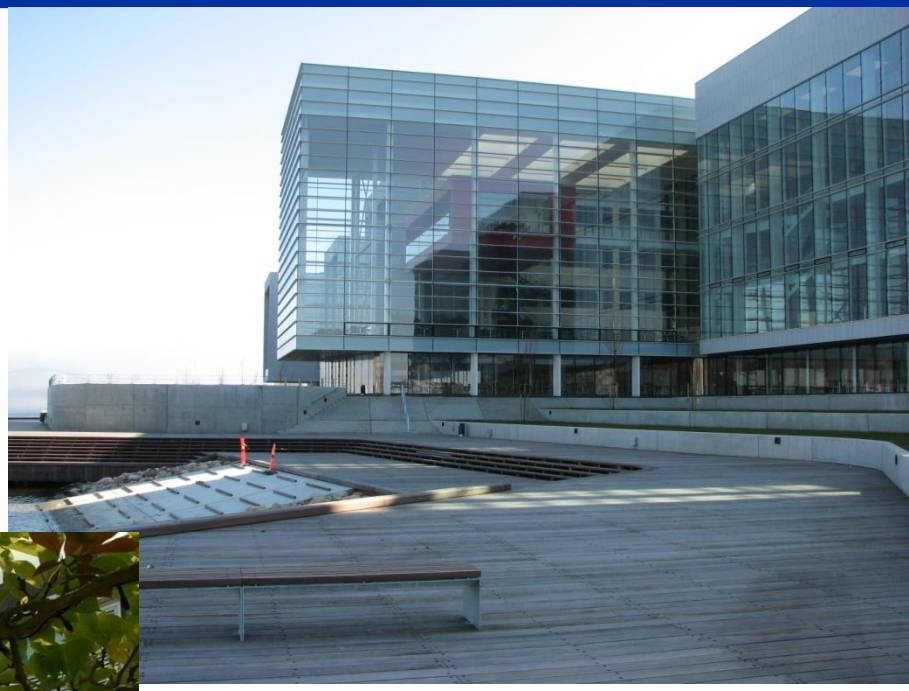
UNIVERSITY OF SOUTHERN DENMARK

Birgir Norddahl

Department of Chemical Engineering



Campus Odense

Campus Sønderborg

Biotechnology and Environemental Technology

Faculty of Engineering

Students

Odense: 2 300 students
Sønderborg: 300 students

Foreign students

Odense: 680 students
Sønderborg: 120 students

Research in Fac. Technol.

- Software Engineering And Technology
- Embedded Software
- Intelligent Sensors & Actuators
- Mathematical Modelling
- Artificial Intelligence
- Robotics
- Nanotechnology
- Mechatronics
- Structural Engineering
- Entrepreneurship
- Manufacturing Technology
- Sourcing
- Supply Chain Management
- Product Development
- User Centred Design
- Chemical Engineering
- Biotechnology
- Environmental Engineering

Dept. of Chem. Eng., Biotech. and Environmental Tech. (CBE)

Research groups

Bioproduction technology

- Refining of animal and vegetable raw materials to food, feed and pharma.
- Reduction of GHG and recycling nutrients in biological production systems
- Biomass conversion for industry and energy

Chem. Engineering

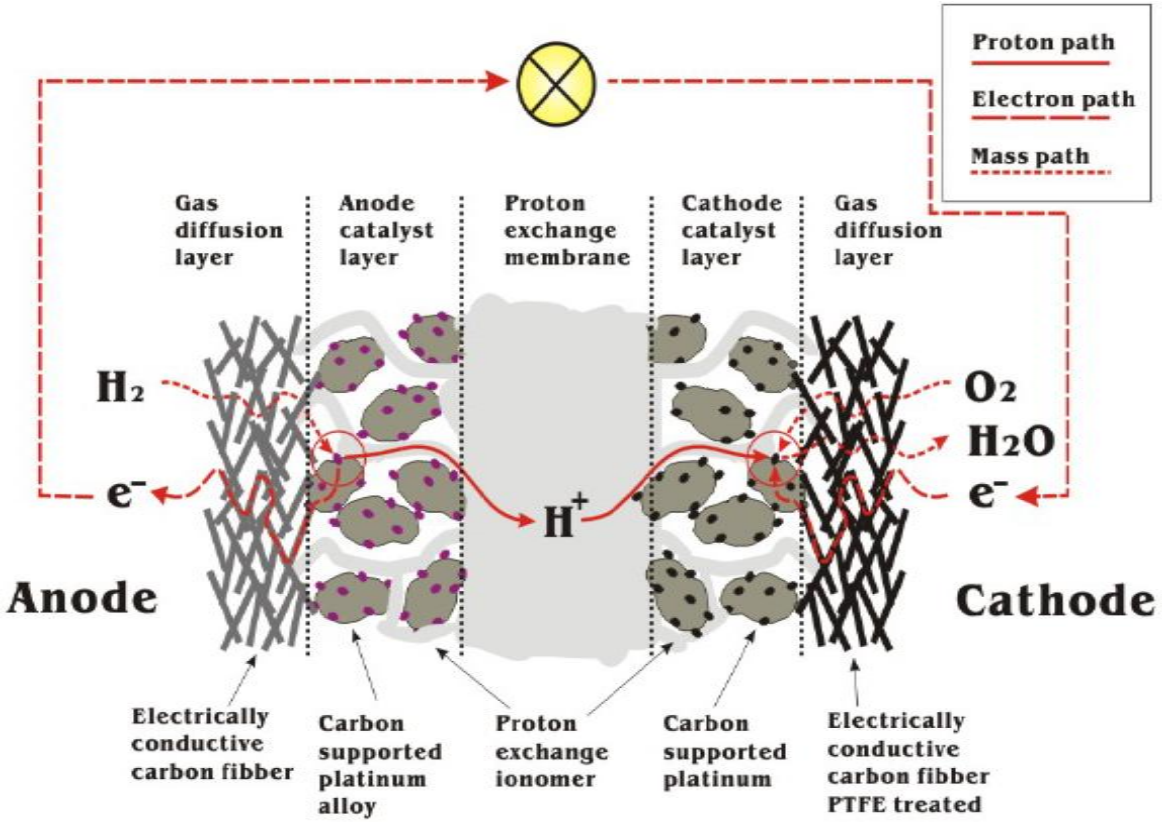
- Membrane technology and separation processes
- Reactor design and reaction technology
- Material Science and Fuel cells

Environmental Engineering

- System and life cycle analysis
- Waste handling technologies
- Environmentally sustainable technologies

Low temperature Fuel Cells (PEFC)

- Why Fuel Cells?
- What is fuel cells?
- What is the strength of (



Membrane technology: Membrane distillation

Making c ncentrate of:

E
f

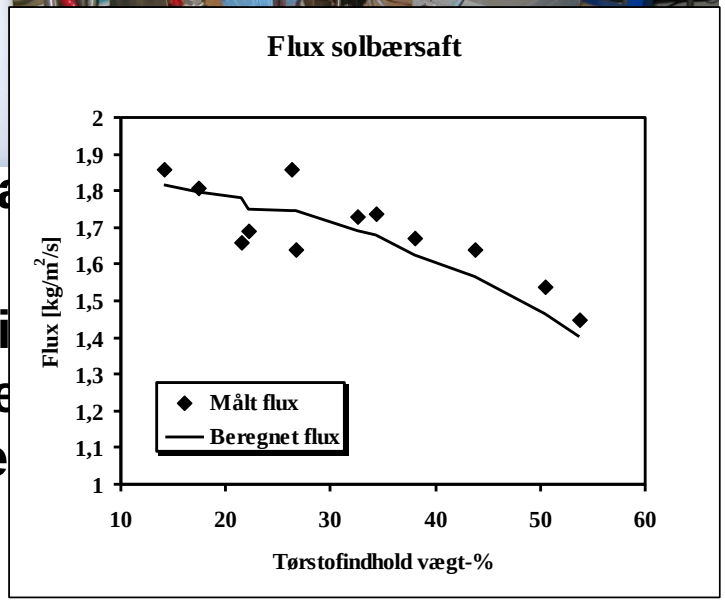
Irriga

Maki
Whe
Che

We build our own pilot plants

We model the watertransport

..and do the scale-up from lab to full scale



Biorefinery Whole Crop Concept

Optimised harvest

Oil seeds

Straw

Optimized logistics

Biodiesel and by-products production

Pre treatment oil seeds

Enzymatic transesterification - continuous process

1

Glycerol to monomer for polymers conversion

Biodiesel

Straw pretreatment steam hydrolysis

Simultaneous saccharification and fermentation in membrane bioreactor

Animal feed

Fatty acids to Nutraceuticals conversion

15% to biodiesel production

1

Biohydrogen

Bioethanol

Biogas plant

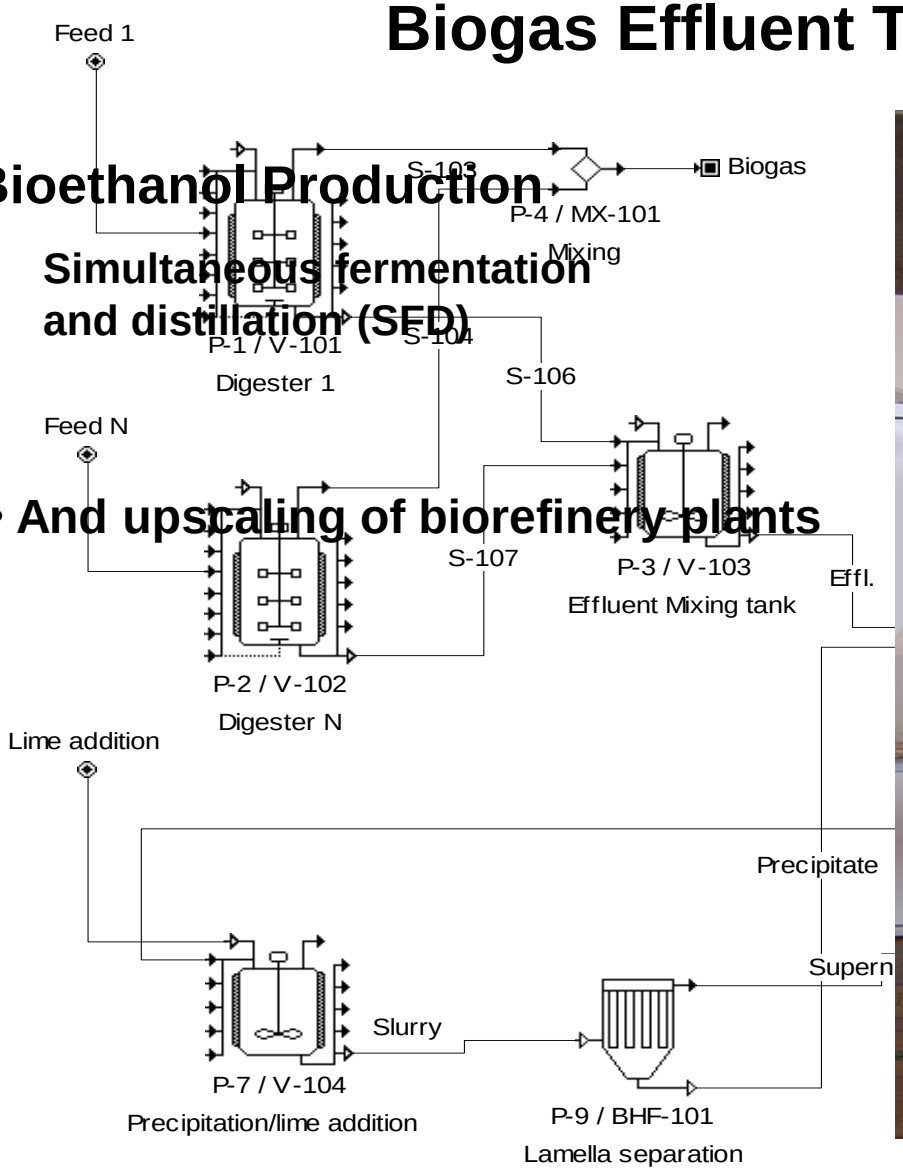
Power and Heat

Conversion to methanol

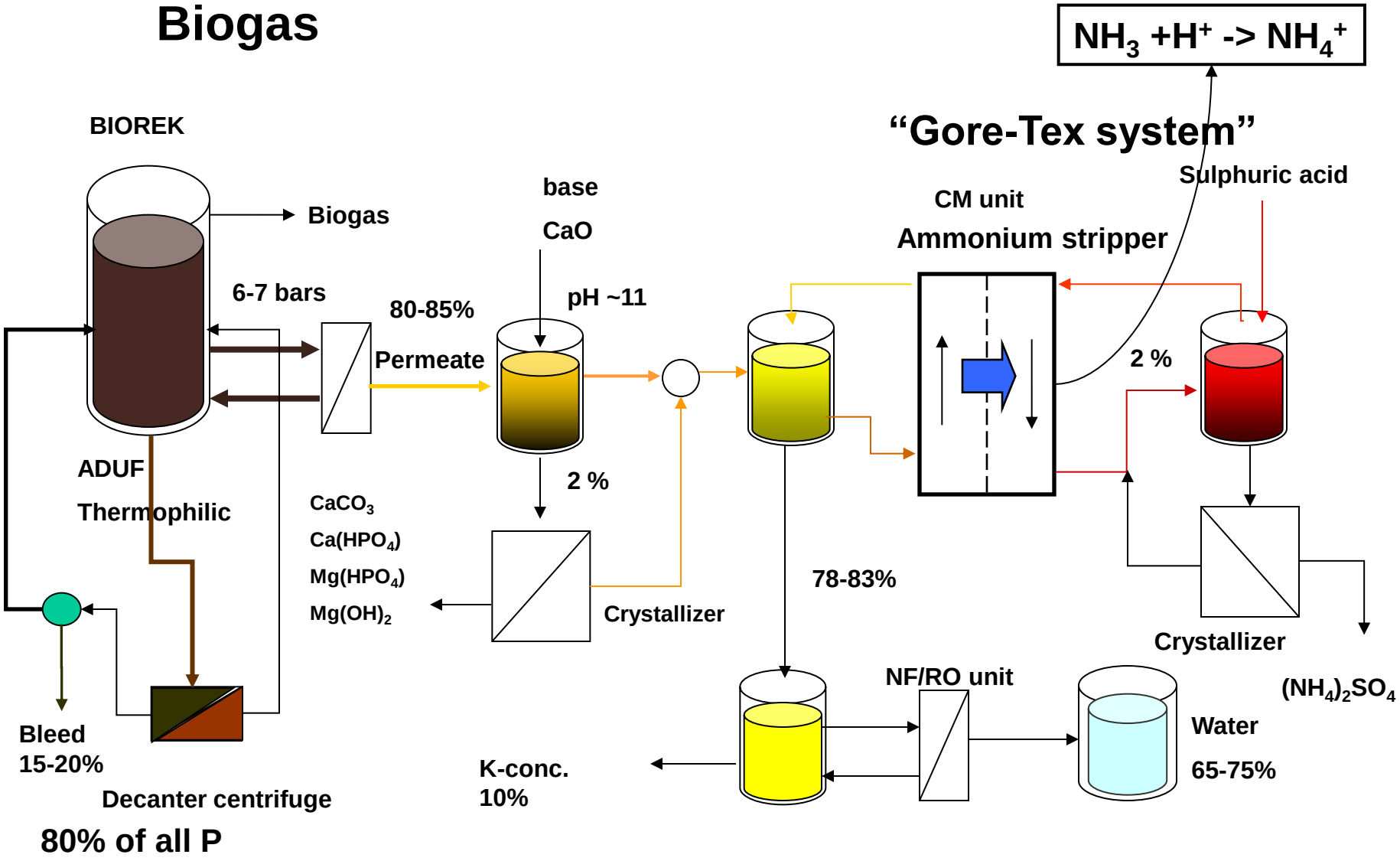
Biogas Effluent Treatment Plant

Bioethanol Production

- Simultaneous fermentation and distillation (SFD)
- And upscaling of biorefinery plants



Biogas


$NH_3 + H^+ \rightarrow NH_4^+$
BIOREK
"Gore-Tex system"
Sulphuric acid
CM unit
Ammonium stripper
Biogas
base
CaO
6-7 bars
80-85%
pH ~11
Permeate
2 %
ADUF
Thermophilic
$CaCO_3$
$Ca(HPO_4)$
$Mg(HPO_4)$
$Mg(OH)_2$
Crystallizer
78-83%
Crystallizer
NF/RO unit
$(NH_4)_2SO_4$
Water
65-75%
Bleed
15-20%
Decanter centrifuge
K-conc.
10%
80% of all P

UAB Kurana - Lithuania

Ammonia stripper

Biorefinieries: Reactor design, reaction technology, process simulation and separation technologies

- **Where does CBE contribute?**
  - Transesterification of triglycerides to biodiesel
  - Production of bioethanol
  - Simulating biorefineries based on rapeseed oil
  - Upscaling Biorefinery plants
  - Producing CH_4 from CO_2 and H_2 biologically
- **CBE strength**
  - Built our own pilots
  - Make our own models
  - Broad contact to industry and universities

EC Projects

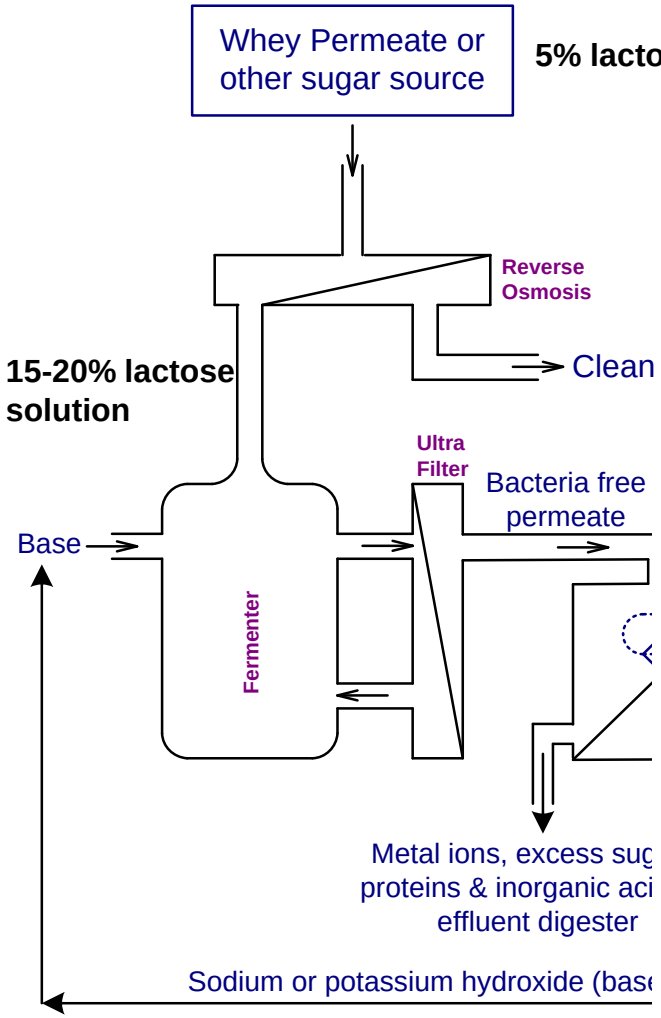
- **Tech Transfer France/Denmark to Bulgaria FP4**
- EC COPERNICUS CIPA-CT-0202/94 – Industrial partner – 1994-1997
  - Production of bacteriocins from Lactic Acid Bacteria (LAB)
  - Develop continuous fermentation of LAB and HLa
  - Prepare pure HLa for PLa (biodegradable plastic)

- **Renewable energy in Cyprus FP7 (PIGWASTEMAN)**

1. Managing pig manure and organic waste (as feed for biogas plants)
   I. Producing renewable energy and fertilisers
   II. Converting waste to commodities
   III. Enhancing agriculture technology

EC COPERNICUS project CIPA-CT-0202/94

Lactic acid production and purification in combined NF and ED-BIP unit



Hidden agenda

PIG WASTEMAN

LIFE03 TCY/CY/000021

The project aimed to support the Cypriot authorities in the design and implementation of a pig waste management and disposal policy in accordance with EU directives

These technologies developed were tested in pilot farms which, in turn, were used for the production of guidance documents and policy formulations for sustainable management of pig farming wastes

One formulation was for establishment of biogas plants, where the digested effluent found use a suitible fertiliser

My role in the project as WP leader – apart from administration

1. To investigate the possibilities for using anaerobic digestion to obtain the scope in the project.
2. Evaluate the economy in the proposed schemes
3. To assess whether the proposed schemes were in compliance with ”Best Avaiable Technology – BAT”
4. … and how did it work out? …

Items for collaboration

1. **Collaboration with the biogas group in Piment Laboratory – St. Pierre**

- **Comprise exchange of experience regarding digestion of complex substrates.**
- **Exchange of methods for growing micro algae including the use of specific light sources (LED's) as photon supplies.**
- **Develop biorefineries for organic waste materials from tropical foodand bevarage productions**

Thank you for your attention