



Mini membrane unit;  
the missing link between idea  
and industrial realization  
of membrane processes

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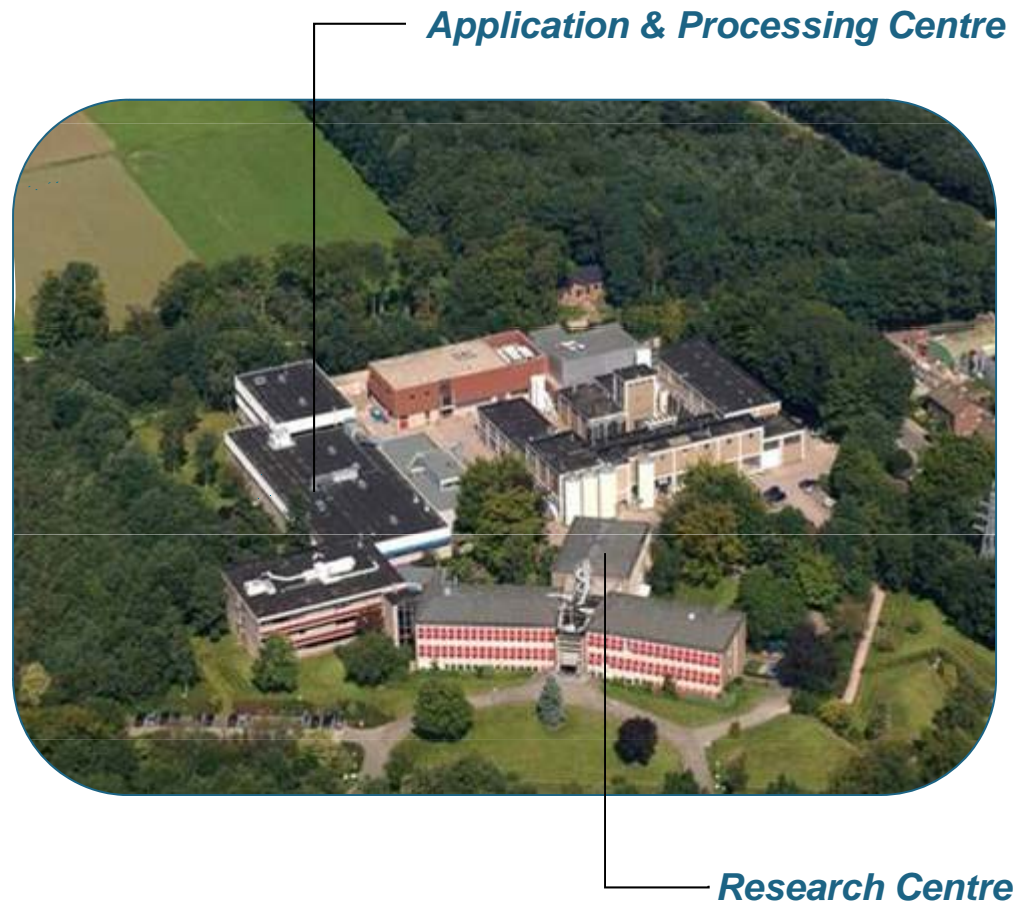
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NIZO pilot plant



## Introducing NIZO food research

- Independent, private contract research company for the food industry
- HQ in The Netherlands (Food Valley)
- Offices in France, UK, USA, Japan
- 150 professionals
- From lab to industry
- Food-grade pilot plant
- ISO 9001:2000



# History



1948

Founding N.I.Z.O.



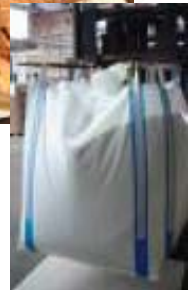
1974

Pilot Plant



1996-2004

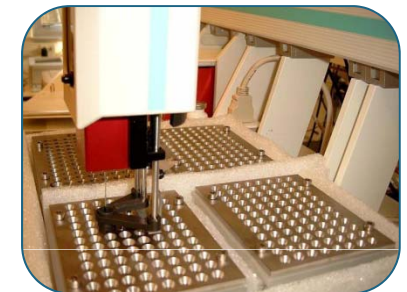
NIZO food research



2009  
Management  
Buy-out

# Services

- Research
  - Contract
    - Bi-lateral
    - Consortia
  - Pre-competitive
    - Platform for Industrial Fermentations (Kluyver)
    - Top Institute Food and Nutrition (TIFN)
    - ...
- Application / Product Development
- Production
- Consultancy
- Analyses



## NIZO has a long history in membranes

- First membranes were purchased in the late seventies
- Nowadays several semi-industrial units are available at NIZO, e.g.:
  - 3-stage UF spiral wound unit
  - 2 stage RO/NF spiral wound unit
  - 2 stage MF ceramic unit
- Many new products are tested in NIZO's pilot plant:
  - Lab tests using disposable membranes behave differently than industrial membranes
  - Small changes in substrate or operational conditions can have a large impact on performance

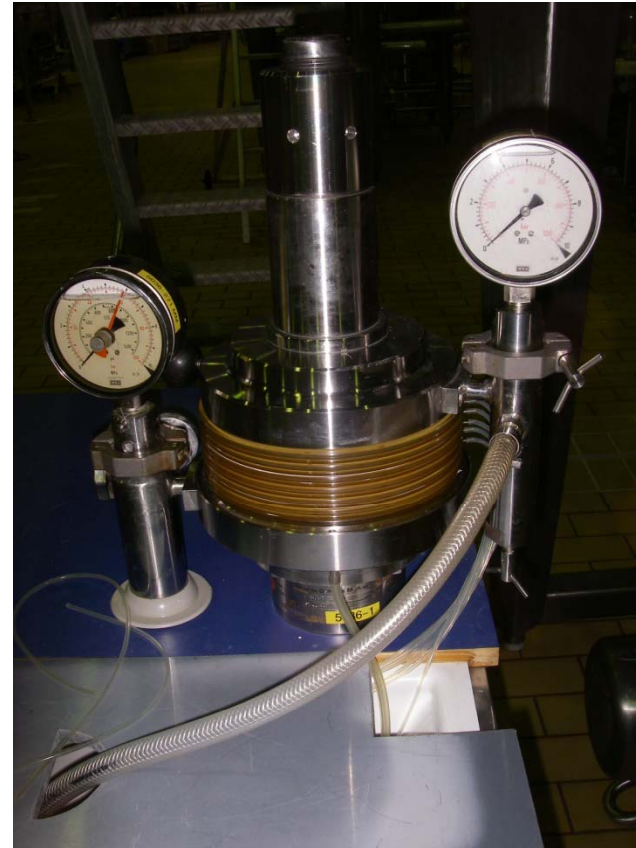
## Factory floor support

- NIZO experts support plants in their daily operation:
  - Membranes are getting more and more popularity in the food industry
  - Main difficulties in membrane operations:
    - Fouling
    - Short life time of membranes
    - Bacteriological issues
    - Low flux
    - Preferential flow
    - Retention issues
    - Cleaning times are too long
    - Cleaning costs are high
- Main causes:
  - Choice of membranes is not optimal
  - Installations are not properly dimensioned
  - Operational conditions are not suitable for the product

→ Test phase of membranes has been too limited

## Selection procedure of a new membrane process (I)

- Many different suppliers with their own definitions:
  - Cut-off
  - Clean water flux
  - Sizes
- ➔ Customers must put in considerable effort to find out which could be suitable membranes
- Testing various flat sheet membranes on LAB20 system :
  - First impression of retention
  - Relative flux



## Selection procedure of a new membrane process (II): Skid mounted membrane testing (usually 4“ spiral wound)

- Non-uniform dimensioning of membranes hamper easy exchange
- Different membrane specifications require versatile equipment
- Large amount of product needed, which becomes waste
- Testing for a short period of time may overestimate performance
- Laborious data collection

➔ Testing the best membrane for the job and determination of the optimal conditions is a **costly process**

## **NIZO's mini membrane unit**



*Together to the next level*

# Testing industrial membranes made easy

- Scada controlled:
  - Limited effort of operator needed
  - Automated data collection
  - Remote control is possible
- Versatile with regard to membranes:
  - Pressure vessels of various dimensions can be mounted
  - Spiral wound, capillary, tubular and flat sheet membranes
  - Temperature controlled 5-80°C
  - RO/NF feed pressure up to 40 bar
  - UF/MF circulation flow 20 – 4000 l/h
  - DF adjustable ratio
- Limited amount of product needed:
  - 2.5“ spiral wound membranes
  - Small hold-up of installation
  - Hold-up can be largely recovered undiluted
- Fit for food industry
  - Skid mounting; dimensions L x B x H = 1.80 \* 0.80 \* 1.90
  - Hygienic design
  - In situ membrane thermal sterilisation possible

## Design new membrane unit

- Data collected must be transformed into new process design
  - What are suitable membranes for the job
  - What diameter of membrane should be taken
  - How many membranes should be put in a pressure vessel
  - How many stages are applied
  - How many pressure vessels parallel
  - Which spacer should be chosen for the various stages
  - Which feed and circulation pumps are needed
  - How is the temperature maintained
- → Costs of ownership need to be calculated

## Cost of ownership factors

### Capital costs, machine and building:

- Write-off
- Interest
- Maintenance

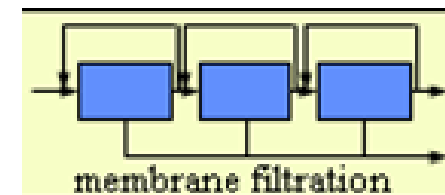
### Operational costs:

- Cleaning costs:
  - Water
  - Energy
  - Chemicals
- Power consumption by the pumps,
- Chilling costs
- Product losses in permeate/retentate
- Life-time of membranes (guaranteed)
- Labour



## Data transfer into process design

- Premia process simulation by NIZO:
  - Multi-stage installation:
    - Input: flux and retentions
    - Output: membrane area /CF/feed flow
  - Cost module:
    - Total cost of ownership



## Summary

- Membrane processes have a lot of potential in the food industry
- Importance of selection of the membranes should not be underestimated
- Process conditions do have a large impact on performance
- Mini membrane unit eases selection of membranes and operational conditions
- Mini membrane unit has proven to generate reliable data for industrial size units
- Premia software can help to design installations
- Cost of ownership can be calculated with Premia

Apply more membrane processes, but take your time when making choices in the product-process combination

thank you for your attention