



Alternative Food Processing

Exploiting the full potential of alternative proteins



Process technology for the fermentative production of alternative proteins



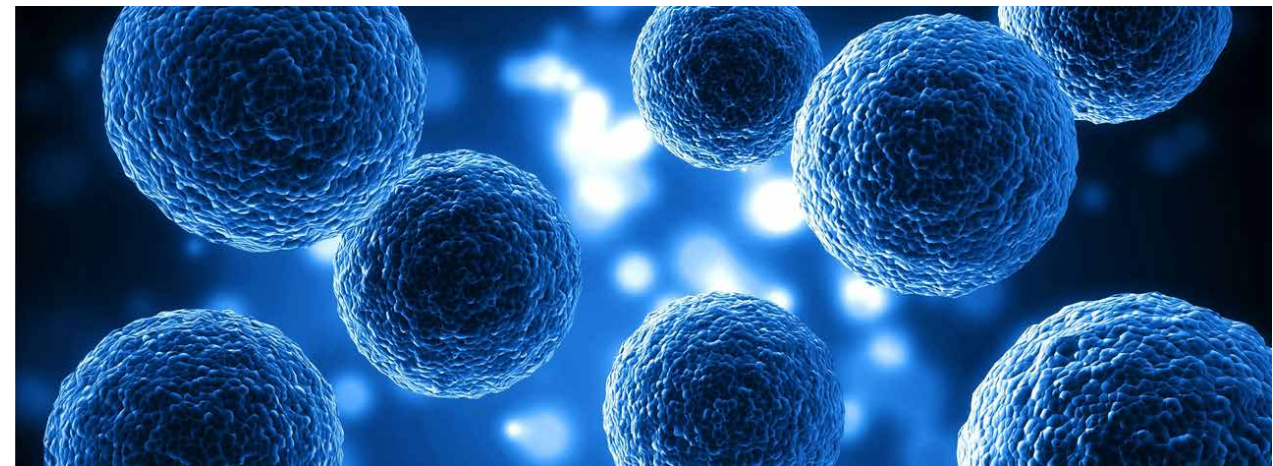
To be able to continue to supply the world's growing population with vital nutrients and at the same time use the available resources sparingly, the nature of protein sources will change in the future.

The solution? Alternative proteins. This is because food of animal origin can be replaced with plant proteins, precision fermentation or cultivation of biomass, all of which provide equivalent products. And the increased efficiency in production means that natural resources are used more efficiently.

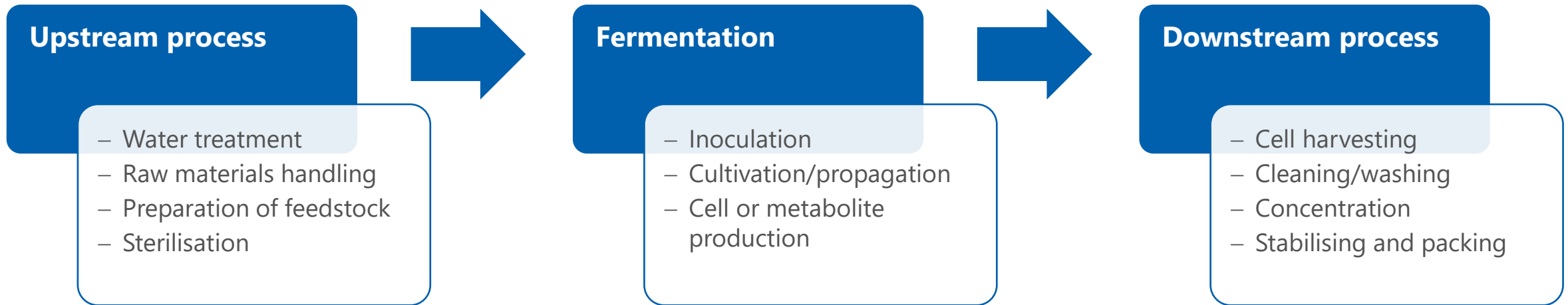
Krones supports food producers in designing the process technology and scaling it up to a higher production output for the production of alternative proteins.

At a glance

- Process expertise and market know-how in the food and beverage industry
- Ideally coordinated technological solutions
- Economic conceptual design of the complete installation
- Energy-efficient process



Process overview



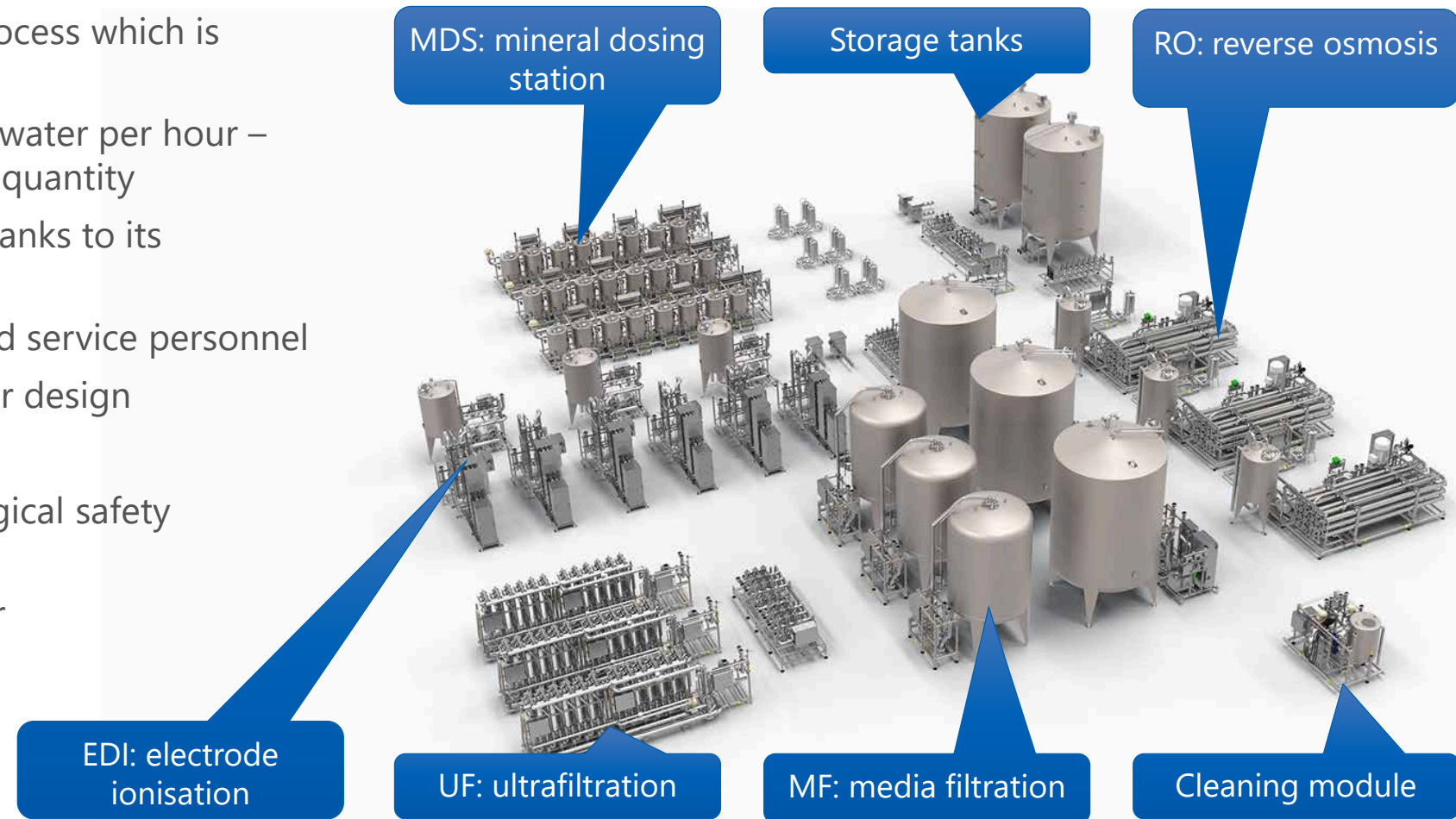
The composition of a **fermented product** always depends on the **microorganism**, the **substrate** used and the **process parameters**.



Hydronomic modular water treatment system



- It operates with a water treatment process which is tailored exactly to your requirements
- It prepares between 5 and 120 m³ of water per hour – optionally with a variable production quantity
- Minimised quantity of waste water thanks to its sophisticated technology
- Best possible access for operators and service personnel
- It can be expanded thanks to modular design
- Hygienic design throughout:
 - Guarantees the highest microbiological safety and reduced cleaning work
 - The stainless steel design allows for complete sanitisation with hot water



Raw material handling

From raw material handling to powder solution

- Tailor-made solutions adapted to customer requirements
- Use of solid and liquid raw materials and handling taking into account the powder properties
- Integration of suitable proportioning systems
- In-house tank and skid production
- Installation and commissioning on site



Module 1 based on the design of the CombiCube



UHT – Krones aseptic technology



The Krones family of aseptic lines offers solutions for a wide variety of processes – from raw materials to the filling of sensitive products.

Technology:

- Indirect and direct steam-heated UHT lines with FDA proof of concept
- Gentle heat treatment for highest product quality through tubular heat exchangers from our own development and production
- In-depth know-how in filtration with our UniPure hydronomic water treatment and beverage filtration technology
- Comprehensive know-how for various sterilisation processes: From thermal product treatment to the disinfection of packaging materials with PAA, H₂O₂ or Ebeam to cleanroom technology in our isolator fillers.

Experts:

We bring together a broad range of professionals from the fields of bottling and process engineering, chemistry, microbiology, brewing, dairy, mechanical engineering and software development with one goal: ***enabling the safe production of food.***

Experience:

- More than 130 aseptic systems (HTST and UHT)
- Approximately 500 aseptic filling systems
- We supply aseptic solutions to all major key accounts in our industry (beverage and dairy companies) worldwide.



Shutting off of pipe systems: Aseptic metal bellows



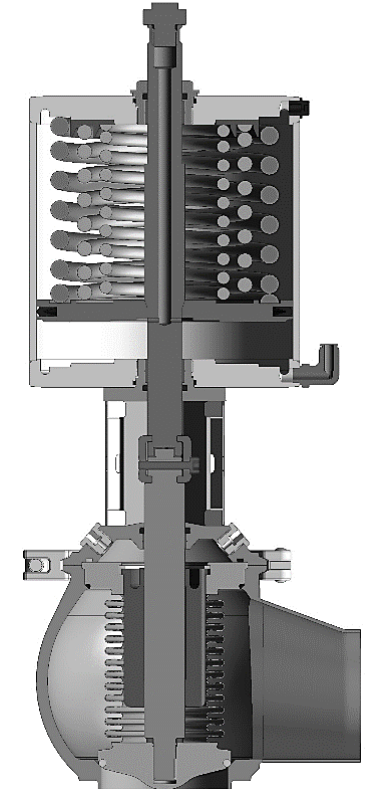
Seat valves

In aseptic and sterile processes

- Hermetic separation of the valve interior by means of metal bellows
- Bellows with inner support for
 - reducing vibrations in the process
 - increasing the lifetime of the bellows
- Optionally available:
 - two-piece screwed-on valve disk (sealant material EPDM/FKM/HNBR)
 - one-piece valve disk with sealing ring (PTFE compound)
- Connections for leakage drain/bellows monitoring
- Rotational decoupling on linkage between valve shaft and actuator for torsion-free lifting motion of the valve disk
- Housing design for optimum cleaning and gentle product transfer



SA seat valve



Separation of incompatible media in pipe systems: Aseptic metal bellows



Aseptic double seat valves

Reliable separation in aseptic and sterile processes

- Safety when lifting the bottom valve disk with additional locking of the top valve disk
- Free cross-sectional areas in relation to the pipe diameter
- Tilted flushing valve:
 - to protect the bellows
 - for optimum cleaning of the safety area
- Bellows with support:
 - reduced vibrations in the process
 - increased lifetime of the bellows
- Connections for leakage drain/bellows monitoring
- Actuator with integrated cycle functions for:
 - fast cycle times and low air consumption
 - torsion-free valve disk lift motions



MA aseptic double seat valve

Shut-off product tanks: Valves with tank connection



Tank outlet valves

With targeted adjustment to suit the process conditions

- Floor-level connection: Risk of sedimentation in the valve connection minimized
- Proven technology from the product family
- The optimal valve for each application
- Actuator allocation according to product pressure
- Connection to tank certified by TÜV SÜD according to Pressure Equipment Directive 2014/68/EU
- Active support for the correct valve selection and design



ST tank outlet valve



STA tank outlet valve



STD tank outlet valve



MT double seat tank outlet valve



MTA aseptic double seat tank outlet valve



Requirements to a bioreactor



Tasks

- Homogenization → to prevent sedimentation of cells
- Mixing → to provide adequate...
 - ... mass transfer of nutrients within the overall tank volume
 - ... heat transfer between the tempering jacket and the tank contents
- Aeration → to supply the cells with oxygen
- Feeding → to supply the cells with nutrients and other ingredients
- Sampling
- Sterile environment → to prevent contamination

The recirculation of the tank volume under sterile conditions is the key task of an efficient fermentation process.



Dynamic fermentation

Recirculation for an efficient fermentation

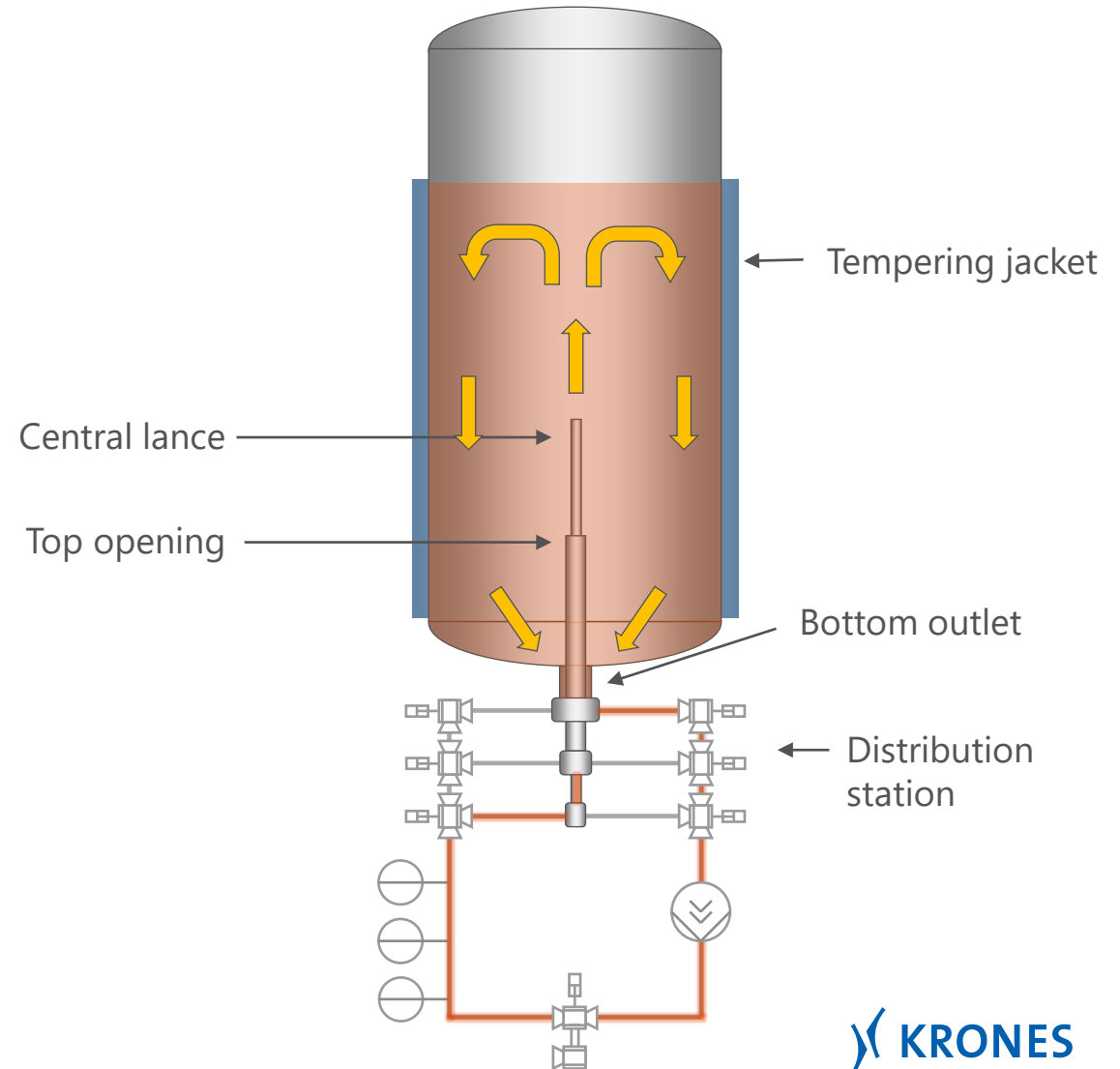


Flexibility and scalability

- Available tank sizes: between 500 and 100,000 litres
- Prototype on a laboratory scale, validation and test capacities possible with partners
- Various outlet housings at different heights within the tank: are not only used as outlet but also as inlet
 - Different flow directions possible (for homogenization, aeration, fluidized bed process or sedimentation for cell harvesting)
- Flexibility through pipe diameter dimensioning and adjustment of the volume flows in the pipe system
- Fed-batch or continuous mode possible

Cost and process efficiency

- Continuous mixing in a recirculation circuit: use of a recirculation unit instead of an agitator
- Can be retrofitted into existing tanks
- Maintainability through easy accessibility of seals, field devices and motors
- Fewer spray shadows during cleaning for an improved cleaning result
- Representative measurement of process parameters by means of continuous flow through the field devices in the circuit



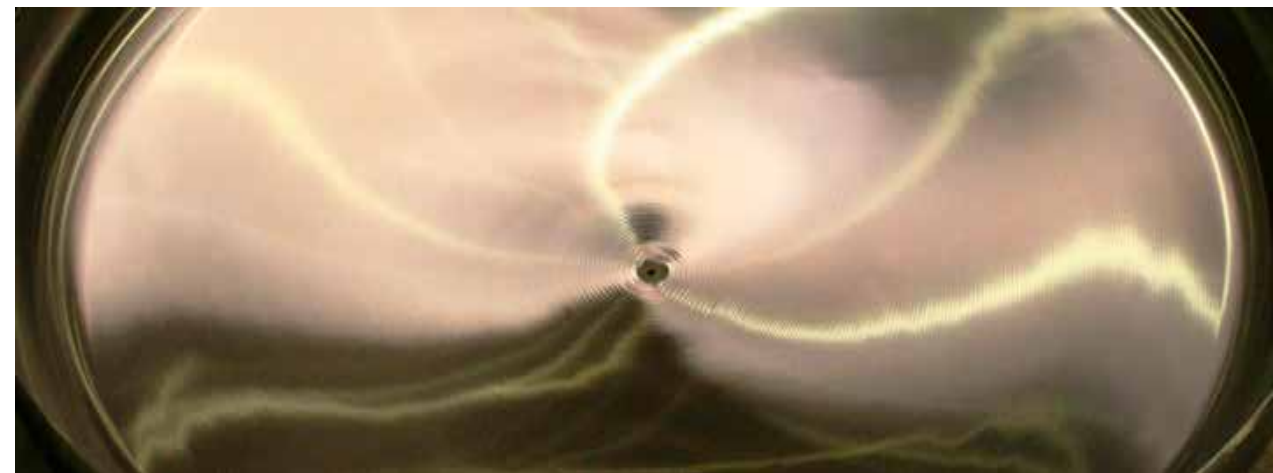
Tank construction

From tank to bioreactor



Our expertise

- Manufacturing halls specially designed for tank construction
- Automated processes for tank dome and tray production
- The work steps are precisely coordinated and carried out by qualified welders.
- High-performance and program-controlled production machines for cutting, drawing and welding work
- Highest quality through a globally recognised and standardised welding and inspection procedure
- Surface treatment with polishing and pickling solutions, also ceramic blasting of the outer surfaces



Surface coarseness Ra 0.8 μm

Tank construction

From tank to bioreactor



Our services

- Integration of the required agitator
- Implementation of sterile limits such as magnetically coupled motors or steam/condensate barriers
- Engineering of transfer lines and dosing points with suitable valve technology
- Mechanical and electrical integration of field instruments
- Tailor-made engineering for your process



Aseptic dosing

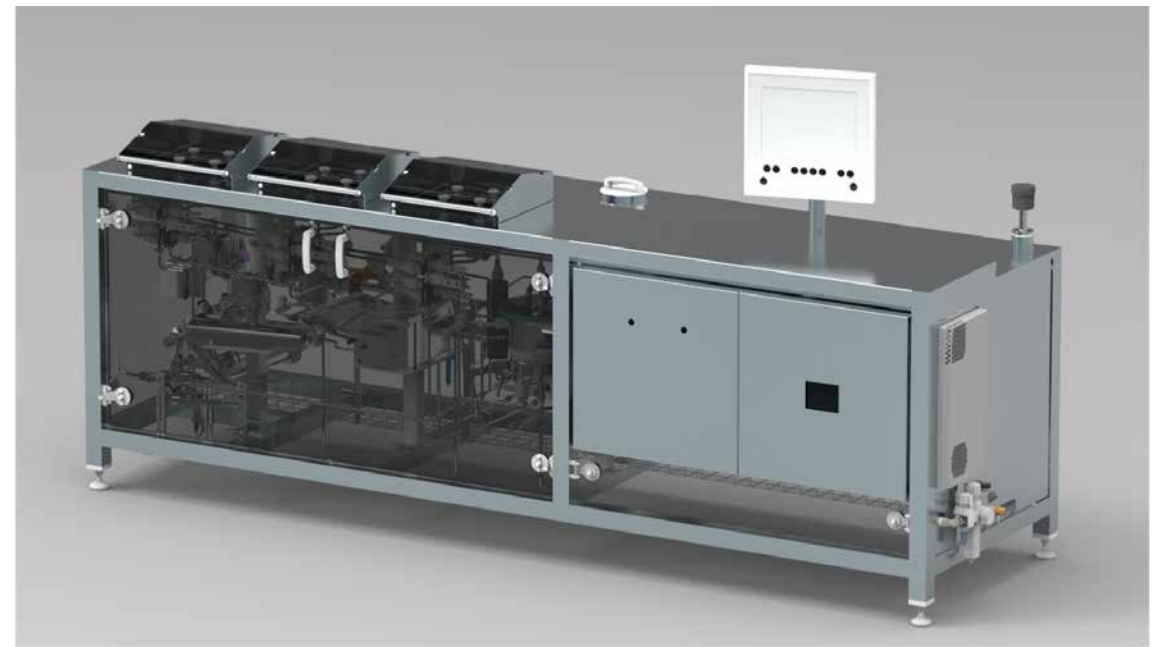


Aseptic dosing from tanks



- Prepared connections for faster tank change-over
- Capacity/dosing of 24 to 1,500 litres per hour

Aseptic dosing from bags



- Dosing of 2 to 20 litres per hour
- Three operating platforms possible for continuous production

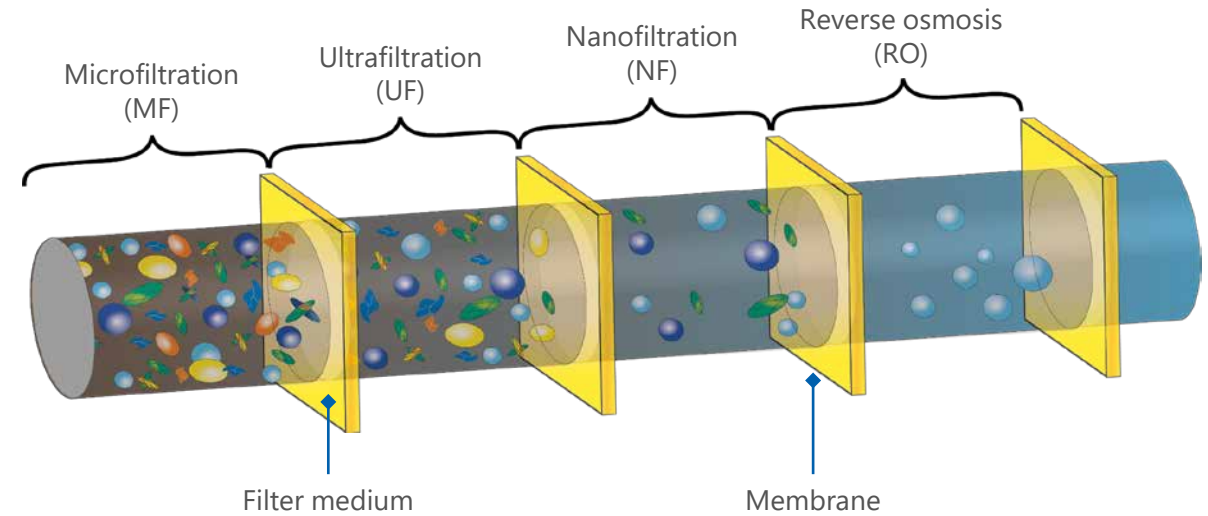
Membrane filtration systems



The energy and water efficiency of bioreactor systems play a key role, especially in the new-food area. The membrane filtration systems can be used for various areas of application. Whether for vegetable protein sources or fermentation-based products – various systems are available for concentrating or fractionating a wide range of substances.

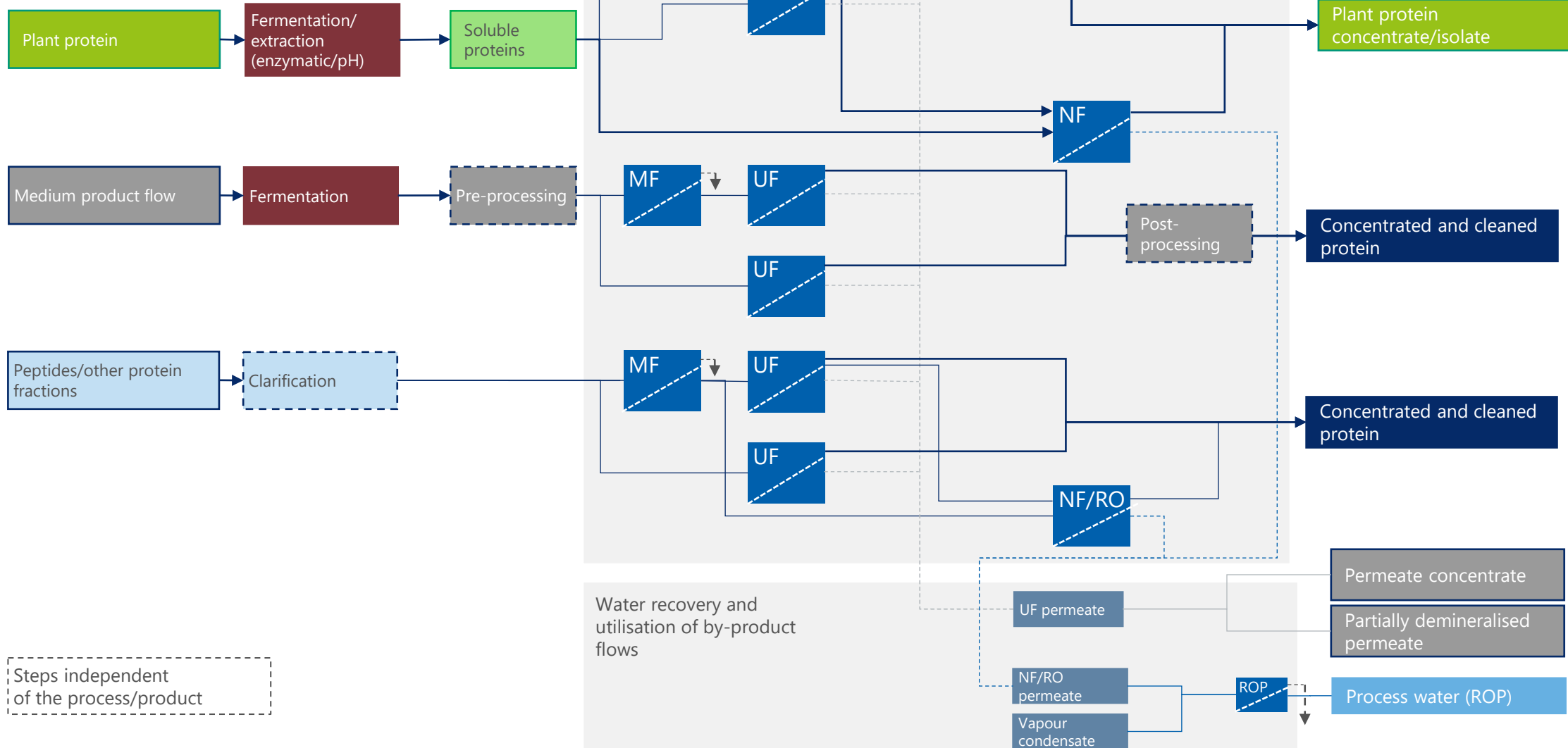
Applications:

- Fractioning of proteins
- Purification of ferments
- Concentration of
 - proteins
 - lipids
 - peptides



Applications

Alternative food



Botec F1: Batch-oriented technology



The Botec F1 process control system makes it possible to use equipment, raw materials and energy more efficiently – making it not only suitable for breweries, but also for beverage companies and dairies that produce in batches.

Botec F1 monitors and controls all of the steps included in batch production in real time. This enables the system to meet the requirements for a reproducible manufacturing result – while at the same time assisting the operators with their manual actions.

At a glance

- Create and manage recipes
- Plan, edit and trigger production orders
- Control, monitor and document production processes in real time
- Trace product batches seamlessly
- Exchange information transparently with higher-level IT systems



The products of the Krones Lifecycle Service



How can Krones help you to improve production sequences in your company?

The answer is clearly and simply: We offer you for your Krones machines and lines exactly those Lifecycle Service products which are tailored to your requirements. Regardless of whether this concerns the perfect performance of your line, the ideal organisation of your warehouse or comprehensive after-sales support: The Krones Lifecycle Service experts are always there to help you reaching your goals and turn your wishes into optimal solutions.



Product development in the field of alternative food processing

Your ideas put to the test!



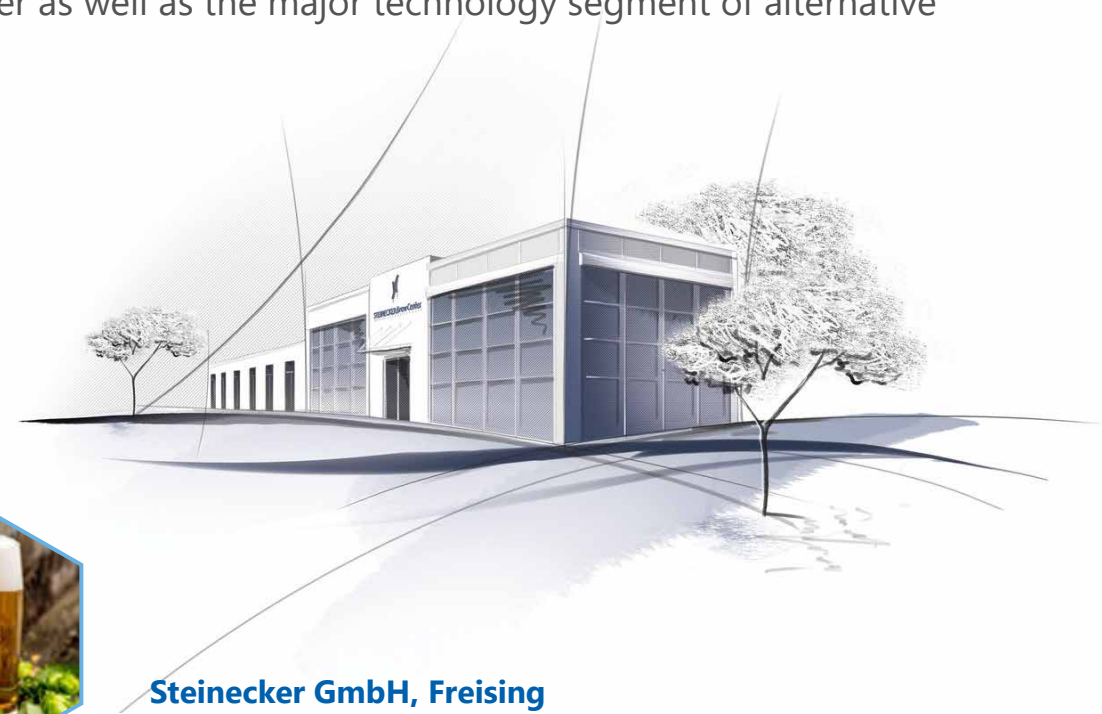
In our competence centres, in addition to sophisticated systems technology, our experienced technologists are at your disposal to develop new products or optimise existing recipes together with you.

At the Krones Process Technology Center, the focus is primarily on thermal product treatment. There you have, among other things, the opportunity to carry out tests for direct heating, homogenisation, filling and the sterile tank.

In our Steinecker Technology Center, it's all about the manufacturing of beer as well as the major technology segment of alternative proteins – from raw material processing to fermentation.

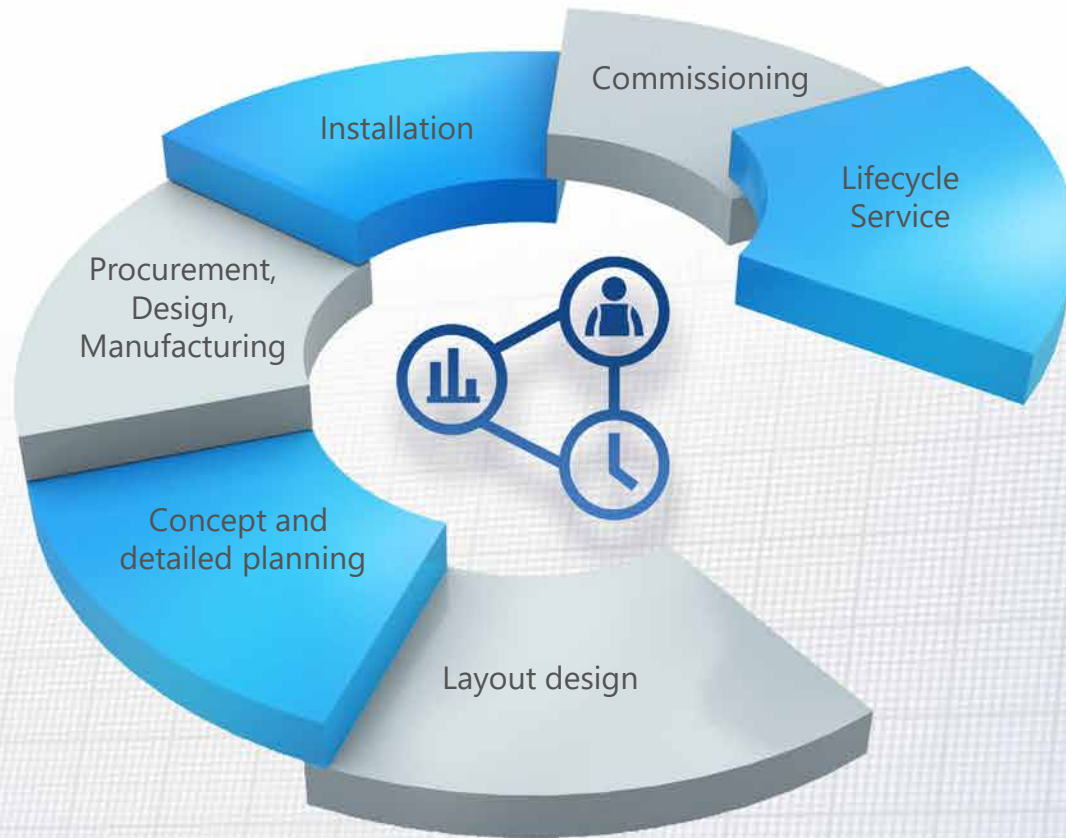


Krones AG, Neutraubling



Steinecker GmbH, Freising

Everything from a single source



Our goal? Satisfied customers and building long-term partnerships. No problem thanks to our decades of experience in the realisation of major projects and our international network of experts, because:

At Krones, we offer you the entire range of services for comprehensive project implementation – from product development to layout design, in-house engineering and manufacturing, right through to software integration and Lifecycle Service.

**SOLUTIONS
BEYOND
TOMORROW**

