂, H₂) up to 1 VVM (1 L up to 2,8 VVM)*

*all specification may change



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Fermenters from Bioreactors.net

1 L fermentor



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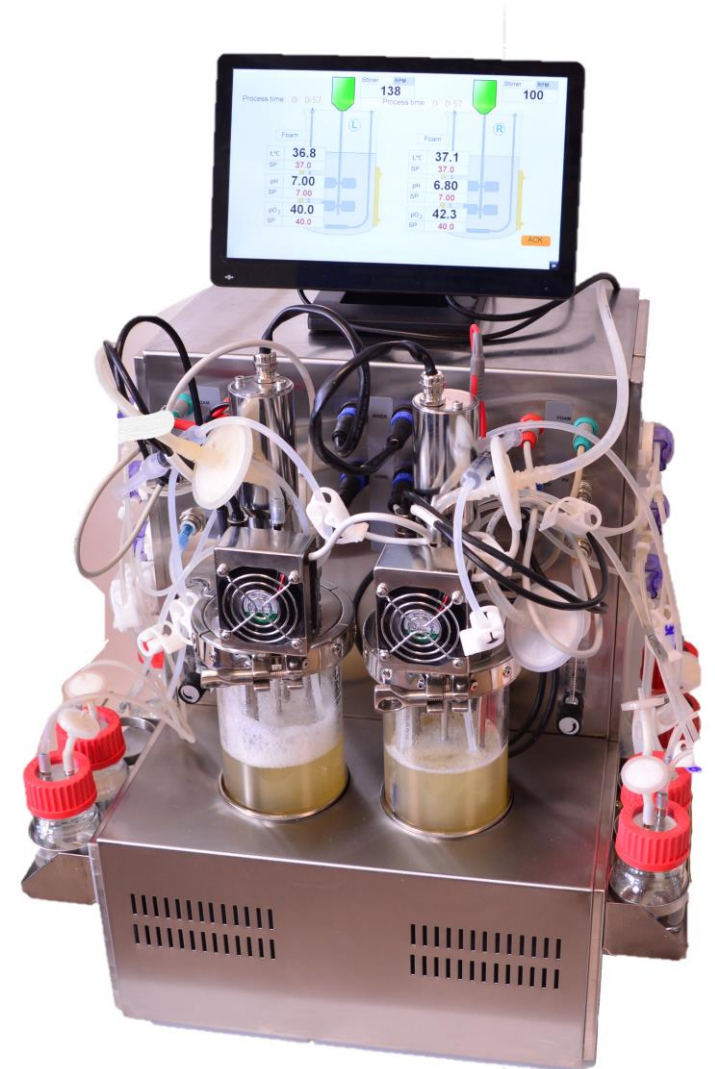
2 x twin fermentation set up.

Temperature control system equipped with Peltier element.

Gas supply controlled by MFC; micro sparger; gas mixing chamber.

Variable speed, temperature, pH and gas supply for optimization.

Sensors: temperature, pH, DO, foam.



Fermenters from Bioreactors.net

- 0.4 – 0.7 L working volume
- 40-2000 rpm rotation speed
- 15-60 °C working temperature
- Air supply 2 VVM, additional gas supply (O₂, N₂, CO₂, H₂) 1 VVM



20 L fermentor

Gas supply controlled by MFC; ring sparger; gas mixing chamber.

Variable speed, temperature, pH and gas supply for optimization.

Sensors Temperature, pH, DO, foam.

Possibility of fed batch with two different feed medias



- 8 - 28 L working volume
- 40 - 600 rpm rotation speed
- 5 - 135 °C working temperature
- Air supply 2 VVM, additional gas supply (O₂, N₂, CO₂, H₂) 1 VVM



200 L fermentor

Gas supply controlled by MFC; ring sparger; gas mixing chamber.

Variable speed, temperature, pH and gas supply for optimization.

Sensors Temperature, pH, DO, foam.

Possibility of fed batch with two different feed medias



- 40 - 225 L Working volume
- 40 - 600 rpm Mixer rotation speed
- 5 - 135 °C working temperature
- Air supply 2 VVM, additional gas supply (O₂, N₂, CO₂, H₂) 1 VVM

2000 L fermentor



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Gas supply controlled by MFC; ring sparger; gas mixing chamber.

Variable speed, temperature, pH and **gas supply** for optimization.

Sensors Temperature, pH, DO, foam.

Possibility of fed batch with two different feed medias

- 500 - 2200 L Working volume
- 40 - 250 rpm rotation speed
- 5 - 135 °C working temperature
- Air supply 1 VVM, additional gas supply (O₂, N₂, CO₂, H₂) 0,5 VVM





Homogenizer (Q3 2023)

It is well suited to a variety of applications including **ultra-high pressure** or **severe duty applications**. The design enables many products to be processed and the modular construction provides flexibility.

Modular hygienic **design** consisting of a 3-piece valve housing and 3 - 5 individual cylinders.

Plunger Lubrication System: **Aseptic**

- Pressure range up to 1,500 bar / 21,750 psi
- 15-30 °C machine working temperature
- 500-1000 L/h
- Product Temperature reaches 95°C



Centrifuge (multipurpose separator)



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Various processes: Separation – concentration - cleaning, clarification with hydraulic seal - purification and bacterial clarification processes.

Configurations

Concentrator type

Heavy liquid phase is the main part of incoming stream (example milk skimmer)

Purifier type

Light liquid phase is the main part of incoming stream (example butter oil purifier)

Clarifier type with hydraulic seal

Any kind of clarification (milk, juices, oils, fermentation broths etc)

Clarifier type with internal recirculation

Milk bacteria clarifier

- 1-3000 L/h flowrate
- 1.7 L solids chamber
- 11,000 rpm Bowl speed



Hydrocyclone (to be purchased)



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Designed as compact self-cleaning automatic filters and manufactured of stainless acid-resistant steel.

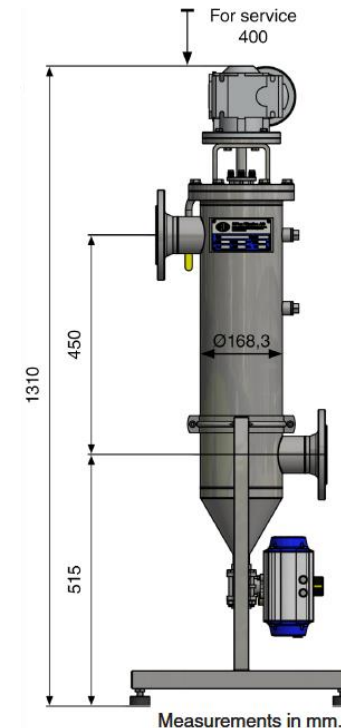
Designed for **hygienic** use in sectors such as: various cheese products, chocolate, coffee, honey, egg, beverage, oil and fats, sugar

Capacity (at a viscosity of 1 cSt and as a pressure filter)

Diff. pressure	Strainer area cm ²	30 µm	50 µm	100 µm	150 µm	200 µm	300 µm	500 µm	1000 µm
0,05	1.500	12	14	22	24	24	24	24	24
0,10	1.500	15	18	28	31	31	31	31	31
0,15	1.500	19	23	36	37	39	39	39	39
0,20	1.500	24	27	44	45	47	47	47	47

Capacity (m³/ h) at different filtration rates (µm).

- Max 150 °C Working temperature
- Volume: 15 L – Drain Chamber volume 0.9 L
- Filtration: 30-50-100-150-200-300-500-1000 Micron





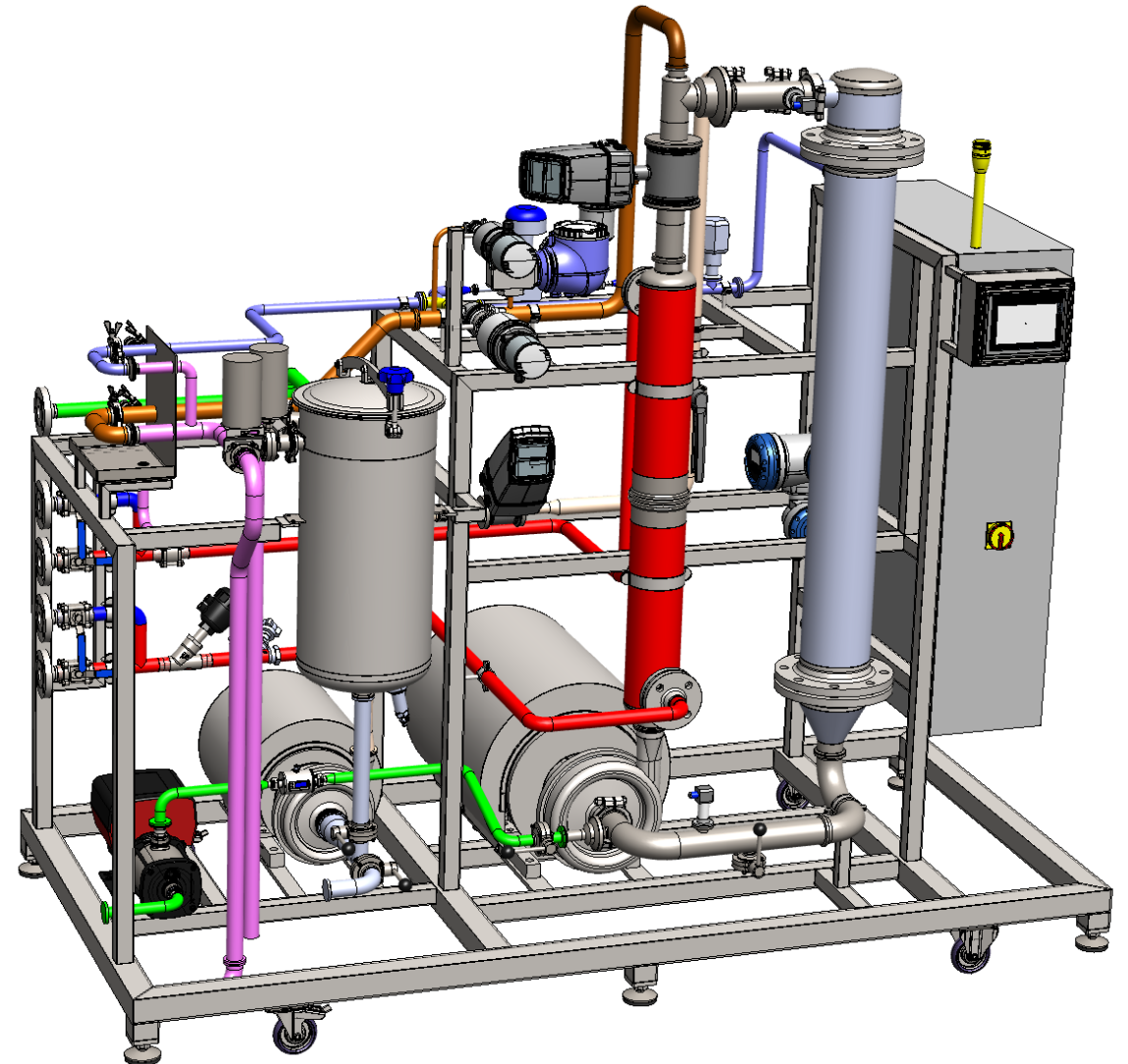
Filtration (to be purchased)

Ceramic membrane system

- Microfiltration
- Ultrafiltration

Microfiltration /Ultrafiltration (MF/UF) pilot unit which is installed with ceramic elements for aseptic clarification of fermentation broth.

- 15-50 °C Working temp.
- 2.45 m² Membrane Area
- 100-500 L/h Feed Flowrate
- 1 -5 bar working pressure





Evaporator (to be purchased)

Auto filling of the tank if low level detected.

The control system includes a **density meter** (Coriolis type) for control of the concentration factor.

Condenser of the tubular type for condensing the vapor

- 190 – 200 kg/h Water evaporation
- Calandria with integrated separator. The calandria is complete with liquid distributor at the top of the calandria to ensure an even distribution of the product.





Spray dryer

Drying of final powdered product from solutions.

Internal or external spraying nozzle and heated air for **gentle drying process**. Other nozzle systems (e.g. rotary atomizer) can be installed.

Cyclone and **bag filter** catches particles.

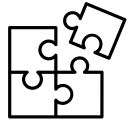
- 5-10 L/h
- Nozzle according to product properties
- Adjustable temperature





Equipment and expertise specifications - biorefining

Pilot plant and equipment (food grade)



Multiple process units available at one spot

All units are adaptable to fit customized process

Certified for food production



Process developed and adapted to every biomass

Minimal waste



Stirred tanks

Heat exchanger

Decanter centrifuge

Wet mill

Spray dryer

Decanter centrifuge

Vibrating sieve

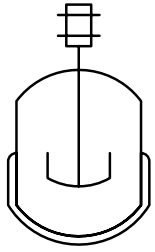
Clarifier centrifuge

Column chromatography

Dry fractionation unit

Membrane filtration

SANI membrane



Stirred tanks



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Two **reactor tanks** with 800L capacity each.

Heating and **cooling** possible.

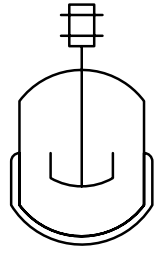
Stirring suitable for both liquids and viscous suspensions.

pH monitoring and adjustment.

Load cell for weighing contents.

- 100-800 L capacity
- 8-98 °C
- 0-50 RPM stirring speed





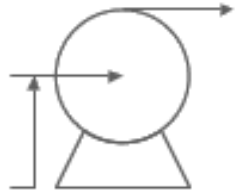
Stirred tanks



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Two **types** of stirring





Wet milling

Colloidal and disc mills are available for **milling of slurries and suspended solids.**

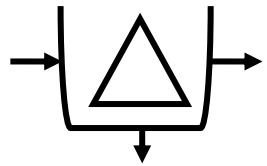
Can be used in combination with reactor tanks for **continuous processing.**

- 800 L/h capacity
- Colloidal mill MZ-100, particle size $> 100\mu\text{m}$
- Perforated disc mill ML-150, various screens



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Decanter centrifuge

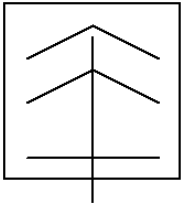
Solids-liquid separation by density.

Fast operation with **high capacity**.

Variable speed for yield optimization.

- Solid – liquid separation
- Up to 4.500 rpm (3500G)
- 305 Diameter
- 1000 L/h capacity





Clarifier centrifuge



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High-capacity **solids-liquid separation** by density.

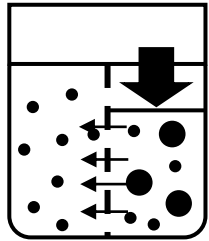
Variable speed for yield optimization.

Better separation efficiency than decanter centrifuge.

Collecting smaller solid quantities

- Fine particle separation
- Max. 12.500 rpm (22700 G)
- 300 L/h





Membrane filtration

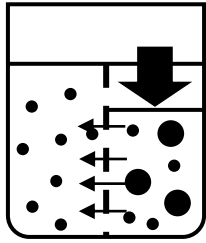
Concentration of dissolved components.

Separation by **particle or molecular size**.

- Microfiltration
- Ultrafiltration
- Nanofiltration
- Reverse osmosis

- 70 L Minimum working volume
- Up to 1000 L/min





SANI Membrane filtration



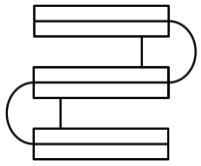
Size **fractionation** and **concentration** of dissolved components.

Lower tendency to clog due to shaking motion.

Available in both **laboratory** and **pilot scale**.

- Microfiltration
- Ultrafiltration

- 25 L Minimum working volume
- Continuous operation 100 L/h



Heat exchanger



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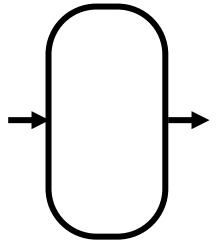
Liquids can be heated **directly** in heat exchanger.

Contents in reactor tanks can be **heated with steam** from heat exchanger.

- **Pasteurization and sterilization.**
- **Enzyme activation/inactivation.**
- **Bleaching.**
- **Heat precipitation.**

- Up to 140 °C in heat exchanger
- Up to 100 °C in reactor tanks





Column chromatography

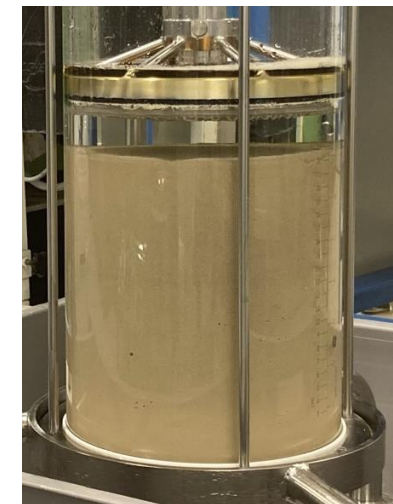


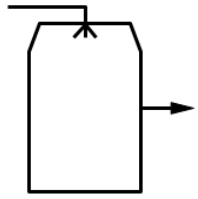
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Separation of soluble components by different binding affinity to chromatography packing (e.g. resin beads).

Useful for **separation of similar sizes molecules** where membrane separation is not possible.

- Multi-range UV detection
- Finer components (pigments, phenolics, proteins.)





Spray dryer

Drying of **final powdered product** from solutions.

Internal or external spraying nozzle and heated air for **gentle drying process**. Other nozzle systems (e.g. rotary atomizer) can be installed.

Cyclone and **bag filter** catches particles.

- 5-10 L/h
- Nozzle according to product properties
- Adjustable temperature





Belt drying

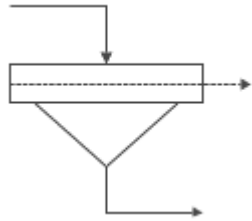
DryingMate belt dryer

The dryer is designed specifically for test drying and smaller productions

The drying chamber is equipped with three inspection sections, wherein one can see the product all the way through the dryer.



- Air drying max 250 °C
- Capacity up to 50 kg/h
- Residence time min/max 10/40 min



Disc Refiner

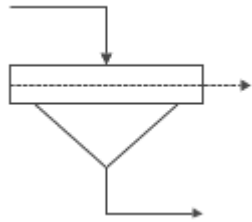
Pulp is refined homogeneously while it is circulating

All parts in contact with the refined material are made of non-corrosive materials like bronze and stainless steel

Refining chamber can be cooled by circulating cold water which protects samples from heat generated by refining

- The beater operates with a mass consistency from 2 to 8 % and has a continuous circulation chamber with a 50L capacity.
- The diameter is 300 mm. The distance between the discs can be adjusted between 0 and 9 mm.





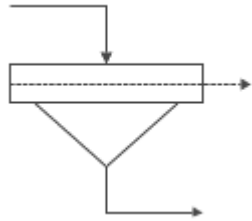
Ultra-high temperature processing (UHT)

Minimize the presence of microorganisms while equally minimizing the chemical changes within a product post processing.

UHT process, works with customers to ensure they optimize quality, efficiency and productivity by applying the best solution for a given application

- Food processing technology that almost sterilizes liquid food by heating it above 135 °C (275 °F) – the temperature required to kill many bacterial endospores – for 2 to 5 seconds

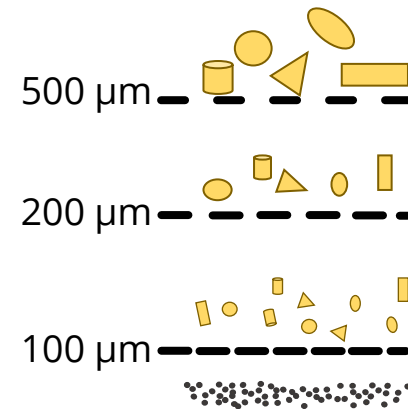




Vibrating sieves

Shaking provides size separation for a wide range of **dry materials**.

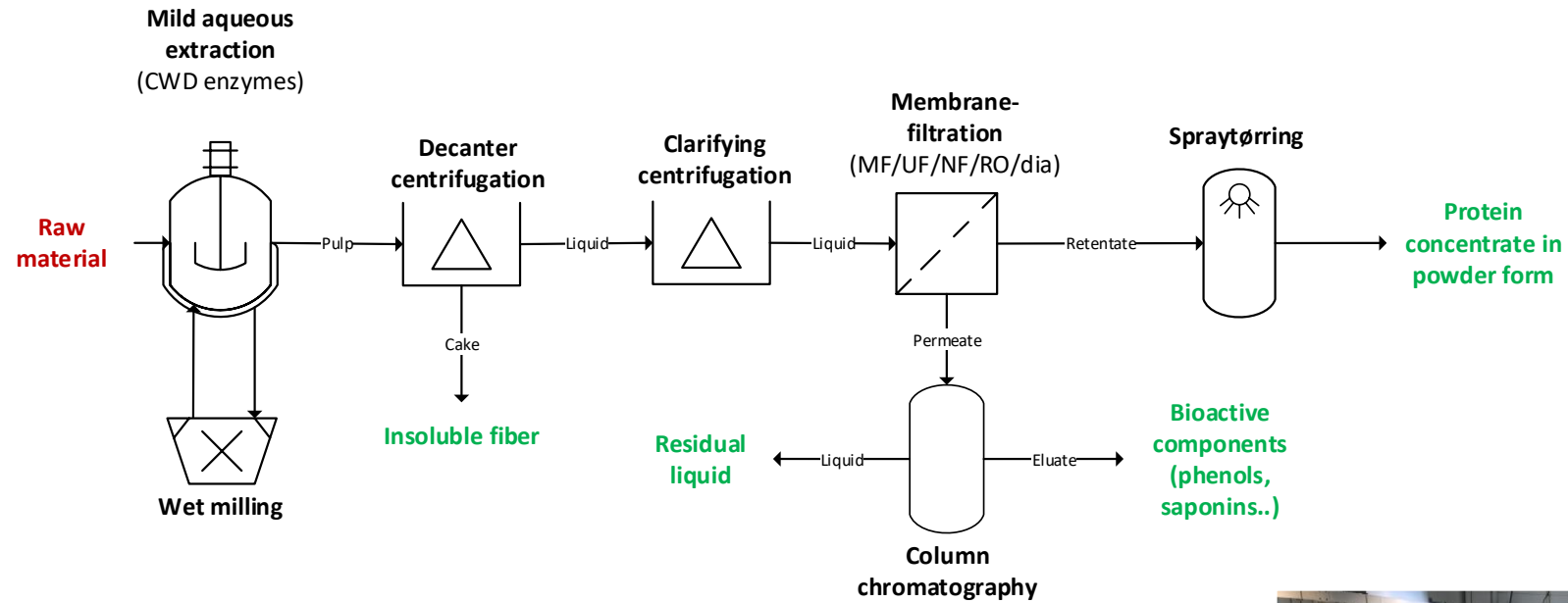
Stackable sieves **available in multiple sizes**.



- Russell Compact Sieve®
- 100 μm to 500 mm screens available



Process example





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Evaluation of results

-DTI Competences

- Physico-chemical properties
- Functional properties
- Sensory Benchmarking
- Potential applications evaluations
- Nutritional value
- Market insights
- Application Testing



Food Technology



Product development

New processes, e.g. 3D printing and fermentation

Food ingredients

Development of prototypes in our FoodtureLab



Food safety

HACCP

Food Safety Culture

Food fraud prevention

Hygiene and microbiology

Food labelling & regulation

Novel Food

Food allergens



Characterisation

Texture, structure and consistency

Chemical analyses

Shelf life studies

Application tests



Pilot production

Extrusion

Pelleting

Testing enzymes and ingredients



Consumer tests

Consumer acceptance testing

Product comparisons

New product prototype tests



Competences plant-based products

- In depth knowledge on plant proteins and extrusion/texturizing of plant proteins
- Product- and recipe development
- Ingredient and product characterization - chemical, physical, textural, sensory, shelf life
- Food safety and regulation insights, labelling
- Novel food regulation insights
- Market insight into plant-based trends – Innova Market Insight
- Pilot scale equipment within meat analogues



DTI Facilities for ingredients

Ingredient development & testing

Texturizing of plant proteins in pilot scale



Product- & application development

Development of recipes and test of ingredients in FoodtureLab



Analytic facilities

Advanced physical, chemical analyses



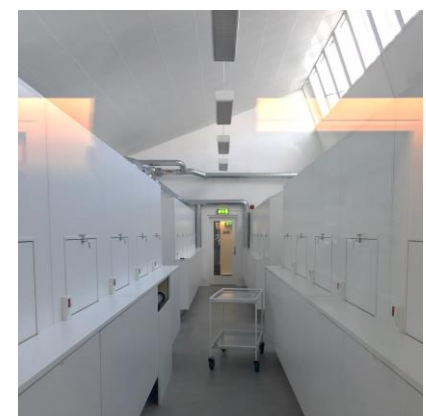
Pilot scale

MeatLab : Pilot scale test meat analogues



Sensory testing

Sensory Lab for consumer acceptance
Sensory profiling



Laboratory analysis: functional properties of food products



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- Water- and oil binding
- Emulsification (capacity, stability, activity index EAI)
- Fat/oil binding or absorption capacity (OAC)
- Foaming (capacity, stability)
- Water activity (A_w)
- Solubility / resolubility
- Protein solubility
- Heating stability
- Viscosity
- Gelling
- Particle size distribution
- Morphology
- Color (powder or solution)
- Density
- Etc.



Application Testing

We cover a broad range of plant-based categories

- Meat analogues ; meatballs, patties and sausages
- Plant-based milk
- Other plant-based dairy products ; cheese, yoghurt
- Other categories : Plant-based eggs, mousse, dressings, tofu etc.





The challenges we help solve

- Development, testing and troubleshooting
- Optimized taste, removal or masking of off-flavor
- Improved texture
- Better appearance, color
- Shelf life
- Consumer acceptance
- Nutritional properties
- Troubleshooting
- Access to specialty labs and pilot plants

