AEE INTEC

AEE - Institut für Nachhaltige Technologien

Process Intensification in Biorefineries using Membrane Distillation (MD)

Austrian Biorefining Stakeholder Workshop

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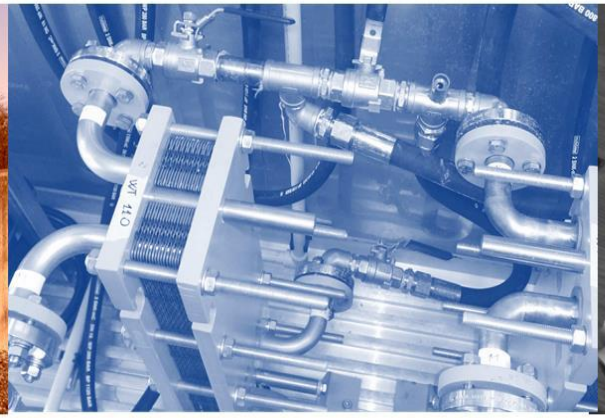
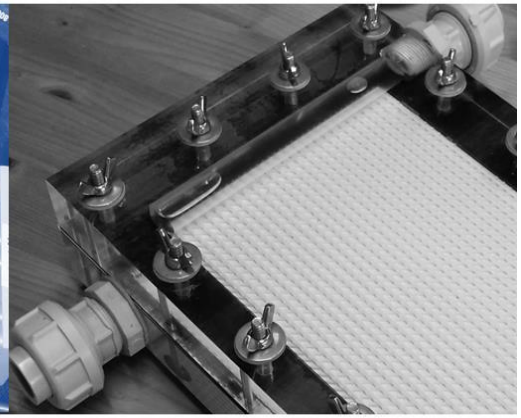
8200 Gleisdorf, Feldgasse 19, AUSTRIA

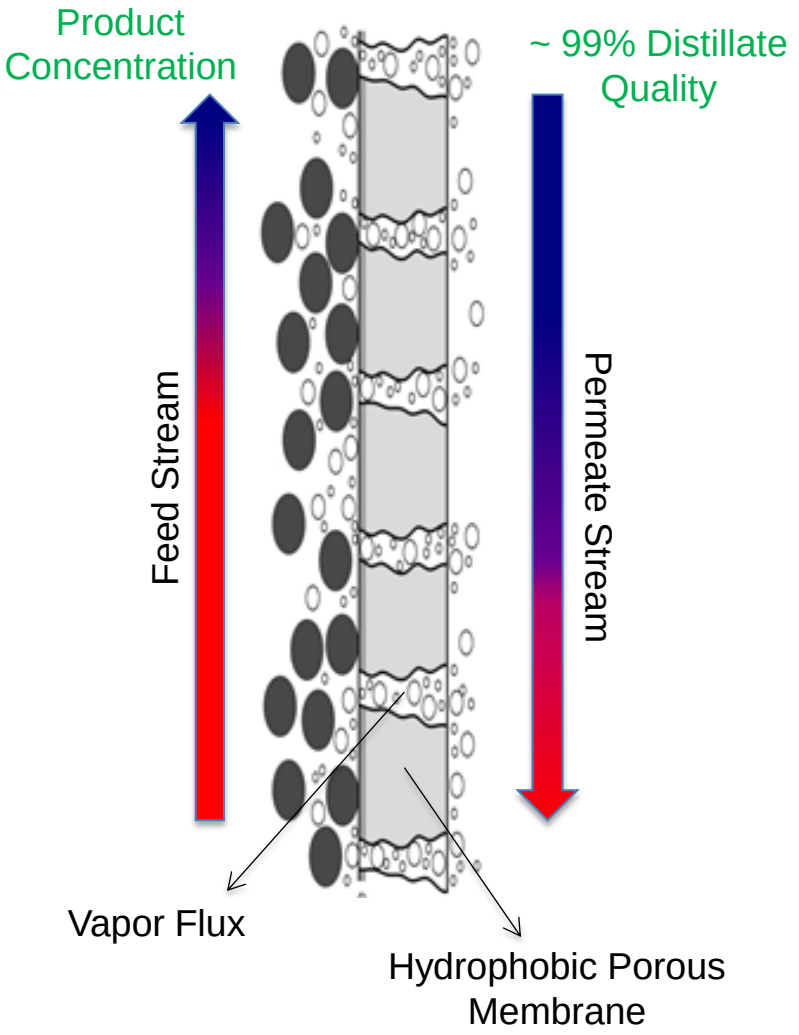
Agenda

- AEE INTEC
- Membrane Distillation
- MD @ AEE INTEC
- MD in Biorefineries

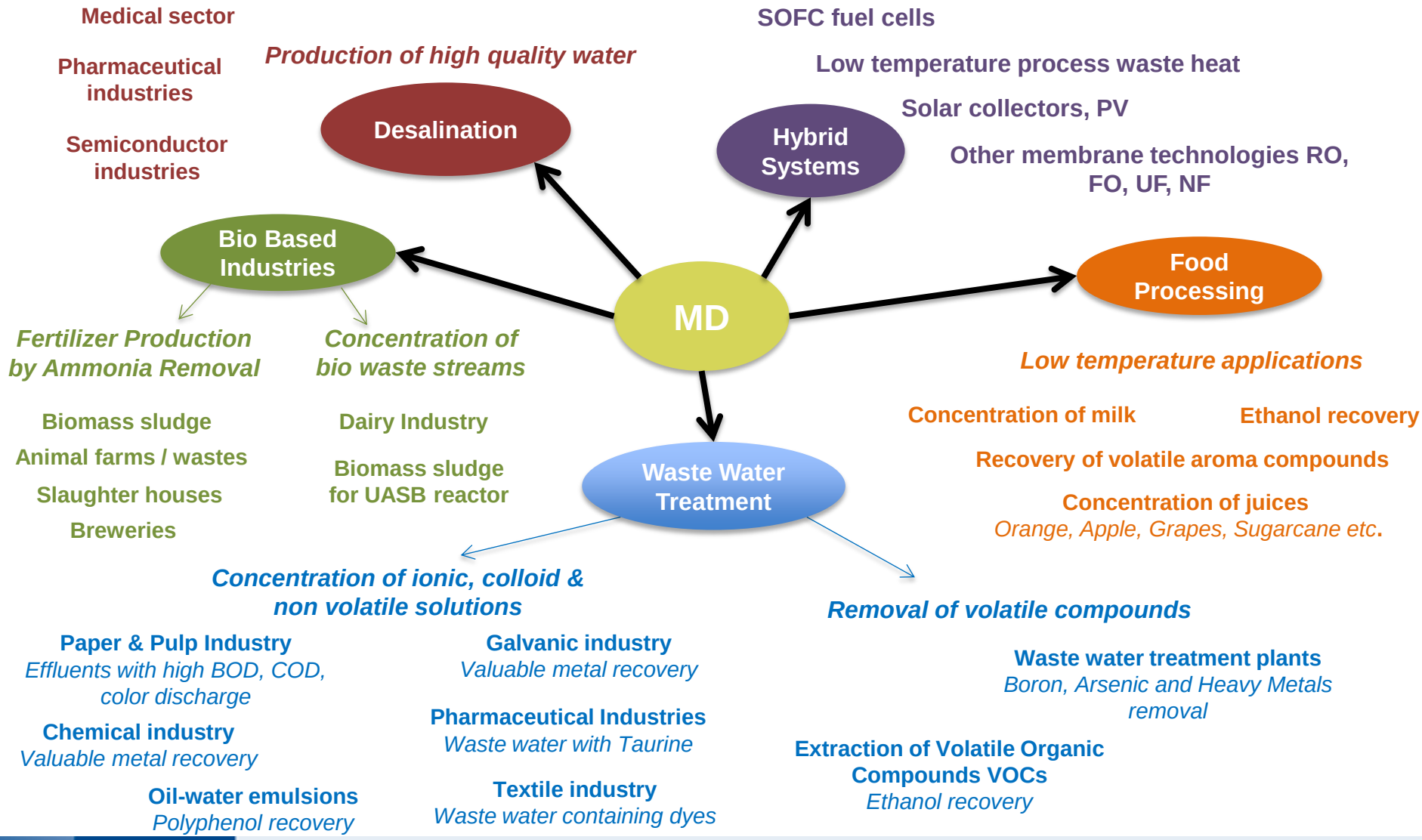




Membrane Distillation MD - Principle

- *Non-Isothermal* Membrane Separation Process
- Driving force: Partial vapor pressure difference (induced as ΔT)
- Vapor phase flux
- Lower Thermal and Electrical energy demand
- Integration potential for Waste Heat or Solar Energy



MD Applications



MD Projects @ AEE INTEC

Feed Concentration

Ammonia Separation

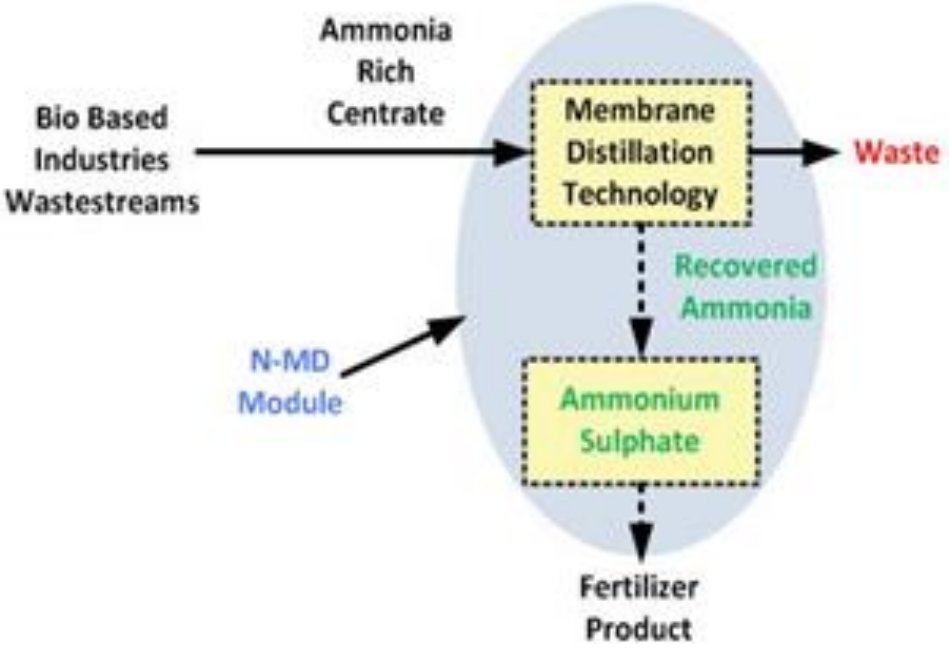
MD Projects

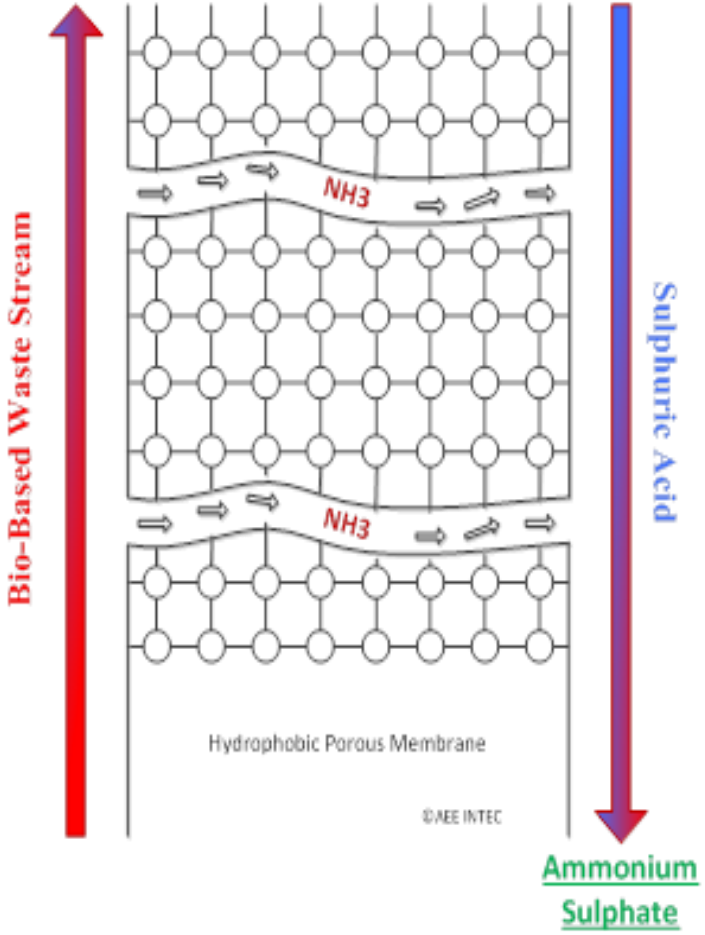
For detail of these projects, please visit http://www.aee-intec.at/

MD in Biorefineries

- Adding value to bio waste streams

$$2NH_3 + H_2SO_4 = (NH_4)_2SO_4$$





MD in Biorefineries

- Average experimental results from AMRE MD

Flow Rate	Feed Temperature	Permeate Temperature	Module Area	dT	NH4N Initial Concentration	Flux
L/h	C	C	m²	C	mg/L	kg/m²h
300	80	20	1.6	0.5	1200	0.02

- Experimental conclusions
  - $\dot{m}_{flux} \propto T_{feed,In}$
  - $\dot{m}_{flux} \propto \dot{V}_{feed,In}$
  - $\dot{m}_{flux,\,NH4N} \propto C_{NH4N\ feed,In}$
  - $\dot{m}_{flux,\,H2O}\ ^{1}/_{\propto} C_{NH4N\ feed,In}$
  - $\dot{Q}_{Thermal} \propto \left(T_{feed,In} - T_{permeat,Out}\right)\ or\ \Delta T$

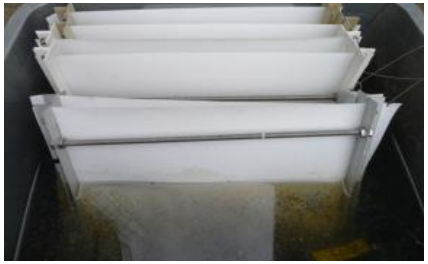
Case Study on MD in Biorefineries

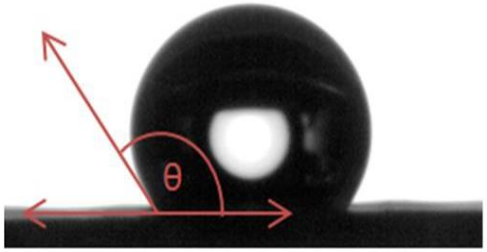
- MD system for treating 900 m³/year Pig manure sludge with 9,8 g/L of NH4N.

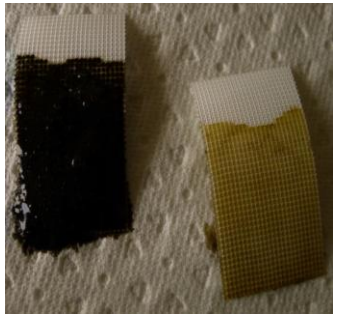
Ammonium Sulphate Product	32.5 ton/year
Specific Thermal Energy	11.1 kWh/kg
Specific Electrical Energy	0.15 kWh/kg
Infrastructure Costs	~ 40 000 EUR
Thermal Energy Costs	~ 7500 EUR/year
Profitability	~ 15 000 EUR/year
Payback Period	2.7 years

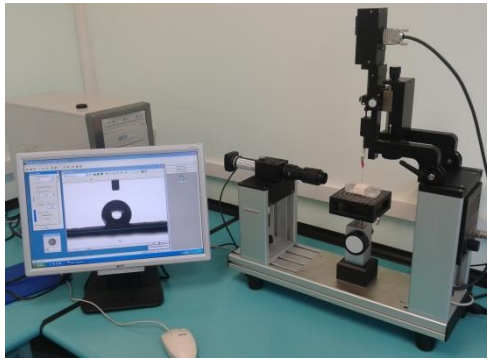
MD @ AEE INTEC

- Membrane Specification
  - Hydrophobicity by Contact Angle Measurements
  - Chemical Resistance
  - Physical Stability by Liquid Entry Pressures (LEP) Tests



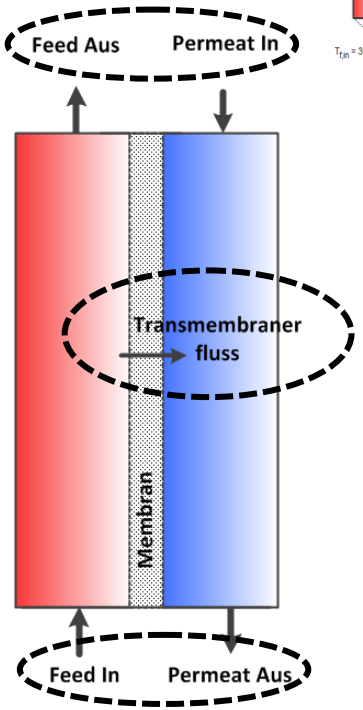


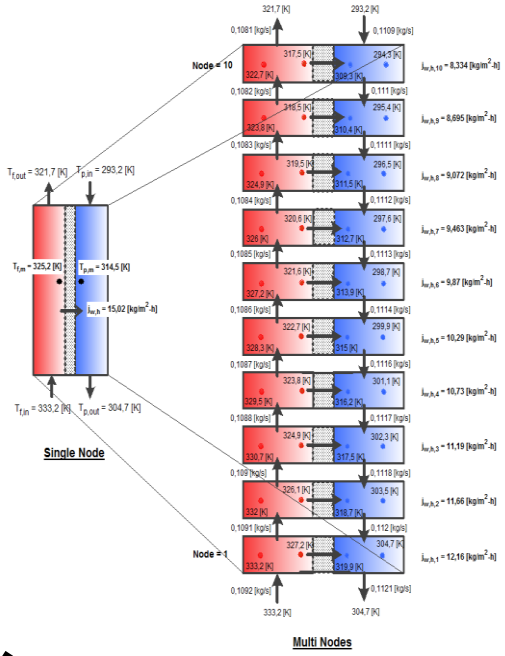


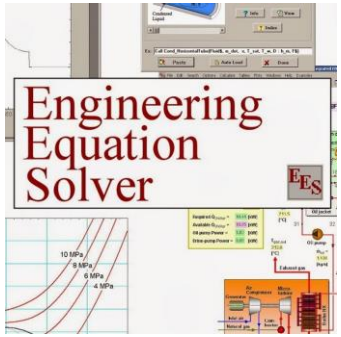


MD @ AEE INTEC

- Module Design
  - Numerical Simulations
  - Module Configuration
  - Geometrical Parameters
  - Process Parameters

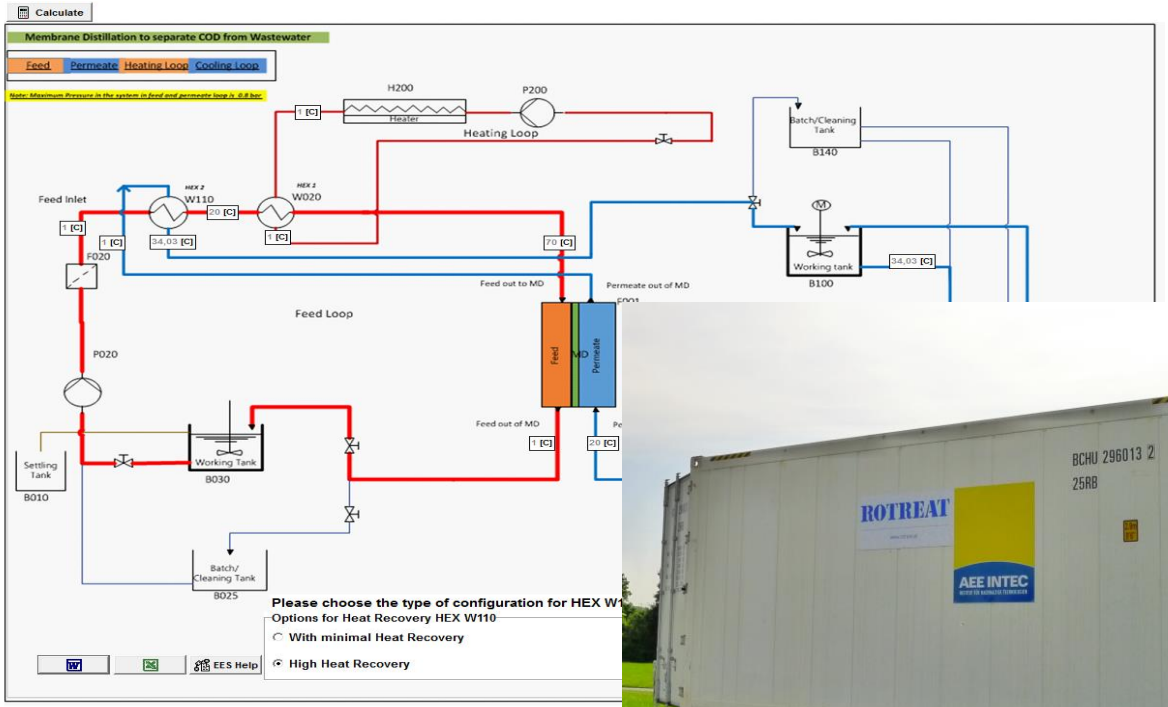






MD @ AEE INTEC

- Membrane Distillation Plant Design
- Module Assembly

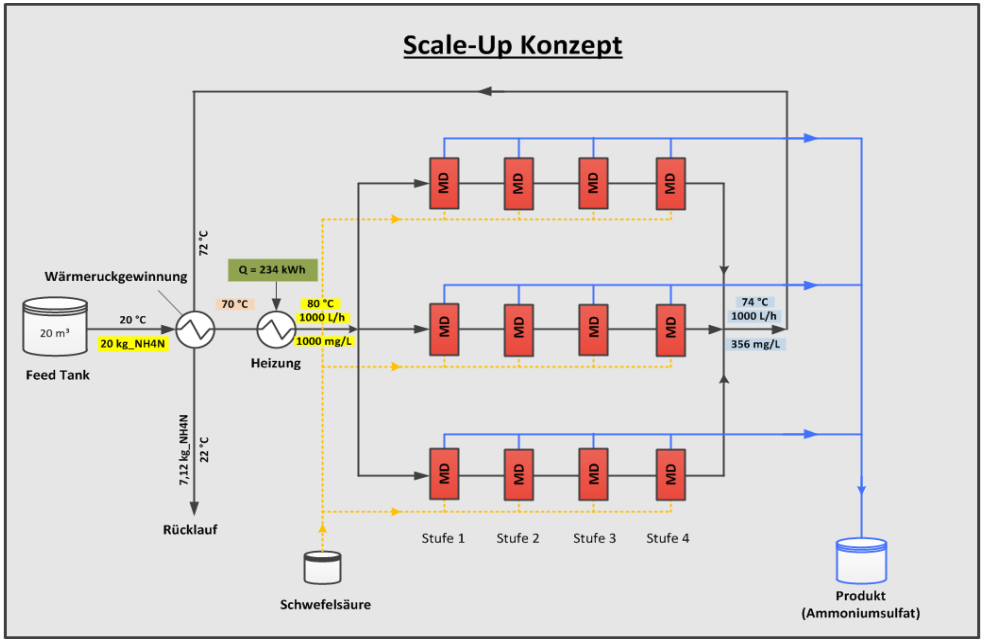


MD @ AEE INTEC

- Experiments
  - Preliminary / Feasibility Tests
  - Lab-Scale Experiments
  - Demonstration Plant Experiments

MD @ AEE INTEC

- MD System Up-scaling
  - Lab / Demo Scale → Real System Design
  - Scheme for MD Process Integration
  - Economics of the MD Process



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IDEA TO ACTION

Thank You for Your Attention !