



Biogas reject water treatment

EPCON history and facts

Business idea

- Separate solids from clean water.
- Energy efficiency through MVR energy recycling.
- We design the plant based upon the properties of the actual liquid to be evaporated.

CLIENT IN FOCUS – PERFORMANCE - EXPERIENCE



Company:

- Specialist in energy efficient MVR thermal separation / evaporation
- Knowledge based company
- Can supply turn key plants as well as components
- Located in Trondheim, Norway
- Owned by 5 entrepreneurs, through their investment company, who all has between 10-25 years background in same business.



EPCON's long history

- 1920 – 1970'ies: Bergs Maskin, dairy and food industry
- 1970'ies - 1986: A part of Landteknikk (LT), dairy industry
- 1986: EPCON established by entrepreneur from LT
- 2010: EPCON re-established with increased focus on key market areas and –products

Partners

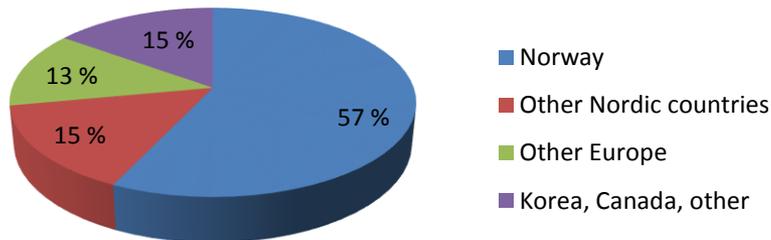
- Sales and marketing:
 - Finland: Ajon APU OY
 - Sweden and Denmark: Process- & Industriteknik AB
 - Netherlands: Enwell BV
 - Licence agreement with SC Engineering in South Korea

- Technology:
 - Sintef (Energy, Fish and marine products)
 - Sulzer Chemtech in Basel (Stripping and rectification)

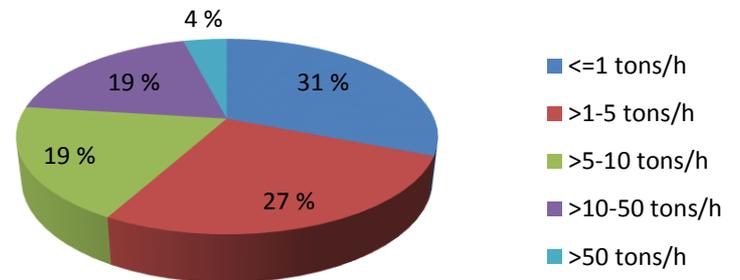
- Financing and operation of plants:
 - ADVEN OY

Long term experience – more than 100 pcs evaporators supplied

Projects subdivided in market areas



Projects subdivided in capacity range
(tons per hour evaporated water)



Focused industries

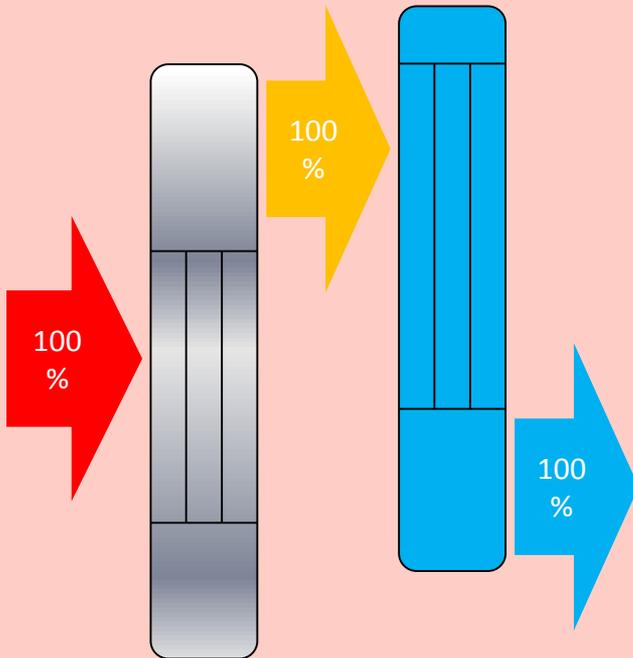
- Biogas reject water treatment
- Industrial wastewater treatment
- Biomarine industry
- Starch industry





Energy efficient dewatering

One effect evap.

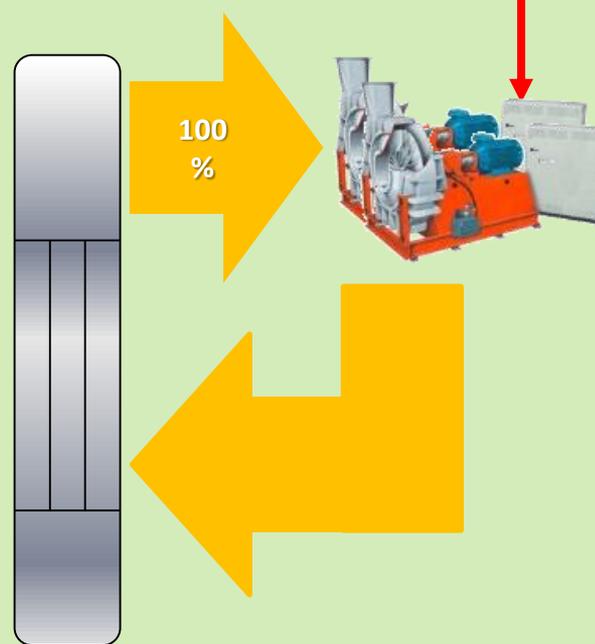


100% energy = 100% evap = 100% cooling

MVR evaporator

- ✓ Mechanical Vapor Recompression
- ✓ Efficient direct heat pump

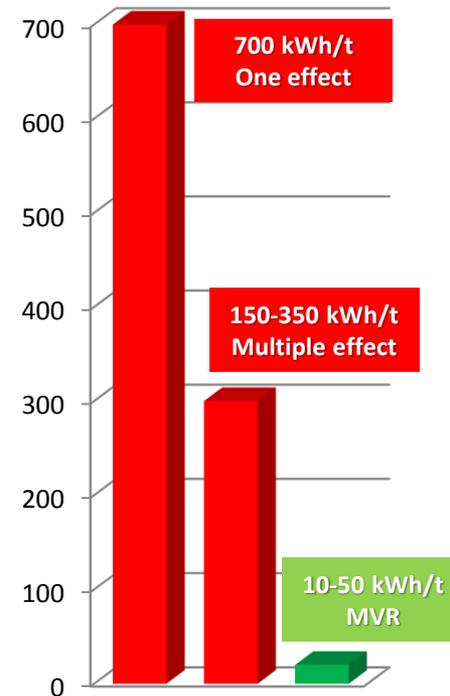
1 - 5% (electric energy)



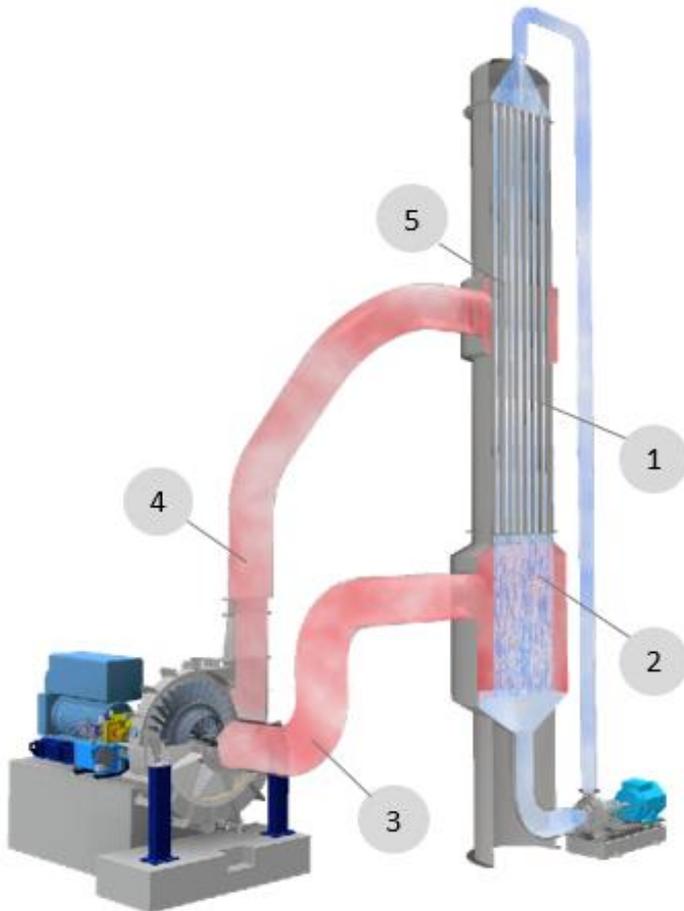
1-5% energy = 100% evaporation

Spes. energy consumption

- ✓ kWh per ton evaporation
- ✓ In multiple effect the evaporator reuses the steam from the previous effect.



What is MVR:



Description to figure.

1. The liquid evaporates in the tubes
2. The liquid is separated from the vapor to give a clean condensate
3. The vapor goes to the MVR fan at 100°C
4. The MVR fan compresses the vapor to higher pressure and temperature (105°C, sat)
5. As the vapor at 105°C is heat exchanged with the evaporating liquid, it condenses into a clean condensate.



Biogas reject water treatment

Why choose evaporation?

- Amount of digestate is reduced.
 - 70-90% of water is recovered
 - Concentrate (10-30% TS) can be used as fertilizer.
 - Makes distribution and storage easier
 - Increased value of fertilizer

- Make up water for digester control
 - Phosforus balance
 - Bleed off ammonia from digester

- Condensate can be used as technical water or for discharge to surface water.

Why choose evaporation?

- Efficient process for dry matter separation
- Reject water treated at high temperature
- Proven technology
- With EPCON MVR evaporator, low energy consumption
- Good operational availability
- Robust technology, long lifetime
- Low maintenance cost

Possible process configurations

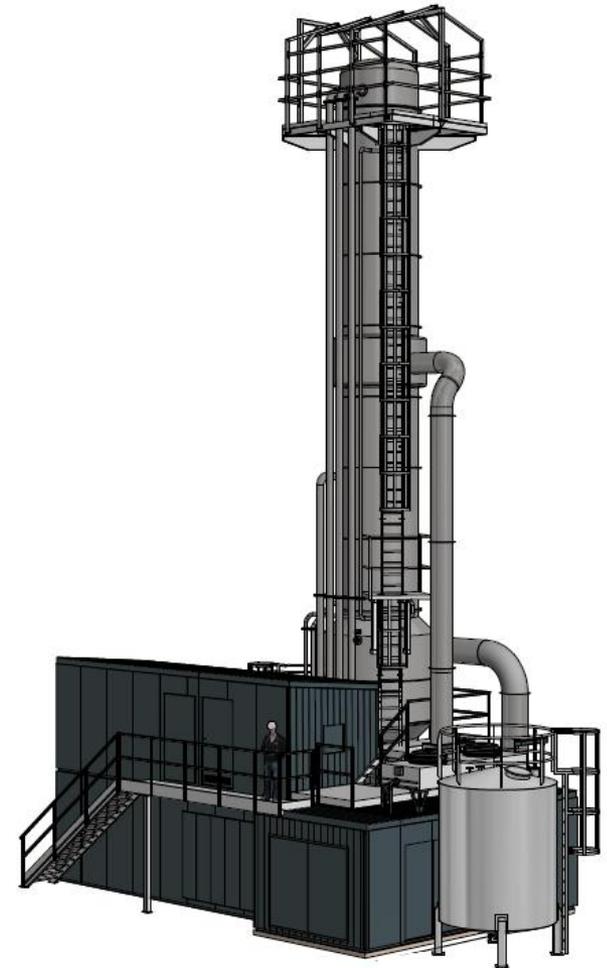
- ❦ Decanter, mixing feed with acid, MVR evaporation
- ❦ Decanter, MVR evaporation, ammonia stripping of condensate
- ❦ Decanter, ammonia stripping, mixing feed with acid, MVR evaporation.

Additionally, a condensate polisher can be installed if required.

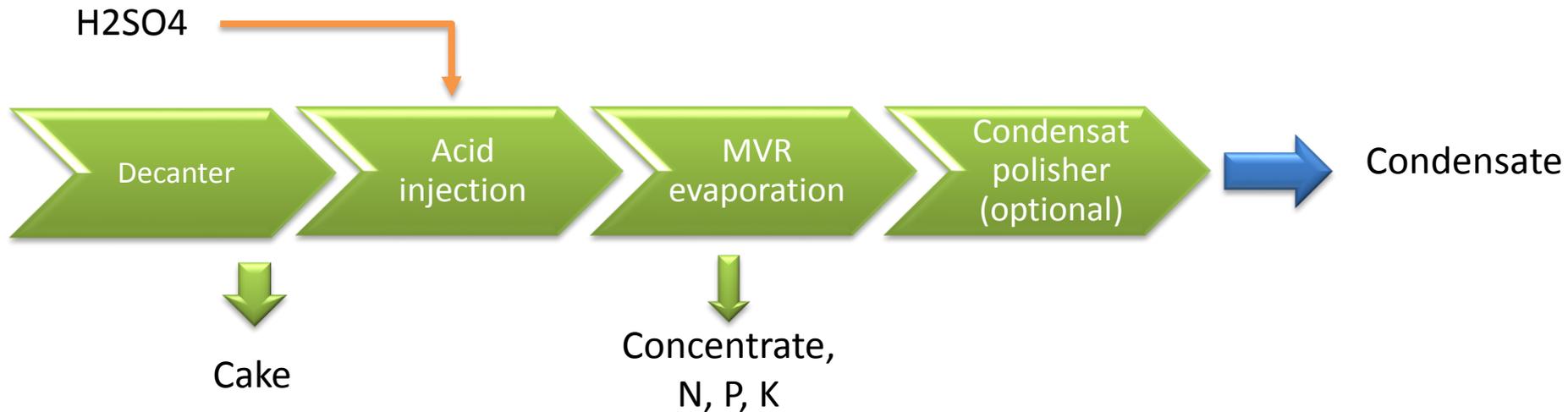


Basis of comparison:

- FFC-MVR-4S-100 +BG
- Reject water: 10 t/h
- Boiling temp: 80°C
- DS from decanter: 2%
- Assumed DS out: 25%
- Feed nitrogen: 4200 mg/l
- Feed ammonia: 3000 mg/l

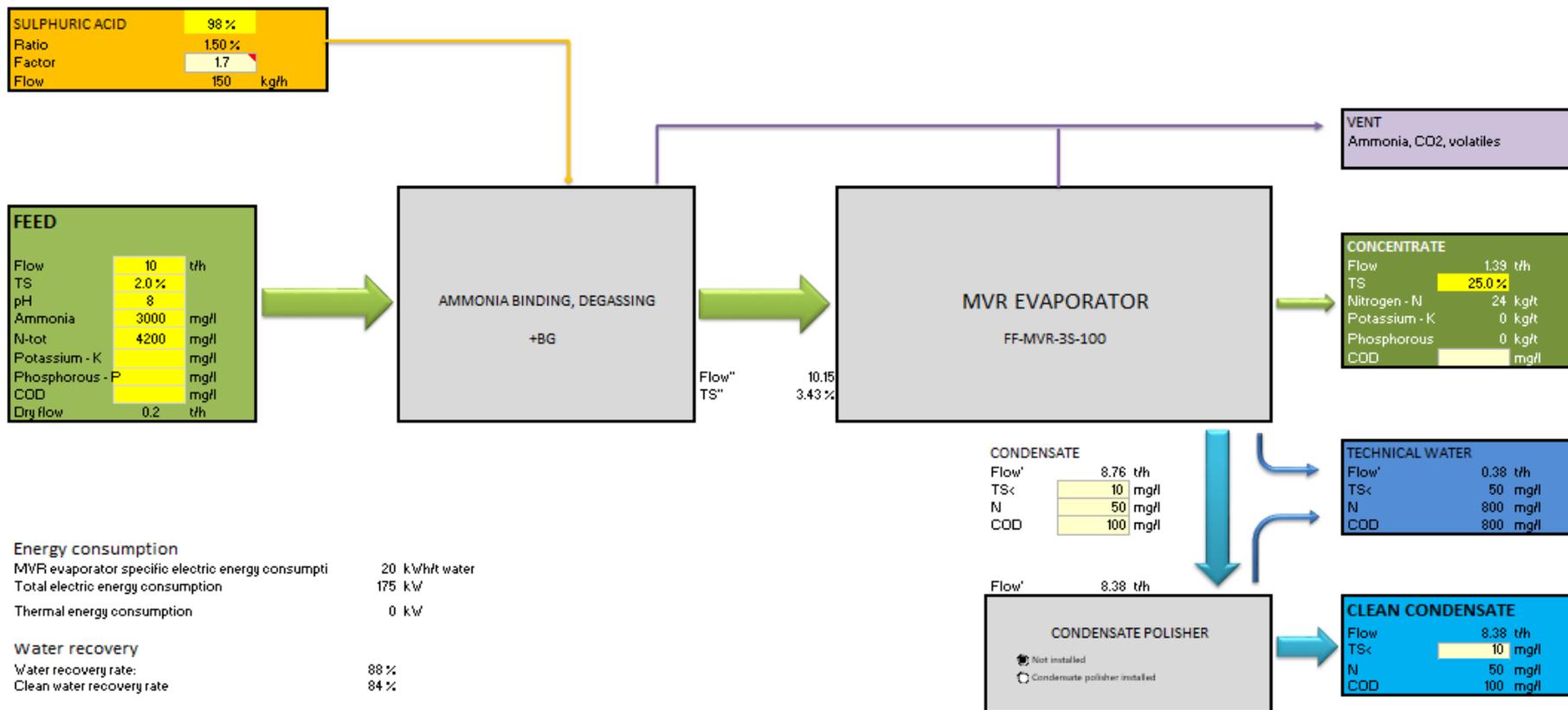


Configuration used at low and medium N content.



- Lowest energy consumption
- Lowest investment cost
- N+P+K in concentrate
- Sulphuric acid required to bind ammonia

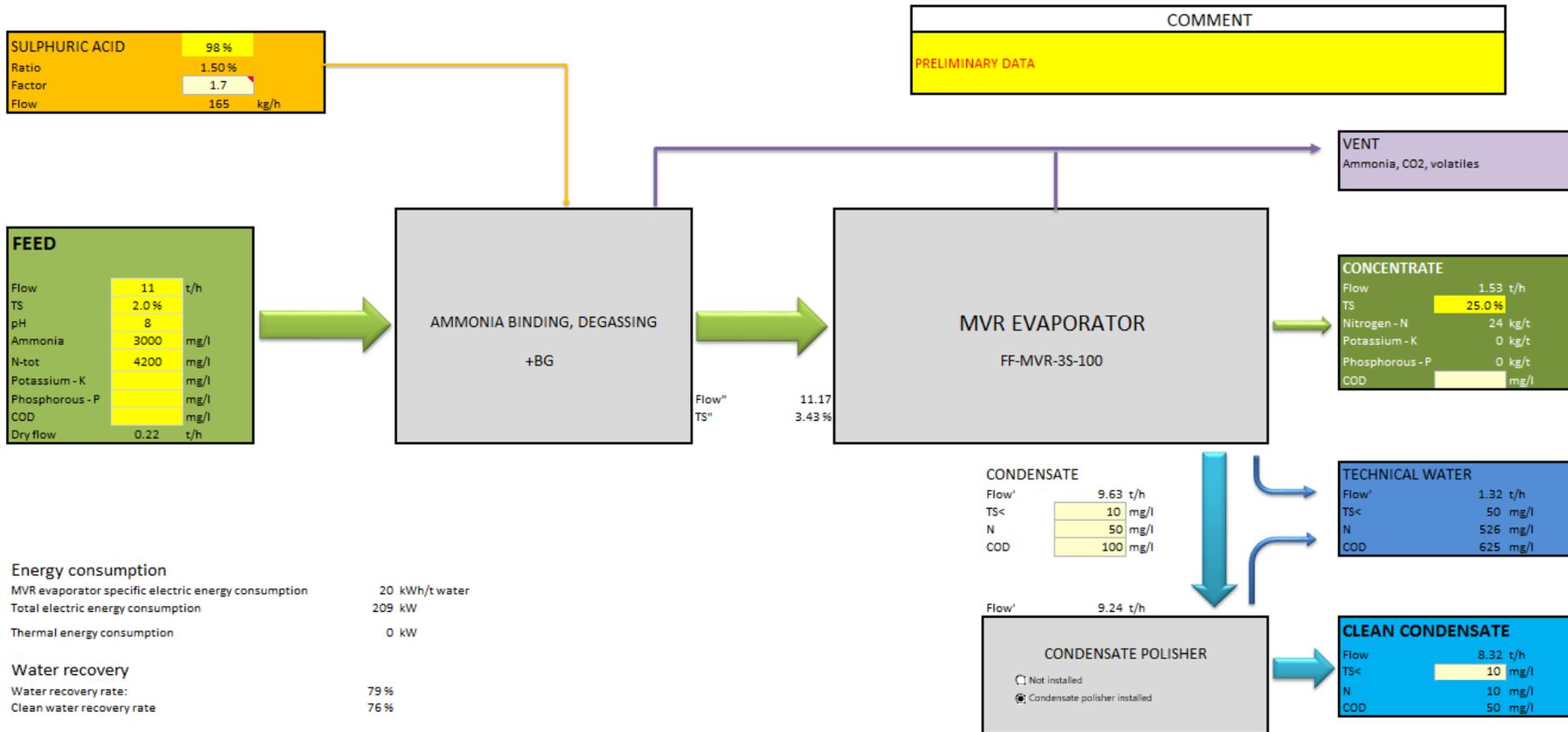
Sample without condensate polisher



Typical values:

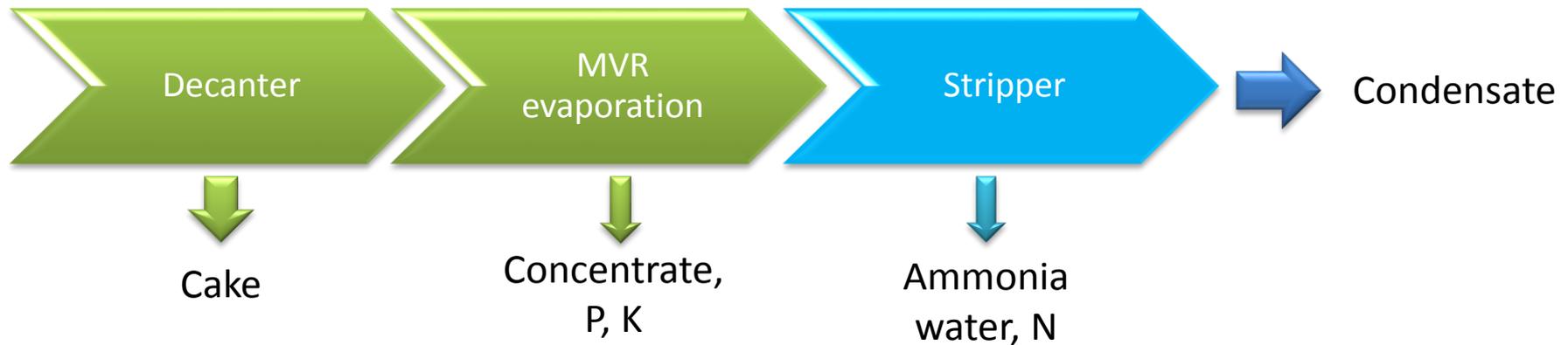
-  N: 10-50 mg/l
-  COD: 50-100 mg/l

Sample with condensate polisher



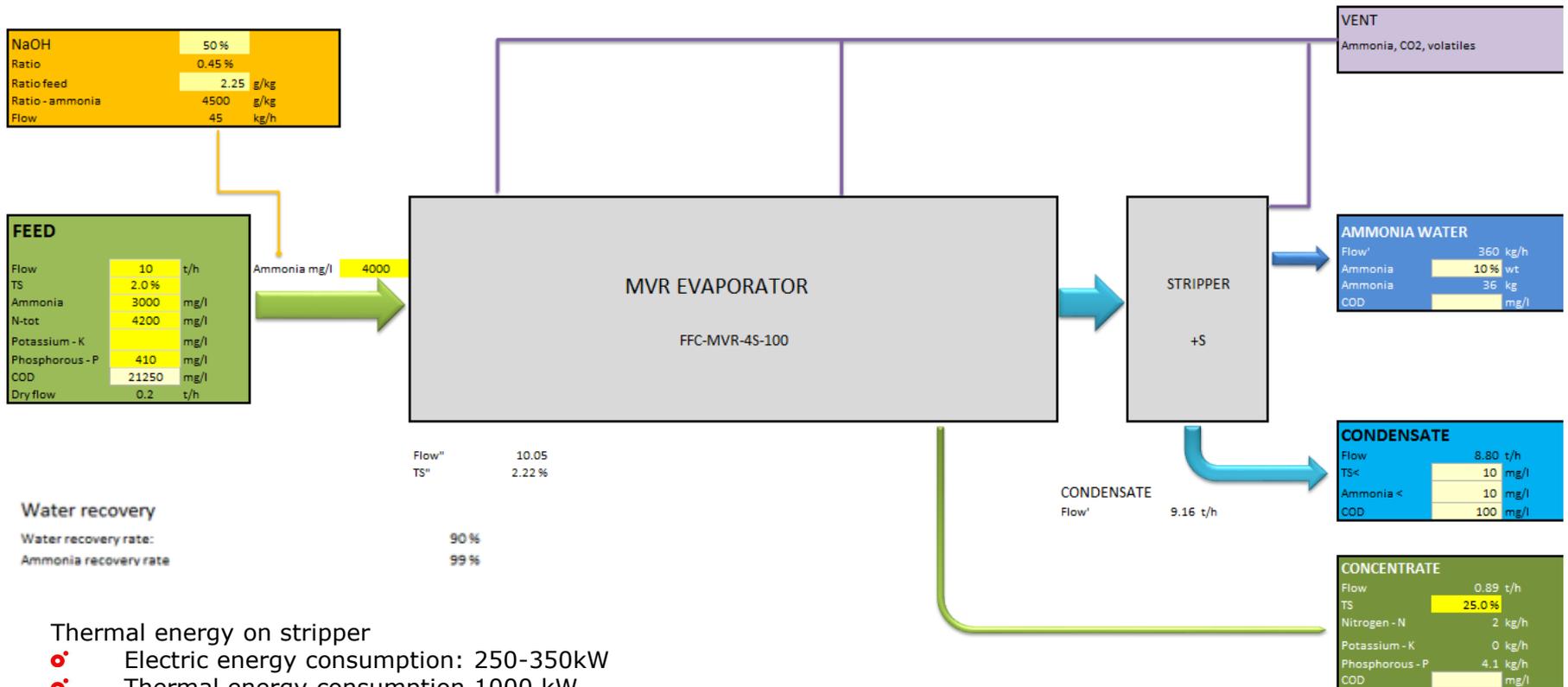
Typical values:
 N: 5-10 mg/l
 COD: 10-50 mg/l

Configuration used at medium N content to keep N separate.



- P+K in concentrate
- N as ammonia water
- NaOH required to keep N as ammonia
- Lower COD and N in condensate
- Easy operation of stripper
- Higher energy consumption (Electric and thermal)

Sample with condensate steam stripper



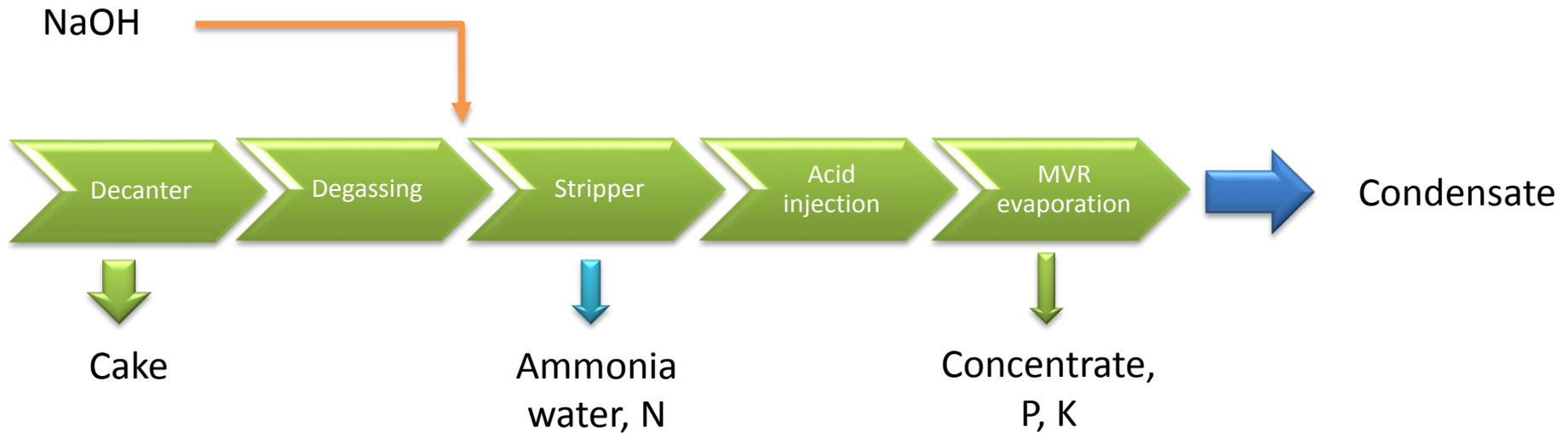
Thermal energy on stripper

- Electric energy consumption: 250-350kW
- Thermal energy consumption 1000 kW

MVR on stripper

- Electric energy consumption: 350-400kW
- Thermal energy consumption: 0kW

Configuration used at high N content (>7000mg/l)



- P+K in concentrate
- N as ammonia water
- NaOH required to keep N as ammonia

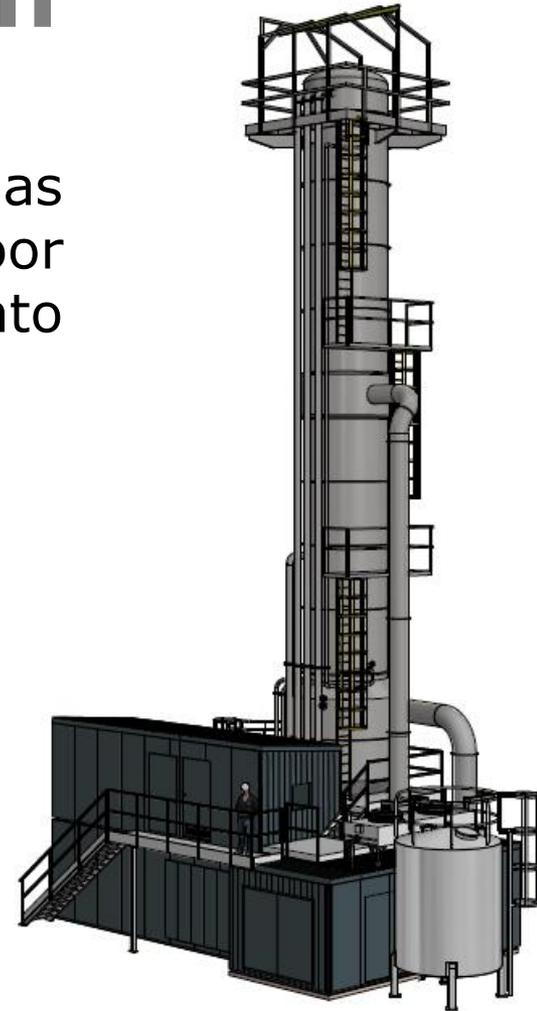
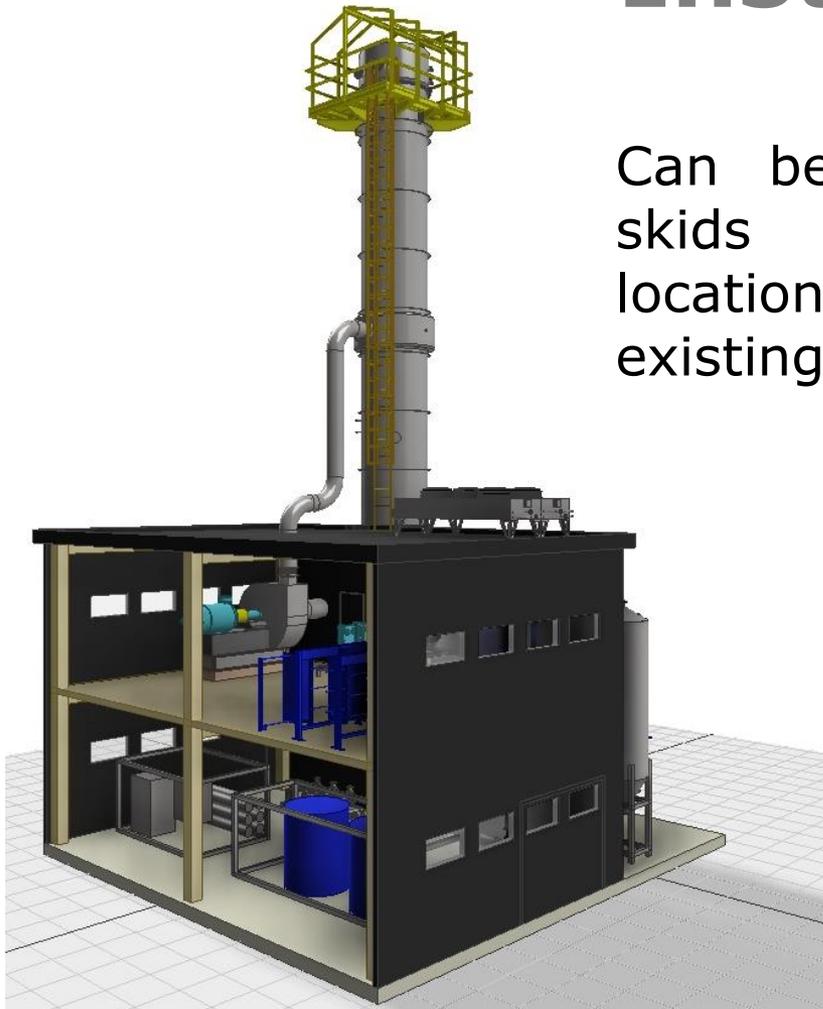
Scope of delivery

We can deliver from turn key to main components, all based upon the clients request.



Installation

Can be delivered as skids for outdoor location or built into existing building.



Biogas references



Biovakka OY, Finland(2008):

Biogas reject water treatment:

- Digester for pig manure and industrial waste
- 100.000 t/y feed
- Electricity from CHPs
- Has condensate polisher installed

- FF-MVR-3S-100 +BG
- Reject water: 13 t/h
- Water recovery rate: 80%
- Boiling temp: 80°C
- DS in/out: 3 / 20-25 %
- El. energy cons.: 200 kW
- Feed nitrogen: 7000 mg/l
- Cond. nitrogen: 10-50 (<10) mg/l
- Cond. COD: 100-500 (<70) mg/l



Suiker Unie Green Energy The Netherlands (2012):

Biogas reject water treatment:

- Digester for sugar mill waste
- 100.000 t/year feed
- Produces gas to grid

- FFC-MVR-4S-190
- Reject water: 20 t/h
- Water recovery rate: 82%
- Boiling temp.: 80°C
- DS in/out: 2 / 12-15 %
- El. energy cons.: 440 kW
- Feed nitrogen: 2760 mg/l
- Cond. nitrogen: 32 mg/l
- Cond. COD: 70 mg/l
- Cond. BOD, 5 day: 42 mg/l



Lab and pilot testing performed for biogas reject water

Lab and pilot testing for more than 10 biogas plants, mainly in Nordic countries.

These projects have not been realized yet.

Tests performed with reject water from digesters fed with:

- Household waste
- Fish farming waste
- Agricultural waste
- Papermill waste
- Waste from food industry
- Municipal sludge
- Mixtures of wastes above



Examples of other relevant experiences

Adven, Finnamyl, Finland

Concentrating potato fruit juice:

- FFE-MVR-3S-420
- Evap. mass: 42 t/h
- Boiling temp.: 72°C
- DS in/out: 3/40 %
- Energy cons.: 705 kW
- Footprint x height = 11 x 13 x 28 m



Danisco, Finland (2008)

Concentrating Barley Steep Liquid :

- FFE-MVR-3S-100
- Evap. mass: 10 t/h
- Boiling temp.: 58°C
- DS in/out: 5/35 %
- Energy cons.: 180 kW



Daesang Corp., Korea (2005)

Concentrating Corn Steep Liquid:

- FFC-MVR-4S-250
- Evap. mass: 25 t/h
- Boiling temp.: 58°C
- DS in/out: 14/50 %
- Energy cons.: 650 kW



Havsbrun, Faroe Islands.

Stickwater evaporation:

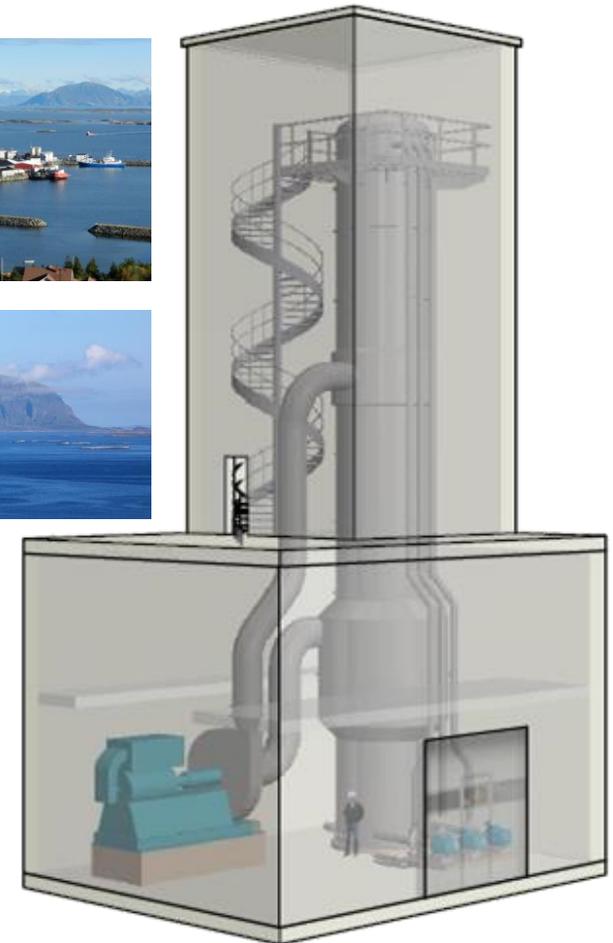
- FF-MVR-3S-300
- Evaporation: 30 t/h
- Temperature: 80°C
- TS in/out: 10/35 %
- Energy consumption: 750 kW



Aquarius AS, Norway (Delivery 2016)

Fish silage evaporation:

- FF-MVR-3S-300
- Evaporation: 30 t/h
- Temperature: 80°C
- TS in/out: 11/48 %
- Energy consumption: 750 kW



Performance before you buy - evaporation testing



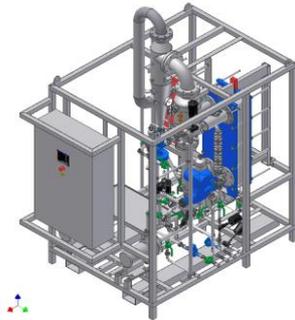
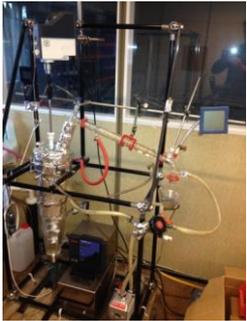
Why evaporation tests?

There are seldom to equal reject waters. Hence evaporation tests are required to determine and verify:

- Water recovery rate, maximum concentrate concentration
- Liquid properties as concentration increases (viscosity, boiling point elevation, density etc.)
- Condensate quality
- Requirement for condensate polisher, if any
- Requirement for anti foaming agents, if any
- Cleaning intervals, CIP procedure



EPCON testing facilities



Lab evaporation test

A suitable first step is often a lab evaporation test. This test confirms the main liquid properties and suitability for evaporation.

Condensate quality can be analyzed after evaporation.

Further condensate treatment can be validated.

A 2-page test report is issued.



Pilot evaporation test

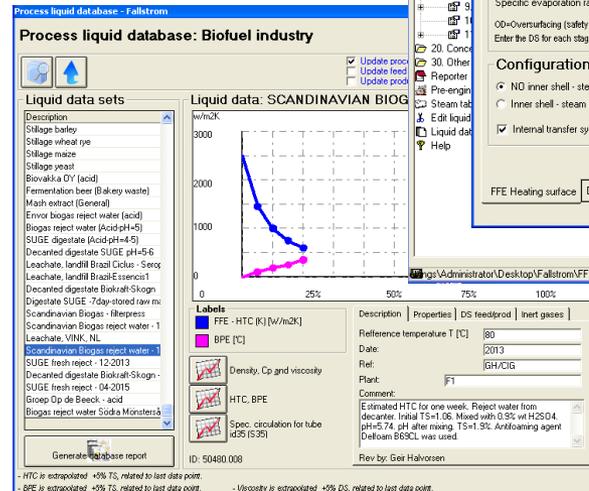
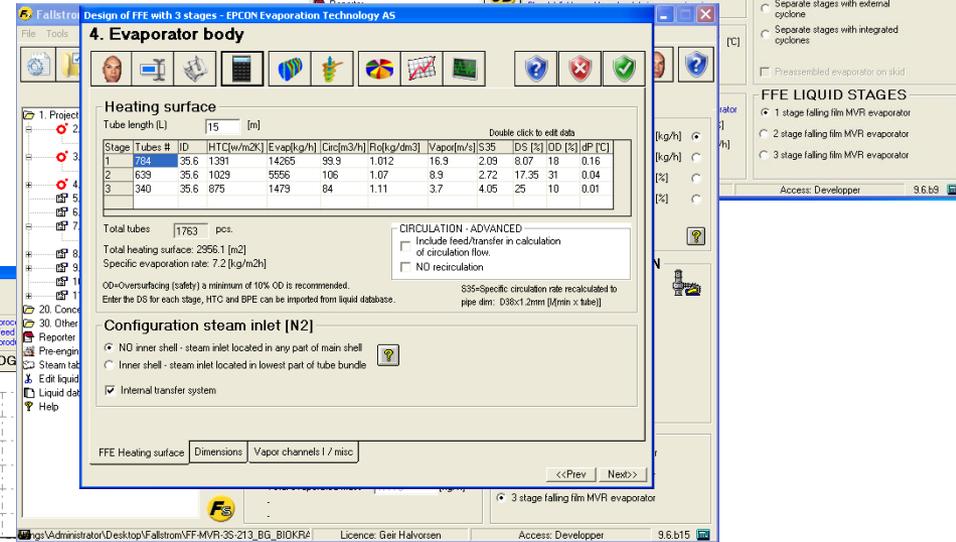
- Short term pilot test can be performed in our facilities.
- EPCON has a container based MVR evaporator for long term tests performed at customer site.
 - Cleaning interval and cleaning procedure can be verified during long term tests.
 - Performance can be evaluated based on variations in raw material.
- Condensate can be sent for further pilot treatment.
- Test report is issued.
- Based on pilot test we can give performance guarantees.



Design software and tools

Design of evaporators

- EPCON software: Fallstrom (1998 – 2015)
- CHEMCAD, CC-therm
- Calculation and construction
 - Visual vessel design (VVD)
 - Autodesk inventor
 - ANSYS designspace



Aftersales services

Aftersales services - an important part of our concept

- Preventive maintenance through online/
remote diagnostic and periodic service
- Corrective maintenance possible within 24h
- Spare parts
- Training / education
- Service Agreement, different types.



Operational financing

ADVEN - our partner in operational financing

- **Adven offers full service on a “build, own, operate” business model**
 - Long term contracts of 10-20 years
 - After the contract the plant may be redeemed or
 - Off balance sheet model, no redemption obligation/right
 - Simple and fixed pricing for full service
 - Complete EPC project, can offer extended scope of supply.
(no project risk for client)
 - Own/finance
(fixed cost included in price)
 - Operate and maintain
(Spare parts and maintenance included)
-  **1) €/monht**
2) + €/m3
- Adven serves over 160 B2B clients with a turnover over of 150 M€/a and staff of 220 people
 - 30 year track record with around 200 industrial cases

Thank you for your attention!

