

A close-up photograph of industrial machinery featuring two prominent red handwheel valves on a silver metal pipe. The valves have circular white labels with technical specifications. In the background, a blue vertical pipe and a silver pipe with a 'MOBIL' label are visible. The scene is brightly lit, highlighting the metallic textures and the vibrant red of the valves.

Annual Report 2025



 Thorkild Kristensen

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Annual Report 2025

As I look back on my 26 years as Head of DTU Chemical and Biochemical Department, I am filled with gratitude, pride, and a sincere sense of wonder at how far we have come together. When I first stepped into this role, our department was much smaller, yet full of ambition. Today, we stand as Europe's 1st rank in Chemical Engineering according to Engi Rank, home to 300 talented colleagues from around the world, united by a commitment to scientific excellence and societal impact. It has been the privilege of my career to witness this growth, help shape it by gathering inspiration from visits to other universities, and from the extraordinary people who make up DTU Chemical and Biochemical Engineering.

This year's Annual Report reflects the breadth and innovative spirit that de-

fine us. You can explore the many ways in which pyrolysis and biochar are opening new pathways for the green transition, from carbon sequestration to improved soil health and sustainable materials. You will meet researchers who literally look into rocks, unlocking the secrets of porous media and geological structures essential for energy storage and CO₂ management. You will also see how digitalization is accelerating advances in coating technology. Across the department, our scientists continue to push boundaries, discovering how proteins can give rise to new functional materials and demonstrating how decentralized production of biofuels can enhance the sustainability of maritime shipping, one of the world's most essential yet challenging sectors to decarbonize.



As this has been my final year as Head of Department, it is important for me to state that we are well-positioned for the future. I am delighted to welcome Professor Anne Ladegaard Skov as our new Head of Department. Anne is a highly distinguished researcher whose work spans the full spectrum from fundamental understanding to industrial application. Her contributions to network structure-property relationships, silicone elastomers, and electroactive materials, have led to groundbreaking insights and generated strong collaborations across academia and industry and she has long term experience from being head of DPC and part of our leader group. The department is truly in excellent hands.

Although I am stepping down from this role, I am not stepping away. I look forward

to continuing as part of the department's leader group, heading the CoaST Centre as well as being responsible for innovation initiatives. My commitment to our shared mission remains as strong as ever.

Thank you to all colleagues, collaborators, students, and partners who have been part of this remarkable journey. I hope you enjoy this year's Annual Report and the stories it tells. Stories not only of scientific rigor but of creativity, collaboration, and the persistent drive to make a positive difference.

The future of the department is bright. And it has been an honor to help light the path.



Kim Dam-Johansen
Professor, Head of Department



Kim Dam-Johansen
Professor,
Head of Department



EDUCATION



371
STUDENTS*

26

COMPLETED
BSC PROJECTS

33

COMPLETED
BENG PROJECTS

105

COMPLETED
MSC PROJECTS

RESEARCH



218

SCIENTIFIC ARTICLES IN
WOS-INDEXED JOURNALS



34

PHD DEFENCES

INNOVATION



8

NOTIFICATIONS OF INVENTION

ORGANIZATION



296

EMPLOYEES IN TOTAL



58

TECHNICAL /ADMINISTRATIVE
EMPLOYEES



85

SCIENTIFIC EMPLOYEES



34

FACULTY MEMBERS



117

PHD STUDENTS
(INCLUDING 6 INDUSTRIAL PHD'S)

Looking Inside Rocks - and Beyond: Revealing the Hidden Dynamics of CO₂ Storage

From X-ray CT scans to microfluidics, exploring CO₂ behavior across scales.

Lowering CO₂ emissions alone is not sufficient to address climate change. We also need to actively capture and store CO₂. The most promising storage option is injecting CO₂ into deep saline aquifers, where it can remain trapped for centuries. Several such projects are now underway in Denmark and around the world. But how does CO₂ behave under underground injection? And can we predict its movement and storage efficiency?

At the AT CERE center at DTU Chemical and Biochemical Engineering, researchers are combining X-ray computed tomography (CT) and microfluidics to answer these questions – literally “looking inside” rocks and fluids to watch CO₂ displace saline water and trigger chemical changes in real time. This work is supported by Innovation Fund Denmark as part of a collaborative effort to develop new knowledge for safe and effective CO₂ storage.

Peering into the subsurface

The team’s first line of investigation focuses on core flooding experiments using cylindrical sandstone samples from the Stenlille aquifer. The core samples are first placed in a metal-free carbon-fibre core holder and fully saturated with brine. The system is then pressurized and heated to reservoir conditions before CO₂ injection begins. At 160 bar and 50°C (conditions matching the aquifer), CO₂ exists in a su-

percritical state, with high density but very low viscosity.

By scanning the cores repeatedly during CO₂ injection, the researchers reconstruct the distribution of CO₂ and brine inside the rock. They find out how carbon dioxide propagates in the rock and displaces brine. This allows them to study trapping mechanisms with unprecedented detail. “It’s like having X-ray detailed vision into the subsurface,” says Postdoctoral Researcher Lijuan Shi.

Surprising behavior at the core scale

The team initially expected CO₂ displacement to follow the classical Buckley-Leverett theory of two-liquid flows in porous media, commonly applied to CO₂ storage. This theory predicts a relatively smooth “front” moving through the rock and replacing most of the brine with carbon dioxide. Instead, the observations revealed a markedly different behavior: CO₂ reached the outlet much earlier than predicted, travelled along irregular, finger-like flow paths, and showed strong variability even when the same experiment was repeated on the same rock sample. Moreover, despite long injection of CO₂ and multiple pore volumes flowing through the rock, around 50% of the pore space remained water filled. From the practical point of view, most of the capacity of the underground storage will

not be filled by the injected CO₂, and brine will remain there.

“These results tell us that if you don’t account for unstable flow, classical models may significantly overestimate storage efficiency,” says Associate Professor Alexander Shapiro.

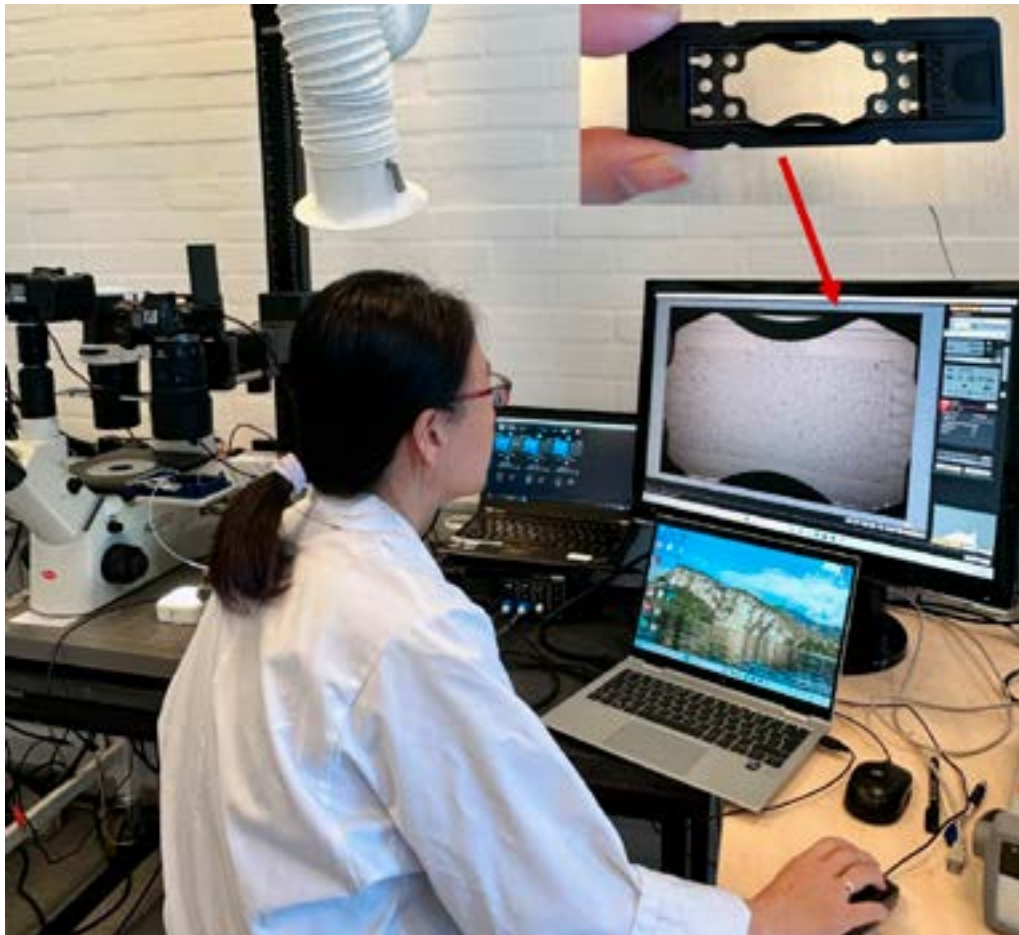
Zooming in with microfluidics

While CT experiments reveal the macroscopic patterns of CO₂ movement, the micro-scale mechanisms driving these patterns remain hidden. To uncover them, the team turned to microfluidic experiments. The transparent, pore-scale glass models mimic the geometry of real reservoir rocks. They allow direct visualization of fluid-fluid and fluid-solid interactions. The process is observed under the microscope and recorded by a fast camera connected to a computer and a large-capacity file storage.

With the microfluidic chip pre-saturated with saline water, CO₂ injection reveals rapid fingering, local brine trapping, and brine evaporation into the CO₂ phase. The evaporation leads to precipitation of salt from the brine. The two forms of salt precipitation are observed: fine crystals and irregular clusters. They can grow rapidly and may impair carbon dioxide injectivity.

From laboratory to field scale

By combining core-scale X-ray CT experiments with pore-scale microfluidics, the project provides a multi-scale understanding of CO₂ storage – from the irregular migration patterns in real rock to the microscopic processes that cause them. These insights will feed into improved predictive models for large-scale CO₂ injection projects in Denmark and worldwide.



Dr Lijuan Shi is conducting microfluidic experiments to visualize CO₂-brine displacement and salt precipitation.
Fei Han

“Being able to see what happens inside the rock – and even inside individual pores – changes the way we think about CO₂ storage,” says Associate Professor Alexander Shapiro. “It gives us evidence that we need to build

better models and ensure safe, long-term storage.”

 Associate Professor Alexander Shapiro

AT CERE - Applied Thermodynamics-Center for Energy Resources Engineering

AT-CERE stands for Applied Thermodynamics - Center for Energy Resources Engineering. The AT CERE Research Centre, as part of DTU's Department of Chemical and Biochemical Engineering, is a centre focused in the areas of Applied Thermodynamics, transport properties and processes, materials science, fermentation technology and mathematical modelling with applications to the energy sector incl. petroleum technology, CO₂ capture, utilization and storage, chemical industry as well as biotechnology with emphasis on biorefinery conversions.

AT CERE is associated with the DTU interdepartmental activity CERE, which is Denmark's leading research centre in a wide range of energy resources which, in addition to the above, also include geoscience. AT CERE and CERE host an industry consortium, which includes around 15 companies from all over the world.

AT-CERE is committed to perform high-quality experimental and theoretical research with international impact, in which we often combine the above disciplines in broader projects of interest to chemical, energy and biochemical engineering. Both fundamental and applied research is being conducted. Many of the applied problems are inspired by or based on input from CERE's industrial consortium.

Our History

AT CERE has, in its various forms, a 30+ years history. The centre in its original form (first as a centre in applied thermodynamics, and later, since 1987, in the form of an engineering research centre, IVC-SEP) was established in the early 1980's by Professor Aage Fredenslund, who was succeeded in the leadership in 1994 by Professor Erling Stenby. Since 2009 AT CERE's activities are connected to DTU's interdepartmental activity CERE.

For more information, please visit CERE's website: www.cere.dtu.dk

Main deliverables to the Consortium members

Corporate members of the Consortium can access and obtain all results directly from the Center for Energy Resources Engineering as soon as they become available, usually one or two years before publication. A computer program for Separation and Phase Equilibrium Calculations, SPECS, is made available for members of the Consortium. A wide range of other software tools are also available to member companies as well as access to an electrolyte database and other facilities. Consortium members are offered also favourable prices for PhD courses organized by the centre as well as access to experimental facilities. Also, students and scientists from the Center for Energy Resources Engineering are available for collaboration with consortium members on projects conducted at company facilities.

Biochar Under the Microscope: Matching Production to Purpose

Biochar, created via pyrolysis, has potential uses in soil improvement and carbon sequestration, but its effectiveness depends on production conditions and is often misunderstood.

Biochar is a carbon-rich material produced by heating organic biomass in a limited-oxygen environment, a process known as pyrolysis. It has a wide range of potential

applications, including soil improvement, carbon sequestration, and enhancement of biogas production in anaerobic digestion (AD) systems.



Batch bottles preparation to study the effect of biochar addition in AD process.  Hamed Baniamerian

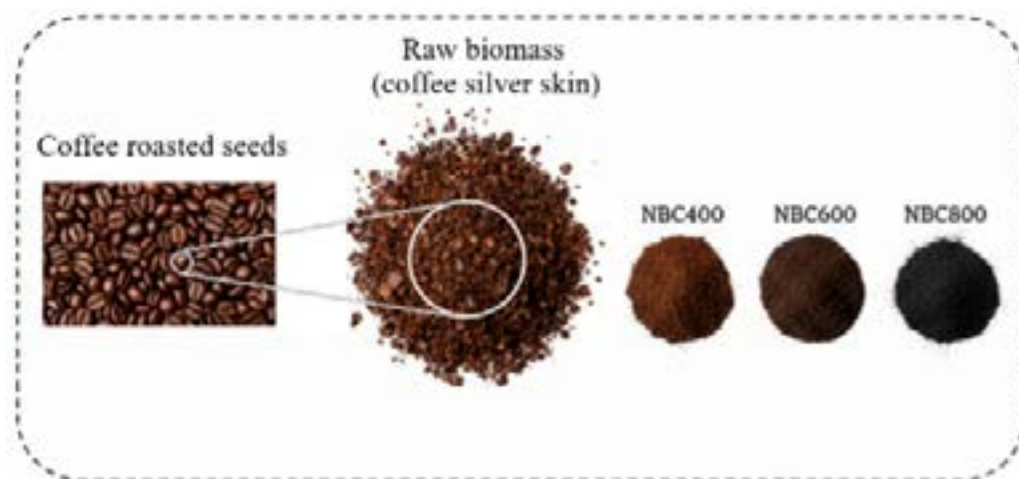


Figure 1: Raw biomass (CSS: coffee silver skin) and biochar samples produced at 400 °C (NBC400), 600 °C (NBC600) and 800 °C (NBC800)

However, there is still no consensus on the effect of biochar and many of these applications are based on misconceptions. The word “biochar” is collectively used independent on the conditions under which biochar has been produced. It is commonly believed that biochar universally improves soil health by enhancing nutrient retention and water-holding capacity, and that it contributes to climate change mitigation through long-term carbon storage. Similarly, numerous studies claim that biochar boosts biogas production in AD. Yet, its properties vary significantly depending on the biomass used, production temperature, and any post-treatment processes – making its performance highly context-dependent. The BioCon group at DTU Chemical Engineering is researching biochar from different angles to find the right match between production and purpose.

Tailoring biochar for AD

It is claimed that biochar improves AD performance via mechanisms such as direct interspecies electron transfer (DIET), microbial immobilization, and adsorption of inhibitory compounds. Yet, BioCon’s investigations challenge this narrative.

“We are conducting a systematic and comprehensive investigation, in collaboration with European partners, into biochars produced from various feedstocks

and at different temperatures or applying post-treatment steps. We analyzed each type of biochar to understand how production parameters influence its physicochemical properties and potential applications”, Professor Irini Angelidaki says.

For example, biochar produced at high temperatures (800-900°C) was found to inhibit biogas production rather than enhance it, due to the content of compounds toxic to microorganisms, while biochar generated at lower temperatures (400-500°C) did not effectively stabilize the biomass. Similar trends were observed in plant cultivation trials. These findings highlight the importance of tailoring biochar production to its intended application.

Experimental Insights

In one study, seven biochars produced from wood, straw, sludge and digestate were tested during mesophilic digestion of cellulose. Despite favorable properties such as high surface area, electrical conductivity and porosity, most biochars did not enhance methane yield. Notably, wood-based biochar gasified at 800°C reduced methane yield by 52%, likely due to the release of toxic compounds such as polycyclic aromatic hydrocarbons (PAHs). In contrast, straw-based biochar produced at 400°C increased yield by 40%, attributed to its incomplete carbonization and residual organics. In this case, the biochar

contributed to methane yield not through DIET, but as co-substrates.

In another study focused on coffee silver skin – a byproduct of the coffee processing industry – biochar produced at 400°C increased methane yield by 45%. However, this effect was attributed to the incomplete stabilization of organic matter due to the relatively low pyrolysis temperature; consequently, the biochar functioned as a co-substrate.

“These results underscore the importance of matching biochar production to its intended application. High-temperature biochars may be better suited for carbon sequestration or soil amendment, while low-temperature biochars can serve as co-substrates in AD, especially in food industry waste valorization,” Tenure Track Researcher Parisa Ghofrani-Isfahani explains.

Mechanistic clarifications and microbial dynamics

Adding biochar increased certain methane-producing microorganisms such as *Methanosarcina* and *Methanobacterium*, but this did not always lead to higher methane production. Some biochars were harmful, reducing microbial diversity and the number of methane producers, likely due to toxic

Anaerobic digestion is a natural process where microorganisms break down organic matter in the absence of oxygen to create biogas and digestate. The latter is the nutrient-rich residue, such as food waste or animal manure. It helps improve soil quality and reduces the need for synthetic fertilizers

effects. Biochars with high electrical conductivity did not consistently improve electron transfer between microbes, and methane production was not linked to surface area or porosity.

Instead, the key factors were chemical groups like hydroxyl and carboxyl and left-over volatile compounds in biochars made at lower temperatures. Analyses showed that biochars produced at 400-500 °C kept more reactive compounds and had smoother, less carbonized surfaces—features that support microbial growth and co-digestion.

Implications for circular bioeconomy

From a sustainability perspective, producing biochar at lower temperatures is more

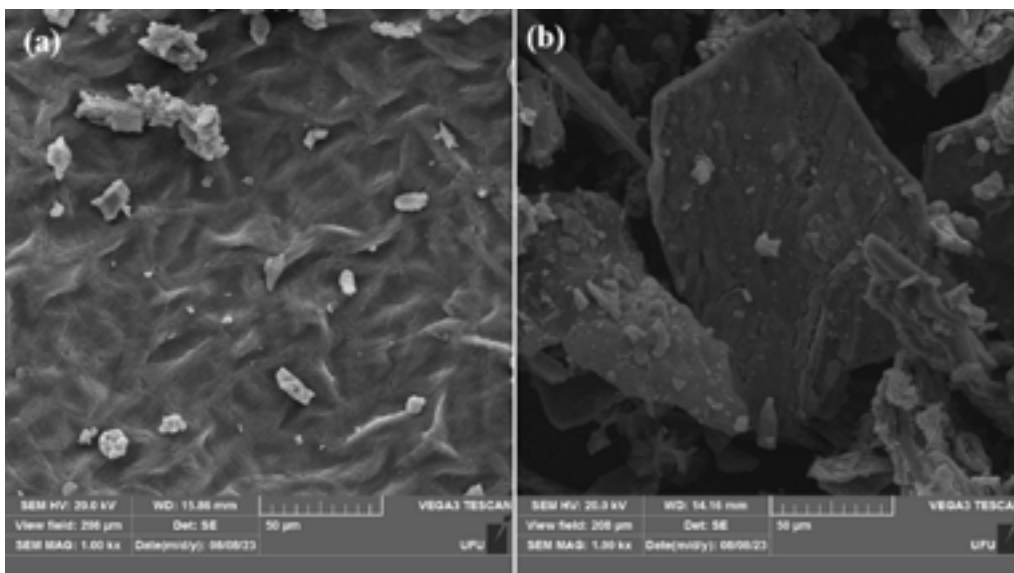


Figure 2: Scanning electron microscopy (SEM) of biochar samples: (a) raw biomass (coffee silver skin); (b) biochar produced at 400 °C (NBC400)

energy-efficient and aligns better with circular bioeconomy principles. Coffee silver skin, for example, can be directly used in co-digestion or converted into low-temperature biochar to enhance methane yield. The digestate can then be applied to soil, contributing to nutrient recycling and carbon sequestration.

"These findings emphasize that biochar is not a one-size-fits-all solution. Its role in AD

process depends on its chemical stability, residual organics, and potential toxicity – all governed by pyrolysis conditions. At DTU BioCon, our work continues to unravel the nuanced interactions between biochar and microbial communities, aiming to optimize its use in sustainable bioprocesses," Professor Irini Angelidaki explains.

 Professor Irini Angelidaki and Tenure Track Researcher Parisa Ghofrani-Isfahani

BioCon

In the Biological Conversions group (BioCon), our goal is to develop and validate novel technologies exploiting microorganisms as tools to transform organic waste and wastewater into useful bioproducts, biofuels, and bioenergy.

Utilizing our expertise in biochemical engineering, we develop new technologies to upcycle nutrients from residual resources. We start from basic science, uncovering the mechanisms behind microbial processes, and we continue to apply research towards the development of new biotechnological solutions in pilot scale.

Our experience in biological biogas upgrading (biomethanation) can serve as a perfect example of the development of environmentally and techno-economically sustainable solutions at pilot-scale.

Biomethanation activities aim to develop and demonstrate at operational environment advanced, automated, and consolidated concept for CO₂ capture and utilization by exploiting synergies with excess renewable electricity (e.g. from wind turbines, photovoltaic plants) to produce high-grade biomethane equivalent to natural gas (>95% CH₄) for grid injection. Demonstrating an efficient and high-rate CO₂ capture, utilization and storage technology can markedly combat global warming. In accordance with the European Green Deal to transform EU to climate neutral in 2050, biomethanation can attract growing attention as it can strongly reduce greenhouse gas emissions from industry and energy sectors.

Our ongoing research on biomethanation is focused on increasing biogas production capacity, accelerating start-up period and avoidance of lag phase, revealing proper stand-by mode strategy, unveiling proper dosage, and trickling of nutrients using digested residual resources. In addition, we have increased focus on new reactor configurations, dynamic modelling, and microbial resource management.

The activities are conducted in strong collaboration with wastewater treatment and biogas plants where the biological methanation is evaluated as an alternative methodology to improve economy and sustainability.

Streamlining Research: Advancing Digitalization at CoaST

Digitalization efforts at the Coatings Science and Technology Centre aim to streamline lab workflows and enhance data management, reducing manual tasks and improving data accessibility for efficient, reproducible research.

At the Hempel Foundation Coatings Science and Technology Centre (CoaST) at DTU Chemical Engineering, ongoing digitalization efforts aim to streamline laboratory workflows, improve research data management, and establish a solid foundation for future data science applications. The initiative addresses two central objectives: reducing the time researchers spend on repetitive, manual tasks, and ensuring that experimental data are captured, structured, and stored in a way that allows for easy retrieval, reuse, and analysis - both now and in years to come.

Many current laboratory tasks are time-consuming and prone to variability. For example, visual inspection and manual sorting of coating test images can be both subjective and tedious. Similarly, research data may be scattered across multiple file types and formats, making it difficult to link samples with their corresponding results, search across multiple projects, or extract information from within the files. These issues consume valuable research time, reduce reproducibility, and hinder advanced analyses such as machine learning.

CoaST integration

The CoaST platform is purpose-built to integrate formulation, sample tracking, environmental monitoring, automated image processing, and data storage in one place. "A key difference from other systems is that all data is stored in a structured, searcha-

ble database. This makes it possible to link information from different experiments and perform complex queries, such as correlating the physical properties of an ingredient with coating performance across multiple projects," says Associate Professor Jochen Dreyer.

The system is accessed via a web-based interface (Fig. 1) and can be used from the laboratory, office, or the CoaST Maritime Test Centre (CMTc) in Hundested. Users log in with their DTU credentials and can access a suite of digital tools.

A central feature is the digital formulation tool. Researchers select raw materials from the database and either set ingredient ratios directly or use an optimiser to determine quantities based on defined constraints, such as volume solids or particle volume concentration. Recipes include detailed preparation steps and can be saved for reuse. When a sample is prepared, the system assigns a unique ID and generates a printable QR code label.

Sample tracking

The sample tracking system records the sample's preparation details, current location, and status - whether it is mounted at CMTc, exposed in a salt spray chamber, archived, or disposed. The QR codes allow automated linking of experimental data and images to the correct sample. For example, photographs taken in the lab or via the

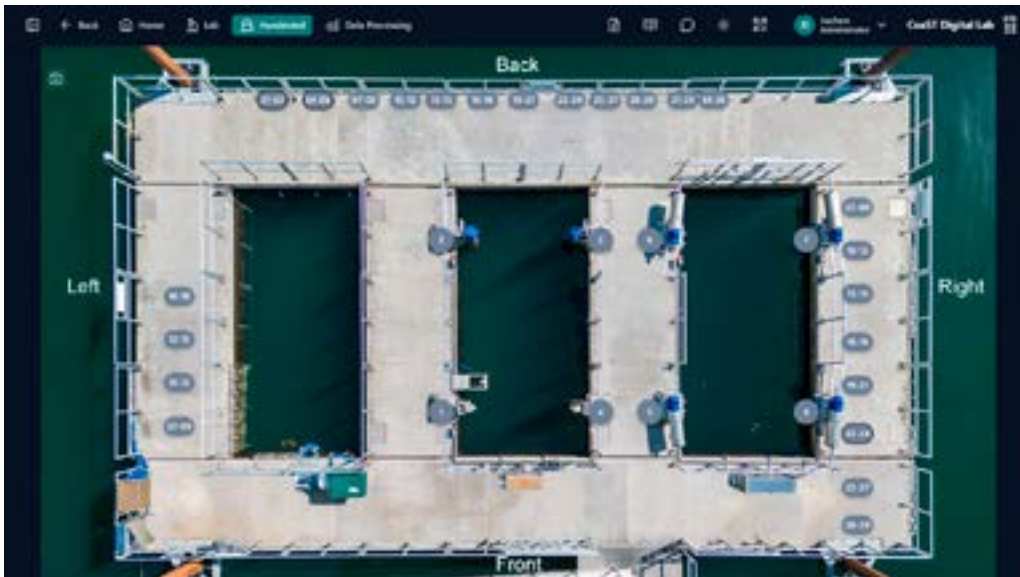


Figure 1: Screenshot of the CoaST digital lab website showing the CoaST Maritime Test Centre (CMTC) exposure and sample management page.

underwater camera in Hundested can be automatically named, sorted, and linked without manual file handling.

Environmental and sensor data, including weather station readings and operational parameters from test rotors at CMTC, are collected and stored in the same database. Live camera feeds can be viewed directly from the platform (Fig. 1), and planned microservices will handle tasks such as automated image processing to calculate species-specific fouling coverage on samples exposed in Hundested.

Developing such a system from scratch is a demanding task, requiring careful attention to scalability, maintainability, and reliability. "Our approach is therefore not only technical, but also strategic: the platform is built with long-term use in mind and designed to adapt as new needs arise. A central principle is user-centric development. The system must be straightforward and intuitive so that researchers see a clear benefit in using it and are not tempted to fall back on fragmented tools or manual record-keeping," says Associate Professor Jochen Dreyer.

Core employees

To ensure this, a core group of PhD students and technical staff from across CoaST

have been closely involved throughout the development process. Their testing, feedback, and suggestions for improvement have been essential in shaping workflows and features, and their commitment has been instrumental in keeping the system aligned with real research practices.

The platform's core infrastructure is operational, including the backend and frontend systems, database, and secure login. The formulation tool, sample ID generation, and QR code labelling are functional, as is the initial image capture pipeline with remote camera operation at CMTC. Environmental and sensor data integration is in place, and the core user group is actively testing features and suggesting improvements.


Several benefits

Once fully implemented, the platform is expected to deliver substantial benefits. Researchers will save time through automation of repetitive tasks, while data will be stored in a consistent and structured format that is easy to search and reuse. By replacing different individual tools with standardised workflows, the platform should improve objectivity, reproducibility, and overall research quality. Most importantly, it will provide

a strong foundation for advanced data analysis and AI-driven research in the future.

Future developments may include enhanced formulation guidance based on accumulated data, tools for experimental design, integrated laboratory documentation, and instrument booking systems. Selective use of AI could assist with tasks

such as automated data analysis or interactive help based on laboratory manuals. While the immediate focus remains on delivering a robust, reliable core platform, the possibilities for further digital transformation are considerable.

 Professor, Head of Department
Kim Dam-Johansen and Associate
Professor Jochen Dreyer

CoaST

The Hempel Foundation Coatings Science and Technology Centre

CoaST is a leading centre for research, innovation, and education in sustainable and primarily organic coatings technologies. CoaST covers coating technologies along the entire value chain from raw materials, over formulation, test and characterization to production and application. In the broad perspective, CoaST activities support development, production, and use of coatings with improved sustainability profiles over the lifetime of the coating.

Coatings for a better future

Coatings are highly complex multicomponent products, which must fulfill many conflicting requirements. Important properties are, for instance, strong adhesion to the substrate or underlying coating layers, adequate viscosity profile, long durability, continuous or durable appealing appearance, and all this at a competitive cost. Functional coatings, in addition, must e.g. provide substrate protection such as resistance against corrosion or biofouling, provide longer escape times during a fire, or remove pollutants through catalytic activity.

Within the area of sustainable coatings science and engineering, CoaST aim to:

- provide in depth knowledge of current coatings challenges
- understand the fundamental working mechanisms of coatings
- develop mathematical tools that quantify coating behaviour
- design and use equipment for accelerated testing of coatings
- design coatings that set new standards with respect to more sustainable formulations and efficient functionalities

Presently, research activities in CoaST focus on the following areas:

- Sustainable raw materials for coatings
- Coating formulation and production principles
- Fouling control coatings
- Anti-corrosive coatings
- Intumescent coatings
- Other functional coatings

The CoaST research approach is based on classical chemical engineering tools combined with formulation expertise often in close co-operation with industrial partners. CoaST's research covers from basic to applied research and range from laboratory work to model based test programs to natural ageing exposures. CoaST's fundamental coating research supports the traditional more empirical approach of the coatings industry and is focused on improved sustainability profiles.

From Thermodynamic and Process Model Development to Practical Software Delivery

The derivation and validation of mathematical models for thermodynamic and process phenomena is an important discipline in chemical engineering and a primary research focus at several centres within DTU Chemical Engineering. However, for computer-aided methods to truly make an impact on industrial practice, they must be adopted and applied in real-world settings. To better address industry-relevant challenges and reduce the barriers companies face when using published models and data, the KT Consortium (KTC) was established in 2017. This initiative brings together industrial partners with the AT-CERE and PROSYS research centres to foster collaboration and knowledge-sharing.

In this context, the Integrated Computer-Aided System (ICAS) has served as the consortium's flagship platform for many years, offering a comprehensive suite of tools for property prediction, molecular design, database access, and process simulation.

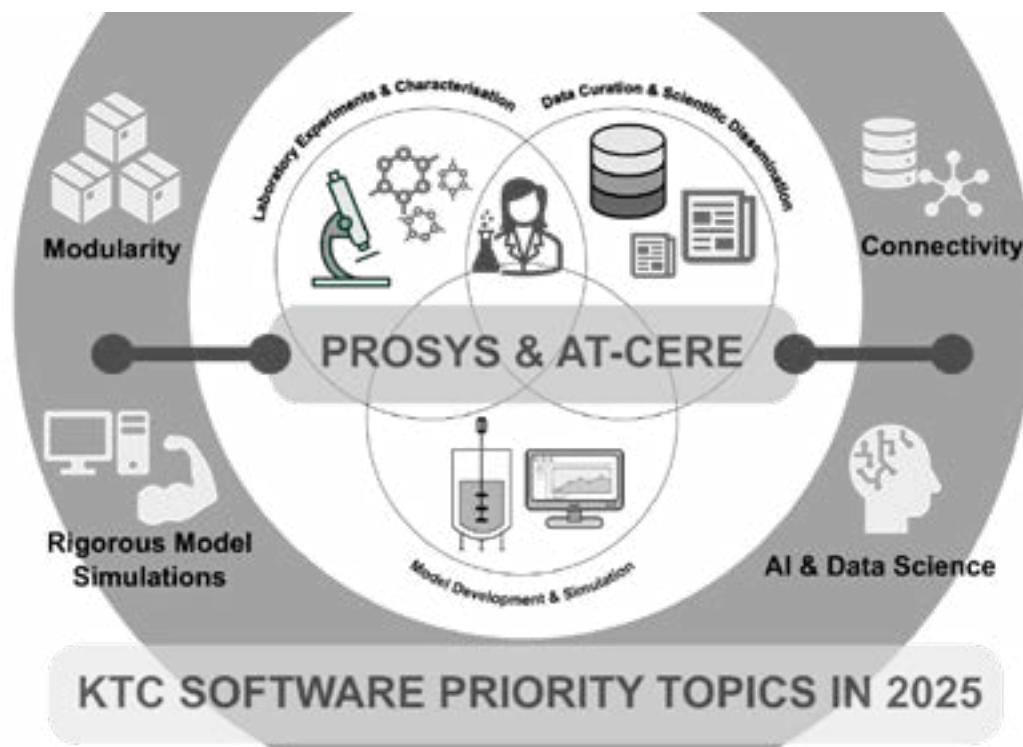
Data Science and Machine Learning

From a research perspective, there is an increasing focus on employing statistical models for various process and thermodynamic applications. Projects exploring the application of these methods in chemical and biochemical systems are already ongoing in the affiliated research centres encompassing both thermodynamic, control, design and monitoring. Based on the inter-

est expressed by industrial members and the relevance of these research avenues, it is a KTC priority to explore possible methods to incorporate data science and machine learning techniques to complement and enhance existing modelling frameworks. By combining data-driven approaches with established physical and thermodynamic models, researchers aim to improve predictive accuracy, uncover new patterns in complex systems, and accelerate model development. This hybrid approach holds promise for tackling previously intractable problems and expanding the practical applicability of research outputs.

Modern Software Delivery

As industrial challenges and digital architectures become increasingly complex, the need for flexible, accessible, and intelligent software solutions continues to grow. In response, the KT Consortium has placed a strong emphasis on modernising the way its tools are developed and delivered. One aspect being investigated is to move beyond traditional standalone applications. Here, the KTC is looking into adopting even more modular and interoperable software architectures. This includes the development of web-based Application Programming Interfaces (API's), plug-ins for widely used platforms such as Excel and MATLAB, and containerised deployment options. These formats can make it easier for member companies to integrate advanced model-



ling tools, whether for property prediction, process simulation, or product design into their existing digital environments. Through these efforts, the KT Consortium seeks to address some of the implementation challenges, lower technical barriers, foster innovation, and ensure that cutting-edge research in chemical and biochemical engineering translates into real-world impact.

The KT-Consortium

Within the consortium, affiliated researchers develop advanced models for thermodynamic and process systems, which are made available to member companies. In addition, curated chemical databases covering electrolyte solutions, ionic liquids, organic compounds, and more are accessible to

members. Beyond software and experimental data, members benefit from early access to research outputs, including manuscripts ahead of publication, PhD theses, and the opportunity to attend thesis defences online. An annual meeting brings together members and affiliates to share updates on ongoing and future research directions across the participating centres.

Practical Information

If you are interested in joining the KT-Consortium or would like to learn more about the collaboration, tools, databases, or ongoing projects, please contact Professor Georgios M. Kontogeorgis.

 Professor Georgios M. Kontogeorgis.

KT Consortium

At KT Consortium we bring together advances and developments made in the area of Process Systems Engineering, Bio-Process Engineering, Applied Thermodynamics and Property Prediction within the Department of Chemical and Biochemical Engineering at DTU and to continuously improve and innovate for a better and more sustainable future.

The KT Consortium is an industry-academia collaboration providing service to company members by fostering a cross-sectorial understanding of (Bio-)Process Systems Engineering and Thermodynamics. The consortium was founded in 2017 based on a long-standing history of collaboration with industry from previous centres and consortia at the Chemical and Biochemical Engineering Department.

We work on developing generic methods and tools using computer-aided systems approach to solve and analyse problems related to product-process modelling, simulation, synthesis, design, analysis, control, and operation for companies within the areas of chemical, pharmaceutical, agrochemical, food, and biochemical industry. KT Consortium is a cross centre activity involving faculty and students from AT-CERE, PROSYS and CHEC research centres. We have close collaborations on a number of projects, work together in funding applications and for supporting our member companies on a wide area of assignments.

As an industrial member of the KT Consortium, one will be provided with state-of-the-art CAPE and PSE methods and tools, the technologies for future chemical and biological processes along with a series of other benefits such as:

1. Participation in the Annual Meeting
2. Web access (via dedicated members site) to:
 - Manuscripts in advance of publication
 - PhD theses (including online defences)
 - ICAS software
 - ICAS training courses
 - Chemical Databases (Electrolyte, IL, organic compounds, etc.)
 - Annual Meetings materials (videos, presentations, workshops)
 - Online seminars (live and recorded) from KT Consortium affiliated staff and faculty as well as invited guests from around the world supported by CERE and PROSYS research centres.
3. Access to collaboration and research from:
 - Student projects
 - Visiting PhD students
 - Joint Research Projects
4. Access to know-how and influence on the research programme.

If you are interested to join KT Consortium or know more about, please contact Professor Georgios M. Kontogeorgis.

Enhancing Waste Utilization through Pyrolysis

Fuller's FUELFLEX Pyrolyser technology was enhanced through the CircFuel project to produce liquid fuels from waste in cement plants, achieving successful pilot-scale pyrolysis oil production for marine fuel by 2025.

The CircFuel project has focused on advancing Fuller's patented FUELFLEX Pyrolyser technology to enable the production of liquid fuels through pyrolysis of Refuse Derived Fuel (RDF) waste in cement plants. The FUELFLEX integrates a pyrolysis unit with the cement process, utilizing hot raw meal to drive the waste pyrolysis. This process produces liquid pyrolysis oil, while remaining gases, char, and raw meal are re-directed for energy recovery in the cement calciner. Project investigations included the potential for upgrading pyrolysis oil for use

as marine fuel through catalytic cracking and hydrotreatment. Completed in 2025, the project yielded significant findings, including the successful pilot-scale production of pyrolysis oil, effective pyrolysis oil hydroprocessing, and the validation of fuel quality for use on marine diesel engines.

Project activities

The CircFuel project was conducted as a tight collaboration between the CHEC research center at DTU Chemical and Bio-chemical Engineering and company partners;



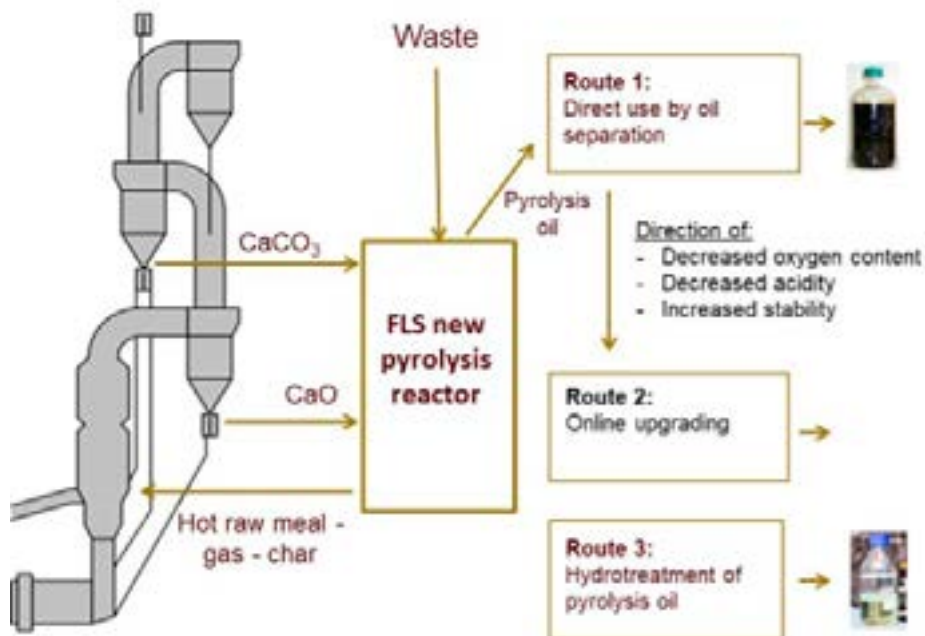


Figure 1. The investigated waste pyrolysis process

including FULLER (Previously FLSmidth Cement), Topsoe, Everllence (Previously MAN Energy Solutions), Geminor, NORDEN, Finsementti and one DTU department: DTU SUSTAIN. The project was funded by Innovation Fund Denmark and the project partners.

Geminor supplied RDF (Refuse Derived Fuel) samples for pyrolysis experiments conducted at FULLER and DTU. The FUEL-FLEX pilot plant at FULLER was modified to produce pyrolysis oil, while the CHEC research center constructed a new setup for pyrolysis and catalytic studies. "The FULLER plant produced larger oil quantities used for hydrogenation studies at Topsoe, while DTU investigated how operational changes affected oil yields and quality," says Senior Researcher Peter Arendt Jensen from the CHEC center at DTU Chemical Engineering.

Using waste instead of biomass resulted in higher heating value oils with lower oxygen and acid content but some wax formation. Adjusting conditions, like using calcined raw meal or higher temperatures, reduced oil acidity and wax but decreased liquid yield. FULLER also studied integrating a FUEL-FLEX pyrolysis unit with cement plants, enabling plant operation with a minimum of fossil fuels while managing

increased ash inputs through proper plant adjustments.

Different upgrading methods for pyrolysis oils were investigated. Catalytic online cracking (Route 2 in Figure 1) was studied as part of a DTU PhD project. Using calcined raw meal as catalyst led to improved oil properties with a reduced oxygen content and reduced acidity. However, the pyrolysis oil property improvements were in this case not sufficient, such that it can be applied as a drop in marine fuel.

A more severe treatment of the oils can be done by hydro treatment of the oils (Route 3 in Figure 1). Such studies were conducted as part of the project, both at RTI (USA) in the form of batch reactor experiments conducted as part of a PhD project, and by continuous trickle bed hydrotreatment at Topsoe. In both cases, the applied pyrolysis oils were produced on Fuller's FUELFLEX pilot plant. The continuous trickle bed oil hydrotreatment led to the largest reduction in acidity and an oxygen-free oil was obtained. A limitation of this oil for marine use was a relatively low so-called flash point temperature. However, removal of the light fraction of the oil led to an acceptable flash point temperature level. Evaluation of the applicability of the oils

for use in marine diesel engines was done by the companies NORDEN and Everllence. The final hydrotreated and distilled waste pyrolysis oil was analyzed with a wide range of different methods relevant for marine use. It was concluded that the product conforms with most values in the commercial standard for marine fuels, stated in the table 3 *Bio-residueal marine fuels* in ISO 8217:2024. Except for the pour point which exceeds the upper limit. However, this property is expected to be adjusted and brought within specification through standard refinery processes.

The waste pyrolysis process was evaluated by LCA analysis by DTU SUSTAIN. The net CO₂ emission change using different routes of oil utilization was evaluated. Net CO₂ emission changes are strongly related to the fraction of biomass present in the applied waste fuel.

Commercialization of the developed processes will be dependent on further up-scaling, and initiatives both in the cement, refinery and marine fuel sectors.

About obtained results

The project demonstrated that it is possible to integrate a waste pyrolysis unit on a cement plant, and by adequate pyrolysis oil upgrading provide a drop in fuel which meet most quality requirements for use in marine engines.

“Potentially, the commercialization of the process will have many benefits for society. Reduced CO₂ emissions for cement plants and heavy marine transport, as well as utilization of a larger global fraction of waste and thereby a reduced landfilling of waste,” Peter Arendt Jensen concludes.

 Senior Researcher Peter Arendt Jensen

CHEC - The Catalysis and High-temperature Engineering Centre

The CHEC Research Centre at DTU Chemical Engineering carries out research in fields related to chemical reaction engineering, with the focus on catalysis and on thermal processes such as combustion, gasification and pyrolysis. The aim is to facilitate the transition to more sustainable and cleaner processes in fuel and chemical production, heat and power production, transportation, energy-intensive industry and agriculture.

Important areas include Power-to-X technologies, development and application of carbon-free energy carriers such as ammonia or metals, use of sustainable resources such as biomass and waste for production of power, fuels and other products such as biochar, and emission control.

CHEC has achieved international recognition through a combination of experiments and mathematical modelling, based on chemical kinetics, chemical reaction engineering, thermodynamics, and fluid dynamics.

Laboratory reactors are used to characterize gas-phase, gas-solid and catalyzed reactions at atmospheric or high pressure in a wide temperature range, sometimes in combination with IR and X-ray spectroscopy. Extrapolation to industrial scale is conducted by use of pilot-scale experiments or full-scale measuring campaigns, often combined with computational fluid dynamics (CFD).

Decentralised production of advanced biofuels for maritime shipping

A Horizon Europe project led by DTU is working on a process that turns waste into valuable resources. This initiative aims to support the green transition.

More than 90% of ships still run on fossil fuels

With a yearly demand exceeding 300 million tonnes of fossil fuel, the shipping industry generates approximately 3% of global greenhouse gas (GHG) emissions. Achieving net-zero emissions has become a global priority for transforming the maritime shipping sector. Targets set by FuelEU Maritime, the International Maritime Organization, and regulations enacted by the EU Emissions Trading Scheme (EU ETS) have created stronger regulatory support for the decarbonization of maritime shipping. However, sustainable alternatives have not yet reached a large scale.

“Future fuels, such as ammonia and methanol, will require entirely new infrastructure, including vessels with dual-engine configurations, along with a complete overhaul of maritime logistics, storage, and bunkering systems”, says Associate Professor Seyed Mansouri.

Waste-to-value. In one single unit

SEAFAIRER focuses on an innovative, patented thermochemical conversion process enabling the co-generation of bio-oil (biofuel), syngas and biochar, as well as the resulting biochar-based carbon removal credits. The project scales up the highly modular technology, which is fit for



standardised containers and with a highly compact footprint - designed for scalable replicability.

Delivering climate-positive marine biofuels

To move beyond current biofuel solutions, SEAFAIRER applies the International Maritime Organisation's "Well-to-Wake" life-cycle assessment methodology, accounting for



total GHG emissions from feedstock sourcing to use of marine biofuels and developing a business case for commercial deployment of the technology in the EU and abroad. One of the project’s key milestones and highlights will be a 30-day campaign of an ocean vessel around the Port of Valencia, presenting the final validation of the advanced biofuel produced.

Validating selected feedstocks

The SEAFairer project will collect, characterize and process 3 biomass feedstocks: rice husk, biowaste sieving material and residual agave bagasse from Mexican tequila production. Through a single-stage intermediate pyrolysis and post-reforming process, the biogenic feedstock is converted into biochar, a natural carbon sink, thus generating carbon removal credits, and is recognised as an effective soil amendment and organic fertilizer: raw bio-oil, which is classified as a biocrude. Thanks to the superior technological process, this raw oil enables the decarbonisation of maritime shipping through seamless integration as a bio-blend with existing marine fossil fuels. Finally, the syngas is rich in hydrogen and is partly (ca. 50%) recirculated into the unit to enable an energy self-sufficient process. The exceeding gas (ca. 50%) has several energy and industrial applications.

Pathways for integration with existing refinery infrastructure. The biofuel, which is the focus of SEAFairer, then engages in two different pathways:

- **Pathway A** (No upgrading) - Direct use of advanced biofuel, validated by marine engine and component testing;
- **Pathway B** (Minor upgrading) - Integration of intermediate biofuel in existing refinery infrastructure

As part of the PROSYS center at DTU Chemical Engineering, a model-based value chain simulation tool is being developed to serve as decision support. This tool will simulate different scenarios in the value chain and assess its primary KPIs.

The SEAFairer consortium

DTU Chemical and Biochemical Engineering, Centro Mário Molina, ETA Florence, Fraunhofer, Fundación Valenciaport, FVTR, KPMG, Petrogal, Tergy Sagava, UABIO.

👤 Associate Professor Seyed Soheil Mansouri

Disclaimer: This project has received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement n. 10117300.

PROSYS

Our main purpose is to perform research and teaching that will contribute to developing technologies for future more sustainable chemical and bio-based production processes.

Furthermore, our activities include digitalization of production processes as well as societal challenges by addressing several Sustainable Development Goals (SDGs), most importantly sustainable production and consumption (SDG12), climate action (SDG13) and affordable and clean energy (SDG7).

Our research work, often in collaboration with industrial partners, involves three main components: **Process systems engineering (PSE)**, **Bio-based transformations (biocatalysis, fermentation)** and **Separation processes (Downstream processing)**.

We develop computer-aided tools for a broad range of processes including food and pharma production, manufacturing of chemicals and wastewater treatment/resource recovery. We work with mathematical modelling and simulation, optimization, process synthesis and design, etc. In recent years, Life Cycle Analysis (LCA) has developed into an important tool complementing traditional techno-economic analysis of process alternatives.

We perform experimental and theoretical work that spans from microscale over lab and pilot-scale to full-scale activities, also including digitalization of the systems studied.

Within fermentation, we work with pure and mixed cultures, and we have also developed activities involving scaling up/scaling down, computational fluid dynamics, and development/test of novel online sensors.

In biocatalysis, multi-step biocatalysis and in-situ product removal (ISPR) are investigated, as well as oxygen supply methods for bio-oxidations. Enzymes investigated include alcohol oxidases, carbohydrate oxidases, cytochrome P450s, Baeyer-Villiger monooxygenases, dehydrogenases, peroxidases, laccases, and transaminases.

Within downstream processing, we cover a broad range of unit operations (e.g. distillation, crystallization, extraction, chromatography), for example investigating methods to obtain improved control of such processes, and have detailed expertise on different applications of membrane processes, particularly classical liquid operations—from microfiltration to reverse osmosis—and use of membranes for enzyme immobilization.

Collaboration is key to our existence, and therefore PROSYS has many international academic partners, and participates in a broad range of industry collaborations. At the Department, we have frequent collaborations with the department's pilot plant.

Proteins in Materials

Bio-based materials, especially proteins, are sustainable alternatives to petrochemical polymers, highlighting their unique properties for innovative composite applications, such as eco-friendly materials for industries like packaging and wearables.

Most polymers being used in society today originate from petrochemical-based raw materials. In the interest of the green transition, there is a strong focus on utilizing alternative feedstocks, such as bio-based materials, biopolymers, and waste resources for materials. At the Danish Polymer Center at DTU Chemical and Biochemical Engineering, this is viewed as a growing research area spanning several research projects that are targeting a diverse range of applications.

Proteins are abundant in nature and are found in many different natural materials, such as in silk (a protein produced by silkworms and spiders renowned for its impressive strength and flexibility) and collagen (a structural protein in animal bones, valued for its resilience and biocompatibility). What is particularly interesting is that due to their highly tailored structural characteristics, they also have the potential to provide extraordinary properties to the field of synthetic materials. By taking advantage of these structural effects, it is possible to obtain materials that are direct replacements of classical polymers, even though they are produced from waste resources and byproducts.

Proteins and bio-based components

A particularly exciting avenue is the combination of proteins with other bio-based components, such as polysaccharides or natural fibers, to engineer composites with enhanced performance and reduced environmental footprints. Recent collaborations have explored the use of proteins like collagen and wheat gluten, compounded with lignocellulosic fibers or agricultural residues, resulting in materials suitable


for packaging, construction, and consumer goods (EU-RAW, IFD EatPack, IFD HiProBio). “The versatility of proteins extends to their use in additive manufacturing processes, extrusion, injection molding and many other classical plastic processing methods, where their unique molecular structures and tunable properties can be exploited,” says Professor Anders E. Daugaard.

Similarly, due to the highly functional structure of proteins, they also have the potential to not only be a replacement for plastics, but to actually bring something more to the materials, where the protein structure can contribute specific properties to synthetic hybrid materials. This is particularly true in the NNF wearables project, which stands out for its innovative approach in combining proteins with silicones to create superior elastomeric materials. By integrating the mechanical advantages of silicones with the biodegradability and functional versatility of proteins, this project aims to engineer advanced materials suitable for wearable technologies. “The resulting protein-silicone elastomers hold promise for applications demanding flexibility, durability, and environmental responsibility, such as soft electronics and biomedical devices,” says Professor Anne Ladegaard Skov.

These examples demonstrate how proteins, through their unique molecular arrangements, can provide remarkable properties and inspire innovative applications in future material development.

 Professor Anders E. Daugaard and Professor Anne Ladegaard Skov



Proteins combined with silicones create a superior elastomeric material.  Thomas Steen Sørensen

The Danish Polymer Centre

The Danish Polymer Centre aims at being at the forefront of the synthesis and characterization of novel polymer materials with a special emphasis on silicone polymers and sustainable polymers. Currently, most focus is directed towards sustainable polymers, plastics, and elastomers for use in a variety of applications, such as commodity plastics, advanced electronics, and soft robotics.

The main objective of the research area is to lead the way toward more sustainable materials. We aim to take part in the transition at all levels of materials development from the fundamental synthesis of new bio-based polymers, across various recycling pathways and toward industrial implementation.

In society, we are targeting a more sustainable use of all materials and plastics in particular. There are a number of pathways towards reaching this - both from a materials sourcing point of view, as well as through conservation of the materials we have and using them in the best possible way. In our efforts to contribute to this challenge in society, we collaborate across the relevant disciplines to take part in the development of the new systems that we require as tomorrow's materials.

Specifically, we currently have research activities in the areas of greener production, using both enzymes as well as classical synthetic methods to prepare polymers from new sources of raw materials. By exploiting waste materials or bio-based raw materials, we target the preparation of materials with a lower impact. Through collaborations, we exploit both chemical, biological, and mechanical recycling to prepare new products or materials that enable easier recycling and permit either simpler or direct recycling of materials. This also encompasses the synthesis of additive components to enable systems to be recycled directly and to simplify these systems to increase their value in a circular economy context.

These activities are supported through our strong chemical synthetic and characterization platform, which we exploit across a broad range of products both in collaboration with other academic institutions as well as with industry.

Biomethanation of Pyrolysis Gas: Advancing Carbon-Negative Energy Solutions

Pyrolysis can convert residual biomass into valuable products, reducing greenhouse gas emissions.

Residual biomass from various processes often has low market value and is commonly disposed of through landfilling or incineration, methods that emit significant amounts of methane (CH₄) and carbon dioxide (CO₂), both potent greenhouse gases. To meet global climate goals, smarter waste management strategies are essential.

From Linear to Circular Economy

Traditional disposal methods reflect a linear “take-make-dispose” model, whereas circular economy principles promote climate-positive solutions. Pyrolysis, which is a process that thermally decomposes biomass without oxygen, produces bio-oil, biochar, and pyrolysis gas. While bio-oil can be used as a renewable alternative to fossil fuels, and biochar improves soil quality and sequesters carbon, pyrolysis gas is typically combusted for heat and power, posing challenges due to its toxicity, flammability, and variable energy demand. Innovative approaches are needed to utilize this gas more sustainably.

Microbial Conversion as a Key Technology

Pyrolysis gas contains carbon monoxide (CO), hydrogen (H₂), carbon dioxide (CO₂), methane (CH₄), light hydrocarbons, and other impurities

such as sulfur compounds. Although catalytic conversion to synthetic fuels is possible, it requires costly purification. “Biological conversion to CH₄ offers a more robust and economical alternative. Mixed microbial consortia (MMC) tolerate impurities and function under mild temperature and pressure conditions, producing renewable CH₄ compatible with existing natural gas infrastructure. This aligns with the EU’s REPowerEU plan by reducing reliance on imported natural gas,” says Associate Professor Ioannis V. Skiadas.

A partnership between PILOT PLANT and the AT-CERE center at DTU Chemical Engineering has successfully shown how to biologically convert syngas and/or CO₂, along with added H₂, using trickle bed reactors (TBRs) in laboratory and pilot-scale setups. The TBRs achieved high conversion rates of gases and high CH₄ productivities. Their design, with a high surface area compared to their volume, helps overcome challenges in gas fermentation, that is, mass transfer rates and microbial growth rates.

Pilot Plant Research at DTU

PILOT PLANT and AT CERE have also demonstrated efficient conversion of syngas and

CO₂ with added H₂ using TBRs. Current work focuses on MMC performance with raw pyrolysis gas, determining inhibition coefficients for process modelling and identification of minimal gas cleaning requirements. Light hydrocarbons, particularly acetylene and ethylene (C₂H₄), account for a significant fraction of gas impurities following pyrolysis. Initial findings show that 1.11% C₂H₄ content in pyrolysis gas, the highest level reported after straw pyrolysis by Stiesdal SkyClean A/S, showed no nega-

tive effect on CH₄ production. Higher C₂H₄ concentrations, however, can inhibit CH₄ production (see figure 1), prompting further studies on long-term effects.

Further steps

Long-term effects at higher C₂H₄ concentrations will be tested in lab-scale TBRs where MMC forms biofilm, and Adaptive Laboratory Evolution will be applied. In this technique, the bioreactor serves as a “microbial gym” for adaptation. Gas impurities act



PhD student Anatolii Michchuk and Associate Professor Ioannis V. Skiadas in the lab.  Berivan Tunca

as selective pressures, enabling microbes to build resilience under stress, much like exercise for the human body (see figure 2). Once adapted, MMC will be inoculated to a semi-pilot TBR, supported by a process digital twin to optimize CH₄ output.

ive. The goal is to connect a pilot TBR to Stiesdal's 1 MW SkyClean plant in Skive and assess the techno-economic and sustainability potential of integrating pyrolysis and biomethanation units", Ioannis V. Skiadas concludes.

"Biochar from pyrolysis will also be evaluated as a packing material and a medium addi-

Associate Professor Ioannis V. Skiadas

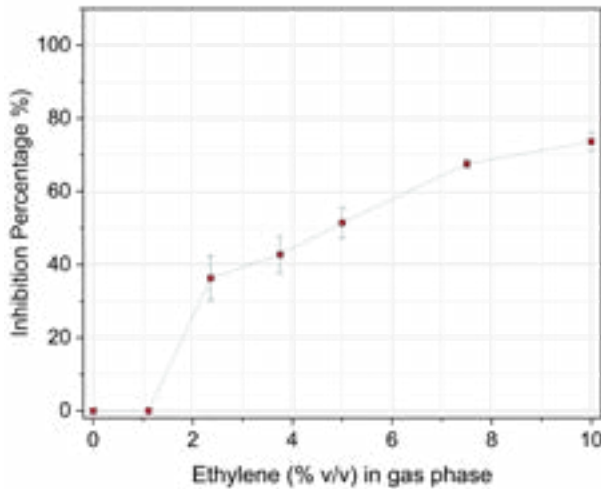


Figure 1. Effect of ethylene on MMC inhibition percentage in suspended growth



Figure 2a. Study of the pyrolysis gas inhibition effect

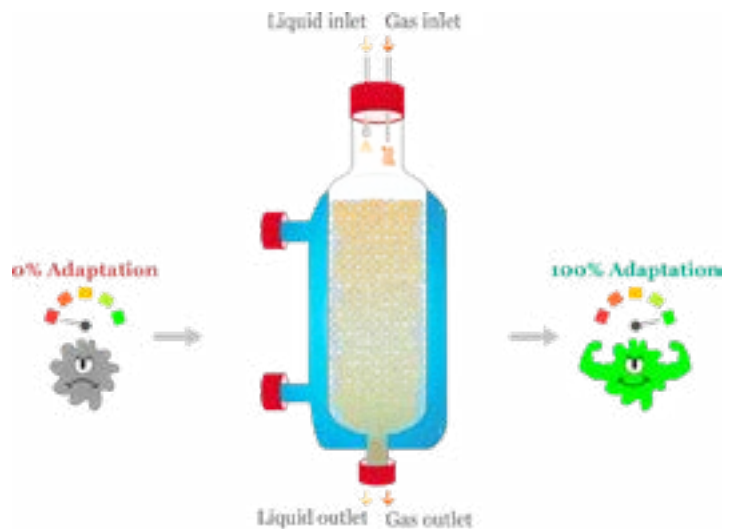


Figure 2b. Adaptive Laboratory Evolution

PILOT

The DTU Chemical Engineering Pilot Plant offers and further develops our unique equipment infrastructure and our strong theoretical and practical unit operation competences within existing and state of the art technologies and processes of the chemical, pharma, biotech, food and energy industries.

Our aim is to provide world-class education for the students, and to be the most attractive research partner for our employees and for industry, educational institutions and society. The recent major expansion of the Department's pilot halls, laboratories and process and analytical equipment will ensure that our educational and research facilities and its activities will be even more attractive, modern and efficient.

With four new large pilot halls in addition to the existing five halls, and a huge investment in new process and analytical equipment, we are able to operate, simulate, and develop many types of unit operations and process lines in pilot scale, representing the life science industry as well as traditional chemical, biochemical and food industries.

A major investment in the digitalization of a significant part of our pilot units has been implemented during 2022-23. The project includes implementation of a Siemens Scada system for educational and research data collection and manipulation, and a virtual reality environment for e-learning to facilitate the remote study of some of the most used unit operations.

A new pilot scale fermentation-based manufacturing line for pharmaceuticals, food and biochemicals, including fermenters from lab scale to 250 litres, and a broad selection of relevant downstream separation and purification equipment, has been approved for handling of Genetically Modified Organisms class 1 in large scale. Furthermore, we have the amplest lab facilities also approved for GMO projects.

We are focusing on attracting new external collaborators to increase our research and innovation activities based on processes, technologies and equipment. This will continue to enhance a dynamic interface and activity between our capabilities and our existing and new external collaborators.

Highlights 2025

20 JANUARY

VISIT FROM DTU CHAIRPERSON OF THE BOARD

Margrethe Vestager, the former EU Commissioner, has become the Chairperson of the Board at DTU. During her visit to DTU Chemical Engineering, she toured our facilities, including the GMO lab. She learnt about our projects in Power-to-X, carbon capture, fermentation, and downstream processing, as well as the digitalisation of our pilot plant.

 Steen Larsen



3-21 MARCH

COURSE ON MOLECULAR SIMULATION OF FLUIDS

During his visit as Otto Mønsted Visiting Professor, Ioannis Economou gave the PhD course "Molecular Simulation of Fluids: Fundamentals and Industrial Applications". The course is designed to bridge the gap between fundamental principles and industrial applications and was attended by 18 students.

30 MARCH

KALUNDBORG REFINERY PRIZE TO PHILIP FOSBØL

Associate Professor Philip Fosbøl received the Kalundborg Refinery Prize, which is Denmark's oldest technology prize. Philip was awarded for his groundbreaking research in Carbon Capture and Storage (CCS).



 Kalundborg Refinery

1 APRIL

NEW PROFESSORS

Six new Professors were appointed at DTU Chemical Engineering: Hariklia Gavala, Anders E. Daugaard, Jakob Kjøbsted Huusom, Ulrich Krühne, Hao Wu and Philip Fosbøl.

11 APRIL

LIFE-SAVING FOAM

Professor Anne Ladegaard Skov presented her life-saving foam to Minister for Industry, Business and Financial Affairs Morten Bødskov when Denmark's first defence accelerator, Defence Tech Denmark, was presented at DTU.



 Morten Bødskovs LinkedIn

2 MAY

LECTURE AT THE ANNUAL COMMEMORATION AT DTU

Professor Anne Ladegaard Skov delivered this year's lecture at the Annual Commemoration at DTU. She shared how she and her team are working on technology to make older people more independent and take the pressure off the public system without compromising quality of life.

5 MAY

VILLUM INVESTIGATOR TO PROFESSOR IRINI ANGELIDAKI

Professor Irini Angelidaki received the prestigious Villum Investigator grant of 30 million DKK for her research project 'BIODESIGN'. The project focuses on exploiting the potential of microbial consortia to enable the utilisation of waste and residues, such as substrates, for high-value products such as biofuels and chemicals.

Line Ravn Gundal



8 MAY

INVESTMENT FROM INNOVATION FUND DENMARK

Innovation Fund Denmark is investing 15 million DKK in a research collaboration involving Danfoss, DTU Chemical Engineering, and SaltPower™. This project, led by Professor Ulrich Krühne with the participation of Professor Manuel Pinelo, aims to develop high-pressure membranes that can harness energy from osmosis.

7-9 MAY

NNF CHALLENGE SYMPOSIUM

The NNF Challenge Symposium: Energy Materials with Biological Applications was a one-day event dedicated to advancing knowledge, fostering collaboration, and celebrating innovation in the field of *energy materials*. It was a joint effort between Professor Anne Ladegaard Skov and Professor Anja Boisen from DTU Health.

8-9 MAY

COAST ANNUAL DAY

The CoaST Annual Day was attended by 50 internal and 44 external participants. followed by a workshop on forming a European Coatings Science and Technology Network.

2-4 JUNE

CERE DISCUSSION MEETING AND KT CONSORTIUM ANNUAL MEETING

Once again, leading minds from academia and industry were brought together to explore cutting-edge developments in chemical and biochemical engineering. 101 participants attended the CERE Discussion Meeting and KT Consortium Annual Meeting.



Jacob Marcussen

11 JUNE

PARTICIPATION IN THE BIOCHAR SUMMIT 2025

Researchers from DTU Chemical and Biochemical Engineering participated in one of Europe's leading biochar events, the Biochar Summit. Researcher Parisa Ghofrani-Isfahani, Tenure track researcher Giulia Ravenni and Postdoc Raïssa Rossi all gave presentations on their research at the big event.

Highlights 2025

13 JUNE

VISIT FROM INDIA

DTU Chemical Engineering welcomed the Anusandhan National Research Foundation and IIT Guwahati for a tour of the department. The Indian delegation were introduced to the department's research activities and the facilities at the Pilot Plant.

17 JUNE

NEW HEAD OF DTU CHEMICAL AND BIOCHEMICAL ENGINEERING

DTU President Anders Bjarklev announced that Professor Anne Ladegaard Skov will take over as Head of Department at DTU Chemical Engineering on 1 January 2026. She succeeds the esteemed Professor Kim Dam-Johansen, who led the department for an impressive 26 years.

 Thomas Steen Sørensen



18-20 JUNE

QUANTUM COMPUTING APPLICATION WORKSHOP

Associate Professor Seyed Soheil Mansouri organized and co-chaired the 4th Quantum Computing workshop that brought together scientists and engineers working in start-ups, industry and academia to discuss how quantum computing and artificial intelligence can be applied to advance biological and chemical processing.

20 JUNE

GRANT TO PROFESSOR PHILIP FOSBØL

Professor Philip Fosbøl received 7.8 million DKK as partner in the VALGREEN project. The project aims at developing a tailor-made CO₂ capture system for brickworks, enabling the production of zero-emission bricks. The solution combines advanced capture technology, AI optimization and circular economy to ensure both environmental requirements and the classic properties of the brick.

26 JUNE

DKK 60 MILLION GRANT FROM THE NOVO NORDISK FOUNDATION

The Novo Nordisk Foundation granted DKK 60 million to a DTU-led project that aims to investigate so-called heterogeneity in gas fermentation across different scales. Professor Krist V. Gernaey, DTU Chemical Engineering, is leading the research project, together with Professor Jochen Förster, DTU Biosustain. The research project will work on a new way to produce food and chemicals - not from sugar, but from gas, such as methane. It is more sustainable because it does not require agricultural land and uses carbon more efficiently.

 Molly Marina



30 JUNE – 2 JULY

INTERNATIONAL WORKSHOP ISPO2025

The International Workshop on Silicone-based Polymers (ISPO25) was hosted by the Danish Polymer Centre at DTU Chemical Engineering. PhD students Nikolett Kis and Christiana Pliakou received the Best Poster Award, while their fellow PhD students Leo Kershaw and Florina-Elena Comanici were honored with the Best Poster Presentation Award.

30 JUNE – 25 JULY

SUMMER UNIVERSITY

Once again, DTU Chemical Engineering held the annual Summer University. 69 participants from primarily USA spent the month of July learning about large-scale processes in our world-class pilot plant.

Steen Larsen



13-17 JULY

WCCE 12 IN BEIJING, CHINA

At the 12th World Congress of Chemical Engineering (WCCE12), Professor Georgios M. Kontogeorgis and Dr. Xiaodong Liang delivered presentations. Additionally, PhD students Javad Amanebadi and Ziyi Zhou received the "Best Oral Presentation" award and the "Best Poster" award, respectively.

18 AUGUST

PROFESSOR INAUGURATIONS

On a festive day in August, new professors at DTU Chemical Engineering gave their inaugural speeches. Professors Hao Wu, Hariklia Gavala, Jakob Kjøbsted Huusom, Ulrich Krühne, Nicolas von Solms, Philip Fosbøl, Manuel Pinelo, Søren Kiil and Anders E. Daugaard all gave presentations on their research, showcasing the diversity of research and the various paths that can lead to becoming a professor at DTU Chemical and Biochemical Engineering.



Søren Vestergaard

18-23 AUGUST

SUMMER SCHOOL

Professor Gurkan Sin held a week-long summer school on Uncertainty and Sensitivity Analysis of Model Output in Engineering Applications for 27 PhD students in August.

29 AUGUST

40TH WORK ANNIVERSARY

We celebrated Ingelis Larsen's 40th work anniversary as a Laboratory Technician at DTU. She has been an important part of DTU at Risø and has spent the past ten years as part of DTU Chemical Engineering.



Brigitte Hannibal

Highlights 2025

9 SEPTEMBER

POSTER WINS FOR COAST

PhD student Mohammad Ghaderi won the EFC Poster Prize at the EUROCORR 2025 conference in Stavanger, Norway. Other CoaST poster winners this year include PhD Luis Heller, recognized at the European Coatings Show 2025 in Nuremberg for his poster on "Self-stratifying coatings," and PhD Shawn Lindner, who won a creativity award at the Coatings Science International Conference in Noordwijk for "Hydrogel Technology: Towards Non-Biocidal Antifouling Coatings." Additionally, both Pascal Guth and Shawn Lindner received poster awards at the International Antifouling Conference in Gothenburg, Sweden.

 Luuk Moone



1 OCTOBER

NATIONAL TEACHING AWARD

Seven outstanding educators received the national Teaching Award, including Professor Ulrich Krühne from DTU Chemical Engineering. Ulrich was honoured for his exceptional ability to combine academic excellence with presence, relevance, and a talent for engaging students. Ulrich was also awarded DTU's teaching prize in 2024.

 Kristoffer Juel Poulsen



1 OCTOBER

VILLUM EXPERIMENT GRANT TO NEFELI NOVAK

Tenure Track Researcher Nefeli Novak was one of the recipients of the Villum Experiment grant. She received the prestigious grant for the project "Can the two-state theory of water revolutionize aqueous solutions?" The grant supports unconventional research projects, and bold and innovative ideas.

3 OCTOBER

ANNUAL POLYMER DAY

The Danish Polymer Centre, DPC, hosted yet another successful Annual Polymer Day. 135 participants, including collaborators, former employees, former students, and colleagues from the department, attended an afternoon of the latest research on polymers and elastomers. Professor Anders E. Daugaard gave a presentation on polymers from new materials. Winner of the poster competition was PhD Student Christiana Pliakou.

10 OCTOBER

PROSYS RESEARCH DAY

The 9th PROSYS Annual Research Seminar kicked off as an informal networking event with 138 participants sharing recent developments from the center's research, including biocatalysis, fermentation technology, downstream processes, mathematical modelling, computational fluid dynamics (CFD), and Process Systems Engineering (PSE) for various processes.

13-17 OCTOBER

SUMMER SCHOOL ON MICROFLUIDICS

DTU Chemical Engineering accommodated the 5th Summer School on Microfluidics, arranged by Professor Ulrich Krühne. The summer school is a 5-day hands-on training course on Bioprocess Development or Medical Applications in Microfluidics.



Mikal Schlosser



19-24 OCTOBER

ECI ENZYME ENGINEERING CONFERENCE

Professor John M. Woodley co-chaired the highly prestigious ECI Enzyme Engineering Conference, held in Helsingør, with attendance of around 150 participants from around the world. It is the second time the conference was held in Denmark after a 40-year gap.

23 OCTOBER

DFF GRANT TO MARLENE

MARK JENSEN AND XIAODONG LIANG

Researcher Marlene Mark Jensen and Associate Professor Xiaodong Liang received a grant from the Independent Research Fund Denmark under the DFF-Research Project 1 program. Marlene's work focuses on magnetic bacteria to address future phosphorus shortages, while Xiaodong aims to improve CO₂ storage simulations to assist policymakers and engineers.

30 OCTOBER

CHEC RESEARCH CENTRE ANNUAL DAY

The CHEC Annual Day was an informal networking event featuring guest speakers from Topsoe and Fraunhofer-Gesellschaft as well as presentations from CHEC. The 90 participants from industry and academia shared a range of research highlights from activities within catalysis and high-temperature processes.

17 NOVEMBER

GRANT TO ASS. PROFESSOR MAGDALENA SKOWYRA

Ass. Professor Magdalena Skowyrza has been awarded the Dr. Techn. A.N. Neergaard and Wife's Foundation grant for her work on developing a novel soft electrode using table-top centrifugation. The grant is administered by DTU, and Provost Christine Nellemann presented the grant to her.

18 NOVEMBER

EXCELLENCE AWARD

Associate Professor Seyed Soheil Mansouri is a co-recipient of the HPC Innovation Excellence Award 2025 for developing an AI platform that combines supercomputing and quantum technology to improve the control of bioprocesses.

Highlights 2025

19 NOVEMBER

DTU YOUNG RESEARCHER AWARD

Postdoc Ginevra Giangeri is currently on an external stay at MIT, supported by a grant from the Independent Research Fund Denmark. She has been awarded the DTU Young Researcher of the Year Award for her thesis titled "Novel Approaches for Steering Microbial Processes in Anaerobic Digestion: Focusing on the Role of Direct Interspecies Electron Transfers."

23-29 NOVEMBER

INVITED ACADEMIC VISIT

Professor Gürkan Sin delivered invited lectures on "Uncertainty Quantification" and "AI in Biomanufacturing," led a specialist workshop on uncertainty quantification, and provided research guidance to the university's PhD students during a one week visit to the Institute of Chemical Engineering and Technology at XJTO University.

1 DECEMBER

PRESTIGIOUS GRANT TO NEW FACULTY MEMBER

Professor Ioannis G. Economou was awarded the prestigious NNF Recruit grant for his project entitled "Molecular Design of Novel Materials for Sustainable Technologies" (MoDeST). He will conduct this research at DTU Chemical Engineering (KT) when he joins the KT faculty in 2026. He is already a well-known figure at KT, having visited us on several occasions, including his tenure as an Otto Mønsted Visiting Professor.



Christian C. Carlsson

5 DECEMBER

KT CHRISTMAS SEMINAR AND LUNCH

The festive day started with presentations highlighting key research for 2025. This was followed by the presentation "Engineering entrepreneurship into your research environment" by Professor Andreas Hougaard Lautsen-Kiel from DTU Bioengineering, as well as an introduction to the year ahead by our incoming Head of Department, Anne Ladegaard Skov. The day concluded with a traditional Christmas lunch attended by over 200 employees from the department.



Cooperating companies

Z

Z1st.Bio

3

3V TECH EQUIPMENT & PROCESS SYSTEMS

A

AGC Biologics
Air Products
Alfa Laval
Algiecel
ALK Abello
Aller Aqua
Amager ressource Center
Applied Chemicals and Materials Division, NIST
AquaGreen
Aquaporin
ARKEMA FRANCE
Arla Foods Ingredients Group
Atlant 3D
Avery Denison
AVEVA
Avista Green
AWAPATENT
Axens

B

Babcock & Wilcox Vølund
Baker Hughes
BASF
Bayer
BioHalo
BioInnovation Institute
BioLean
Biomar
BioMia
Biopharm Services
Bioscavage
Biosynthia
BP
BTG Bioliquids

C

Calsep
Campen
Carbfix
Carlsberg Research Laboratory
Centro Tecnológico Componentes
Chreto
Chromologics
Ckj Steel
C-LEcta
Coloplast
Contura
Cysbio

D

Dall Energi
Dalum
Dampskibsselskabet Norden
Danfoss
Danish Technological Institute
Dansk Gasteknisk center
Dan-Unity

DHI
DSM
Dyadic

E

ECCO
Elkem
Elplatek
EnCoat
Enduro
Engie
Engineering Consulting Corporation
ENI
EnviDan
Equinor
ESSS
Estech
Everllence
Evida

F

Finnsementii
FLSmidth
Fluor Corporation
Fonden Bevar Sjælland
FORCE
Freesense
Frida
Fuji Pharma
Fujifilm Diosynth biotechnologies
Fuller

G

G2B Biosolutions
Gabriel
GEA
Geminor
Glaxo-Smith-Kline
Glysius
GR3N SAGL
Green2X
Greenlab Skive
Grundfos

H

H. Lundbeck
Hafnium Labs
Harper & Vedel
Harriot Wiat
Hempel
Henkel
HENNES & MAURITZ (H&M)
Hillerød Forsyning
Hundested Havn
Hutchinson
Hysytech

I

IFP Energies nouvelles
IFPEN
IKEA
InMold
INNARGI
Innosyn
Insatech A/S

J

Janssen -pharmaceutical company of Johnson & Johnson
Jiangsu Industrial Technology Research Institute

K

Kaffe Bueno
Kalundborg forsyning
Kalundborg Symbiosis
Kanadevia Inova
Karup Kartoffelmelsfabrik
KBC
Koppers
Kvasir Technologies

L

LactoLink
Landbrug & Fødevarer
LEGO
Lemvig Biogas
Leo Pharma
Linde
LiqTech International
Lucent Petroleum
Lundbeck Pharma
Lundsby Biogas

M

Madsen Bioenergi
Mash Makes
Media Medic
Metricorr
Microsoft
Mitsubishi Chemical Corporation
Momentive
Mölnlycke

N

NEO GROUP
Neste Corporation
New Energy Coalition
Nopa
Nordic Sugar
Nova Pangeae
Novo Nordisk
Novonesis

O

Octarine Bio
OMV Petrom
OrganoClick

P

ParticleTech
Pharmacosmos
Pond
PROCESSI INNOVATIVI
Processium

Q

Q-Interline

R

Radiometer
Rambøll

ReCorrtech
Ringsted Forsyning
River Stone Biotech
Rockwool
Roxtec

S

SaltPower
Sanofi
Sartorius
Schlumberger
SemperCycle
Shell
Shell Biogas
Sinopec
Skanderborg Forsyning
Skovgaard invest
Stiesdal Fuel Technologies
SYNESIS
Syngenta

T

Tate & Lyle
Technaro
Teknologisk Institut
Tetrapharm
Topsøe
TORM
TOTAL
Total Energies
Tårnby Forsyning

U

Unibio Group
Unilever
Union Engineering
US Navy, Office of Naval Research

V

Valmet
Vandcenter Syd
Viegand & Maagøe
Viking Malt
Vitol

W

Weel & Sandvig
Wetsus
Wilton

X

Xellia Pharmaceuticals

Ø

Ørsted

Aa

Aalborg Portland

An Eventful Year for KT Students

KT Students is a student organization at DTU Chemical and Biochemical Engineering, aiming to create a motivating study environment and connect academia with future careers. In 2025, we focused on strengthening relations among Danish and international students and promoting the awesome career opportunities within the department and industry.


Spring highlights included a fully booked visit to Everllence (formerly MAN Energy Solutions) for insights into emission technology and marine innovation, and a Lunch Talk with Novo Nordisk's Simon Birchedal on computational fluid dynamics. Social events and study cafés with Kemirådet also drew great interest.

Autumn brought board changes as members graduated or began theses, yet we hosted engaging events: presentations by PhD student Ole Hauge Jensen, alumni sharing thesis experiences, and company visits to Avedøre Power Plant and the National Museum labs. Finally, we want to mention an event this year, which we have not had the pleasure of hosting before: a presentation from an actual student start-up! DTU student Benjamín Medina spoke about his start-up Tint Biotech - the challenges, ups and downs, and gave key advice for students with an entrepreneurial engineer inside wanting to do their own startup.

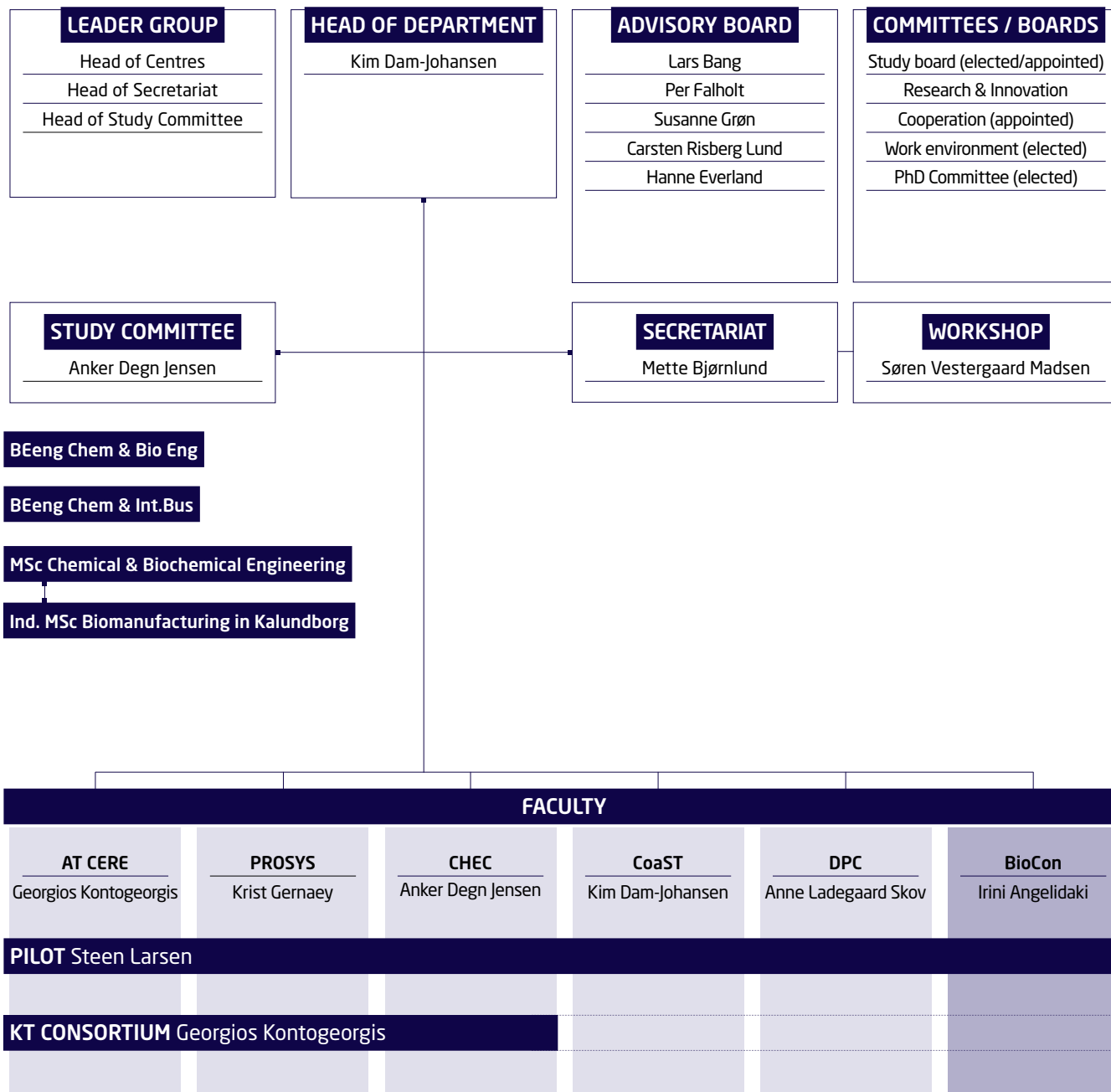
In 2026, we will also bring the NKK (Nordic Chemical Engineering Conference) to us! Last year we participated in NKK in Helsinki,

and this year it is our turn to host. NKK is a conference taking place every year for chemical engineering student organizations from across the Nordic region to gather to collaborate, network and share ideas. We are excited for what the new year will bring us and the institute, and as always, all students with an interest in chemical engineering are welcome in our organization!



KT Students at the Nordic Chemical Engineering Conference in Finland.  KT Students.

Organization



The Faculty 2025

SCIENTIFIC



Alexander Shapiro
Associate Professor



Anders E. Daugaard
Professor



Anne Ladegaard Skov
Professor



Anker D. Jensen
Professor



Georgios Kontogeorgis
Professor



Gürkan Sin
Professor



Hao Wu
Professor



Hariklia N. Gavala
Professor



Helena Junicke
Associate Professor



Huichao (Teresa) Bi
Associate Professor



Ioannis V. Skiadas
Associate Professor



Irimi Angelidaki
Professor



Jakob K. Huusom
Professor



Jakob M. Christensen
Associate Professor



Jens Abildskov
Associate Professor



Jochen Dreyer
Associate Professor



John Woodley
Professor



Julian Kager
Assistant Professor



Kim Dam-Johansen
Professor,
Head of Department



Krist V. Gernaey
Professor



Magdalena Skowrya
Assistant Professor



Manuel Pinelo
Professor



Martin Høj
Associate Professor



Narayanan Rajagopalan
Assistant Professor



Nicolas von Solms
Professor



Peter Szabo
Associate Professor



Peter Glarborg
Professor



Philip L. Fosbøl
Professor



Seyed S. Mansouri
Associate Professor



Søren Kill
Professor



Ulrich Krühne
Professor



Xiaodong Liang
Associate Professor

TECHNICAL AND ADMINISTRATIVE



Mette Bjørnlund
Head of Secretariat



Steen Larsen
Head of Pilot plant

EMERITUS



Kaj Thomsen
Emeritus



Ole Hassager
Professor Emeritus



Sten B. Jørgensen
Professor Emeritus



Stig Wedel
Associate Professor
Emeritus

Advisory Board



LARS BANG
EXECUTIVE VICE PRESIDENT
H. LUNDBECK A/S

"Every day serving more than 7m patients with brain diseases around the globe from European factories requires competitive technological solutions. Our partnership with DTU Chemical Engineering is a cornerstone in developing solutions that really make a difference and is attracting talented new employees."



HANNE EVERLAND
VICE PRESIDENT
EMENDO R&D APS

"As Senior consultant at Emendo Consulting Group, I service the Danish medical device industry broadly. Here I see how innovation is promoted by collaborations with DTU Chemical Engineering and I meet remarkably knowledgeable students and graduates from the department. Plastic are the main components of most medical devices and with the increased focus on the environment impact of plastic the Danish Polymer Center is an important partner for the industry in the development of new and more sustainable polymers."



PER FALHOLT
CHIEF SCIENTIFIC OFFICER
21ST.BIO

"I am a biotech entrepreneur with a long experience from launching industrial biotech products to many different industries, food, feed and technical. With my experience from Industry combined with my DTU insight from being Chairman of the board at DTU I can bring relevant societal needs and challenges into our research and education environment at Chemical Engineering and will use this to help educate the relevant candidates for the future."



SUSANNE GRØN
VICE PRESIDENT FOR R&D PROCESS
PRINCIPAL INVESTIGATOR
NOVO NORDISK FOUNDATION

"Climate change, food waste, global health, and the overuse of antibiotics and pesticides are pressing issues that society and industry must address to shape a more sustainable future. Biosolutions often hold the key to solving these severe challenges of the green transition. Through engineering science and deep skills in biomanufacturing, we can bring these solutions to scale faster and more safely. This will enable us to combat climate change, safeguard biodiversity, protect the environment, and secure sustainable food production for a growing population. At Novo Nordisk Foundation, we are positioned to drive positive change and address these challenges. The Department of Chemical and Biochemical Engineering, as a close partner, is uniquely situated to provide innovative solutions and strong engineering candidates contributing to this essential purpose."



CARSTEN RIISBERG LUND
BOARD MEMBER, FORMER GROUP
EXECUTIVE VICE PRESIDENT FLSMIDTH A/S

"The world must come together to solve the urgent challenges of global warming and scarcity of resources. Developing and commercializing practical technologies together is the hallmark of Danish industry and research institutions. DTU Chemical Engineering has for decades worked with Industrial partners to support and develop this hallmark on a local and global scale.

A unique technology position and strong engineering competences are the foundation for success for all process engineering companies that I am affiliated with. Through state-of-the-art education of international engineers, DTU Chemical Engineering shall continue to ensure the competence needed to maintain this foundation and together with industry we shall address the UN Sustainability Goals and develop practical and sustainable technologies applicable in the world at large."

Teaching

KT considers research based and industrial inspired education and teaching our most important contribution to society and we are involved in:

- The BEng programmes “Chemical and Biochemical Engineering” and “Chemical Engineering and International Business”.
- The BSc programmes in “Kemi og Teknologi”, “General Engineering”, and a digital education taught in Danish, DTU Chemical Engineering are contributing with the specialization in Power-to-X.
- The MSc programmes in “Advanced and Applied Chemistry”, “Chemical and Biochemical Engineering”, “Sustainable

Energy” (with special focus on Bio-Energy), as well as the N5TPolymers MSc programme. MSc in Chemical and Biochemical Engineering, Study line in Biomanufacturing (Industry MSc in Engineering, Kalundborg).

Our students work both theoretically and experimentally with the core disciplines in chemical engineering such as unit operations, transport phenomena, reaction engineering, mathematical modelling, and thermodynamics. They are taught by faculty specializing in these areas with applications in energy conversion, enzyme technology, and biotechnology, polymers, coating technology, catalysis, computer modelling, process and product design.

Courses

1 SEPTEMBER 2024-31 AUGUST 2025

PHD COURSES

28905	Advanced topics in process systems engineering
28908	Rheology of complex fluids (heavy)
28909	Thermodynamic Models, Fundamentals and Computational Aspects
28917	Statistical Thermodynamics for Chemical Engineering
28923	Uncertainty and Sensitivity Analyses of Numerical Models
28927	Advanced Topics in Process Technology
28928	Electrolyte Solution Thermodynamics
28930	Advances in Chemical and Biochemical Engineering
28933	Introduction to Chemical Modification of protein therapeutics
28934	Automation and control of yeast fermentation
28989	Advanced Course on Molecular simulation of fluids: Fundamentals and industrial applications

Courses

Master's and bachelor courses

Below, course numbers and names are shown for 2024-2025, with the number of students attending shown in brackets. Bachelor of Engineering courses are marked with a **(B)**. The other courses are Bachelor of Science courses, Master of Science courses, or common courses.

FALL SEMESTER

28010 Products and Processes - Introduction to Chemical Engineering (56)
28012 Chemical and Biochemical Process Engineering (70) (B)
28016 Mathematical models for chemical and biochemical systems (76) (B)
28020 Introduction to Chemical and Biochemical Engineering (69)
28022 Unit Operations of Chemical Engineering and Biotechnology (60) (B)
28121 Chemical Unit Operations Laboratory (24)
28125 Chemical Unit Operations Laboratory (10)
28140 Introduction to Chemical Reaction Engineering (34)
28150 Introduction to Process Control (36)
28157 Process and Product Design (37) (B)
28213 Polymer Technology (29)
28233 Recovery and Purification of Biological Products (173)
28242 Chemical Kinetics and Catalysis (57)
28244 Combustion and High Temperature Process (52)
28311 Chemical and Biochemical Product Design (91)
28315 Colloid and Surface Chemistry (23)
28316 Laboratory Course in Colloid and Surface Chemistry (3)
28322 Chemical Engineering Thermodynamics (73) (B)
28346 Advanced fermentation technology practicum (13)
28352 Chemical Process Control (28) (B)
28412 Advanced Chemical Product Design (20)
28420 Separation Processes (65)
28455 Process adaptation in fermentation based biomanufacturing (86)
28485 Biobusiness and Process Innovation (195)
28530 Transport Processes (49)
28730 Transport Phenomena (16)
28750 Systematic Methods for Process Design and Analysis (16)
28751 Control systems in biomanufacturing (18)
28831 Computational Fluid Dynamics in Chemical Engineering (19)
28845 Chemical Reaction Engineering Laboratory (14)
28852 Risk Assessment in Chemical Industry (51)
28857 Good Manufacturing Practice - Practical version (53)
28870 Energy and Sustainability (127)
28872 Biorefinery (73)

COURSES GIVEN IN CO-OPERATION WITH OTHER DEPARTMENTS:

12701 Introduction to Living Systems (120)
26010 Introductory Project in Chemistry (58)
27020 Bioengineering (Polyteknisk grundlag) (394)

SPRING SEMESTER

28010 Products and Processes - Introduction to Chemical Engineering (52)
28020 Introduction to Chemical and Biochemical Engineering (67)
28025 Bio Process Technology (45)
28121 Chemical Unit Operations Laboratory (17)
28157 Process Design (39) (B)
28160 Mathematical Models for Chemical Systems (51)
28165 Mathematical models in chemical engineering - online (7)
28212 Polymer Chemistry (46)
28214 Polymer Synthesis and Characterization (18)
28216 Organics Coatings Science and Technology (7)
28221 Chemical Engineering Thermodynamics (24)
28271 Thermal gasification and sustainability (15)
28342 Chemical Reaction Engineering (68) (B)
28344 Biotechnology and Process Design (37) (B)
28345 Chemical Reaction Engineering (108)
28346 Advanced fermentation technology practicum (13)
28350 Process Design: Principles and Methods (74)
28352 Chemical Process Control (36) (B)
28361 Chemical Engineering Model Analysis (71)
28423 Phase Equilibria for Separation Processes (17)
28434 Membrane Technology (70)
28443 Industrial Reaction Engineering (30)
28451 Optimizing Plantwide Control (28)
28747 Applied Process Design and Intensification (14)
28811 Polymers in processes and products (12)
28850 Pharmaceutical Process Development (140)
28855 Good Manufacturing Practice - Theoretical version (118)
28871 Production of Biofuels (26)

COURSE GIVEN IN CO-OPERATION WITH OTHER DEPARTMENTS:

26280 Chemistry and Physics in CO ₂ Storage (12)
26317 Instrumental Chemical Analysis (49)
27020 Bioengineering (Polyteknisk grundlag) (541)
27455 Microbial adaptation to industrial processes (75)
27828 Upstream Process Development (14)
41686 Materials Science (66) (B)
47213 Introduction to Power-to-X (Online) (28)
47334 Carbon capture, utilization, and storage (52)

BACHELOR OF ENGINEERING DEGREES

33 students finished their research programme for the BEng degree. The project titles are listed below:

Mayasa Othman Mandia - Sustainability analysis of silicone-glycerol composites
Marie Borch Nielsen - Impact of washcoat thickness on adhesion and activity in electrically heated reforming
Casper Darling Aistrup - Improving the efficiency of a repulper system for improved capacity and energy efficiency in a spray drying unit
Mikkel Haupt Kidholm - Electromembrane extraction of organic acids from fermentation broth.
Henrik Malthe Hardon - Determination of the impact of antifoaming agents and their removal on membrane filtration processes in enzyme recovery
Andreas Vengberg Aggelis - Improving knowledge of the control system for the water supply on API Purification Processes
Agata Skolimowska - Enhancing the Purity of Bacterially Produced Cellulose
Magnus Byrland Grønvall - Forward Osmosis performance for a hollow fiber membrane module
Jacob Lee Linde-Laursen - Influence of temperature, time, cleaning agent and impact on cleaning of a protein based product
Rima Rabah - Impact of Methanol Exposure on Epoxy Coatings for Sustainable Fuel Applications
Antonie Engelberg Rikardsson and Caroline Louise Myrup Wolff-Sneedorff - Zero Growth, Total Success: Identification of Critical Surface Sampling Points for Aseptic Filling in Pharmaceutical Manufacturing
Laura Suhr Cameo - Quantification of ammonia removal and N₂O production rates in full-scale tanks
Peregrine Samuel Mitchell - Environmental assessment of coupling Power-to-X (PtX) with O₂-Enriched air fermentation
Jonathan Berg Rasmussen - Freeze drying model
Bilal Bohid - Model of heating probability in tanks
Oliver Percy Rasmussen - Upgrading of Pyrolysis Oils in a Continuous Trickle Bed Reactor
Annika Hald Kjeldsen - Enhancing batch process monitoring with interpretable soft sensors using multivariate statistical methods
Iqra Muneeb - Optimized Clean-in-Place for RheoStream
Henrik Sten Holst - Optimization of WFI Consumption During CIP Processes at Novo Nordisk's AM BA Site
Liv Bechgaard Sander and Marcus William Kaiser - Heating waster water to make biogas in sugar processing
Mia Katarina Worch Romberg - Surface modification of silicones by free radical polymerization under super critical CO₂
Roqaya Camilla Nielsen - Parametric Study of Copper Emission from Antifouling Coatings
Charlotte Jakobsen - Pilot-scale experiments with biological conversion of methane in blow-off air at Hellebæk waterworks
Marcus Ravn Skyum - Raman Quantification for Modeling Fermentation Processes
Laura Byvald - Sulfur Reforming
Rasmus Hochloff Zibrandtsen - Purification of contaminated water using the SCL system
Malou Liv Enevoldsen and Mikkel van Hauen Niemann - Waterborne paint without biocides
Nicolai Grønbæk Møller Jensen and Wojciech Przemyslaw Paciorek - Development of an autonomous 3-axis gantry system for sample inspection in long-term corrosion testing
Hicham El Moughni - Investigation of continuous capture chromatography for antibody purification

BACHELOR OF SCIENCE DEGREES

26 students finished their research programme for the BSc degree. The project titles are listed below:

Lukas Tej Marner - Soft sensor development using tensor-network based generative models
Natalie Vaabengaard - Ion Exchange - modeling and experiments
Emilie Dorow Hansen and Bine Marie Johansson - Kinetics of intumescent coatings
Mikkel Christian Rask Levin and Ditte Juhler-Nøttrup - Semi-parametric hybrid modeling for proces systems
Kadiatou Youla - Characterization and correlation of physico-chemical properties in amine-based solvents applied to CO₂ capture
Stine With Johansen - Linear and non-linear models for separation in complex geometries
Thor Marner - Development of a microkinetic model for catalytic ammonia synthesis
Mahault Lorene Anceline Genton - Advanced biofuel process design
Helga Lísá Kvaran - Biogas conversion to microbial protein by methanotrophic-hydrogenotrophic culture
Mars Asmus Brodersen - Experimental investigation of solid-liquid equilibrium in CESAR1 for CO₂ capture applications
Tobias Skakke Jørgensen - Enhancing Cleanability of Cargo Hold Coatings Through Surface and Mechanical Property Optimization
William Luther Hoff - Integration of biochar in anaerobic digestion: effects on biogas production efficiency
Peter Skalborg Jensen - Chemical modification of biopolymers by reactive extrusion
Emil Sejrup Arnbjerg and Martin Meinert Grønvold - Continuous catalytic hydrogenation of pharmaceutical intermediates in a jet loop reactor (JLR)
Anton Sloth Godiksen - Lignin-Based Epoxy Coatings: A Molecular Dynamics Approach
Mikkel Seegert - Mathematical modeling and optimization of a fed-batch process for *Escherichia coli* metabolite production
Abdullahi Mohamed Ahmed Farah - Release of nitrogen during solid fuel pyrolysis
Rasmus Molter Pallisgaard and Rasmus Bower Knudsen - Upgrading of pyrolysis oils in a continuous trickle bed reactor
Christoffer Schülein - Oxidation of NH₃/C₂H₂ fuel mixtures at high pressure
Mohamed Muhidin Omar - Polishing behavior of coatings with non-toxic antifouling additives
Oliver Castenschiold and Katrine Schollert Steenstrup - Supported bimetallic nitrides for ammonia cracking

MASTER OF SCIENCE DEGREES

105 students finished their research projects for the MSc degree. The project titles are listed below:

Matej Pavli - 'Reversed-Phase' chromatography - modeling and experiments
Julie Kirstine Blok Rasmussen and Lukas Sigurd Jørgensen - Acetate to Food: Integrating processing strategies for acetate utilization in protein biomanufacturing
Frederik Kirkeby Schjerning - Analysis of advanced process configurations for pilot scale CO₂ capture demonstrated at ARC
Reyhan Mahendraputra Vyandra - Assay development for stabilities studies of UPO
Laia Vila Vidal - Autotrophic metabolic profiles of acetogenic bacteria under high-pressure conditions
Oskar Emil Lindberg - Determination of degradation in polyolefins from marine plastic and improvement of the material for recycling.
Christos Kommatas - Bioaugmentation strategies to enhance the anaerobic digestion of coffee processing waste
Michail Raptotasio - CFD-Model Driven Optimization for Efficient Oxygen Transfer During Aerobic Cultivation of *Lactococcus lactis* at Industrial Scale
Zannatul Mamnuna Mozumder - Design of a cleaning-in-place pilot plant module to simulate hygienic design challenges
Xiaoyue Tu - Design of high-active perovskite oxide and study on its electrocatalytic CO₂ reduction performance
Emilie Tage Andresen and Laura Johanne Karlsmose - Effect of H₂ on Urea-Based Selective Non-Catalytic Reduction
Panagiotis Rafail Chasapis - Effect of temperature on oxygen mass transfer in bioprocesses at different scales
Davy Christophe Pongy Adiogo - Experimental study of underground carbon dioxide storage
Giriraj Badole - Experimental validation of optimized conditions for syngas biomethanation in Trickle Bed Reactors.
Hjalte Valgeirsson - Empirical analysis of cellulose-based filtration system for aluminium-casting cooling water
Romisa Fakhari - Energy storage in elastomers
Sara Riegels Trangbæk - Enhancing Process Understanding and Performance of Dynamic Crossflow Filtration (DCF) in Pilot scale: A Hybrid Modelling Approach
Oliver Bagger - Establishment of microbial cell factories tolerant to hemicellulosic hydrolysate (1)
Peter Christopher Greisen - Establishment of microbial cell factories tolerant to hemicellulosic hydrolysate (2)
Mateo Sebastian Maiza Arcos - Predicting performance of intumescent coatings on large steel structures using small-scale tests and modeling
Ángel Paísán García - Physics-informed simulation framework for synthetic spectral data generation and chemometric modelling in pharmaceutical analysis
Paul Gerard R Seghers - Grokking hybrid-GNN for molecular properties
Gina Marsal Mercader - Integration of eutectic solvents on bio-based porous absorbents for wound dressing applications
Anas Maher Nasser - Significance of CO₂ reforming kinetics for simulation of eSMR performance data
Maria Mikoroni - Integrating Laboratory and Industrial Scale Data for Optimizing API Manufacturing Processes
Sandra Ósk Alfreðsdóttir - Interactions of inorganic species and bed materials in fluidized bed combustion of biomass
Albert Timm Dickmeiss - Carbonation of minerals
Christina Nord Kruse - Chemical and Catalytic Conversion of Lignin to Organic Coatings
Thomas Størring Sørensen and Johan Christian Jespersen - Continuous mRNA process design and development
Julie Primdal Toft - Methanol as promoting agent in SNCR
Almudena Varela Paz - Model-based impact quantification of process variability on the production rate in industrial API manufacturing
Julie Talevska Poulsen - Density and viscosity measurements and modeling of CO₂ capture solvents
Jacob Lykke Fischer - Alkene Oligomerization over Heterogeneous Nickel-Based Catalysts
Ole Hauge Jensen - Oligomerization of medium length Olefins
Ófeigur Óskar Stefánsson - Improving methanol production from CO₂ through wastewater recycling
Emilie Nørgaard Reimers - Optimization of a chromatographic regeneration process
Rafael Emilio Altamirano Torres - Process design and control of syngas fermenting microbial communities by co-feeding
Sebastian Due - Short path evaporation simulation
Andreas Juhl Sørensen - Simulation and Optimisation of Brew House Scheduling
Alexander Bonde Skov - Kinetic study of clay calcination
Rasmus Kamp Hansen - Synthesis, characterisation and test of new bimetallic catalysts for ammonia cracking
Paul Stanislas René - Techno-economic analysis and optimization of a cryogenic treatment unit from agricultural biogas to CO₂ and LNG
Janez Santana Alvaro - Techno-economic assessment for API production through bioprocessing
Ferran Oliver I Gerones - Tuning decentralized PID controllers for multivariable process systems
Zhanhong Yang - Tuning the electrical and mechanical properties of ionic liquid grafted silicone polymers
Bao Chi Khúc - Development of an in silico hybrid model for tangential flow microfiltration in the downstream processing of GFP
Emil Blicher Hansen - Development of a quasi-global, dual-fuel mechanism for methanol/diesel co-combustion
Jonas Doerk - Development of a flexible model for amine-based post combustion carbon capture and heat integration analysis
Nicolas Donetti - Development and evaluation of PHA-based blends for sustainable pharmaceutical delivery systems
Magnus Banke Johansen - Investigation of amino acids promotional influence on electrochemical carbon capture
Sebastian Cardenas Arenas - Study on CO₂ biofixation in a coculture of microalgae-carbonic anhydrase enriched bacteria
I Gede Eka Perdana Putra - Investigating the influence of feed trajectories on the expression of recombinant proteins for induced *Escherichia coli* cultivations
Kaveri Mani - Researching innovative solutions to boost sustainability and recyclability in flexible packaging applications.
Simone Sinding and Frederikke Kroupa Dupot - Investigation of cleanability and surface properties of plastic materials intended for product contact in industrial CIP processes

Evangelia Giagka - Uncertainty and sensitivity analysis of retrofitted pharmaceutical production line

Freja Andersen Jelling Holm - Zeolitic catalysts for the production of sustainable aviation fuel (SAF); probing the active sites using infrared spectroscopy

Magdalena Gautsch - Analysis of island mode operation of electrochemical CO₂ capture pilot

Nursultan Sheishekeyev - Improving Knowledge of API Purification Processes through Advanced Process Understanding and Mechanistic Modeling

Sofie Ertel - Flexibility analysis of facility design using capacity modelling in pilot scale production

Abu Bakar Ali - Enhancing Cement Industry Sustainability: Experimental Investigation of Solid Fluidization with Pulsation Effects

Sayed Rahman Gulabzoi and Lin Du - Improving safety and sustainability in QCs analytical methods

Eduard Möller Ribas - Growth-rate dependent dynamics of methane metabolism in methylococcus capsulatus

Maria Ørberg Gedsted - Non-invasive NIR spectroscopy on spray-dried pharmaceutical product through product bags

Urania Gjata - Implementation of MPC and PID control strategies for flow rate regulation in industrial downstream processing

Martin Bertram Nielsen - KROBIO - Biofilm Wastewater treatment

Magnus Nørager Pedersen - Modeling of steam methane reforming in an electrically heated tube reactor

Jens Aksel Rasch Madsen - Modelling and control for a two-stage MVR-TRV falling film evaporator

Camilla Tue Baastrup - Numerical and Experimental Investigation of a 200 L STR with and without air flow

Melissa Fernanda Rugholm Jensen - Conversion of methanol to higher olefins as the first step in production of sustainable aviation fuel (SAF)

Karen Hindsholm and Kalliopi Chelidoni - Upgrading of Pyrolysis Oils in a Continuous Slurry Reactor

Mikkel Stub Neubert - Optimizing Enzyme Immobilization on Membranes for Enhanced Stability and Reusability in Green Biorefinery Processes

Borja Miralles Cuña - Process design, simulation and techno-economic analysis of a power to ammonia plant

Federico Ciampi - Semi-synthetic amino acid production through a combination of protein engineering, metabolic engineering and computational biology tools

Charlotte Yong Jespersen - Fungal production of monoclonal antibodies

Leire Echavarren Pardo - Techno-Economic Analysis of Energy Intensive Processes

Reza Tavan - Exploring the degradation of different lignocellulosic waste streams, and the pathways followed during the anaerobic digestion bioaugmentation using newly isolated bacteria

Thomas Swagerman - Development of a Streamlined Modelling Platform for Chemical Property Prediction

Tobias Senika Christensen - Development of Novel Enzyme Membrane Reactors Based on Natural Polymers for Sustainable Biocatalysis

Sólrún Ágústs dóttir - Alternative purification strategies for a recombinant growth factor

Xavier Mateos Giménez - Flower-like mesoporous silica-based pigments for epoxy coating: a product design approach

Pau Cunillera Bori - Characterization and set up of a scale-down reactor system mimicking large-scale fermentation conditions assisted by Computational Fluid Dynamics (CFD)

Víctor Fierrez Juan - Domesticating non-model organisms for the production of biochemicals

Theofani Tsirka - Acetic acid production from CO gas stream in mesophilic Trickle Bed Reactors

Athanasios Fountoulakis - Acetic acid production from CO gas stream in thermophilic Trickle Bed Reactors

Enita Sela - An integrated logistics model for decentralized biopharmaceutical manufacturing

Emilie Overgaard Schmidt - Enzymatic treatment of pyrolysis oil

Ariadni Koletsi - Evaluation of spectroscopic data for estimating monomer fraction of hydrogen bonding compounds

Oskar Møller Clausen - Improving thermophilic cell factories for bioplastic production

Mathias Tong - In-situ NO_x Control in WtE Plants

Nikolaj Sams Falkenberg - Continuous catalytic hydrogenation of model compounds for pharmaceutical intermediates in a Jet Loop Reactor (JLR)

Lucas Frost Kopenhagen - Technology fit of endothermic processes in eREACT™ configuration

Milav Othman Ali - Mechanistic Insights into Disulfide Bond Shuffling in Aqueous Injectable Formulations of Small Peptides

Apostolia Gkatsi - Model-based approach for analysis of design and robustness of multi-client supporting systems in an Active Pharmaceutical Ingredient (API) manufacturing process

Nicolas Møller Jakobsen - Counteracting degradation of polymers during processing by in-situ modification through reactive extrusion

Caroline Mathilde Flach de Neergaard - Morphological analysis of fungal fermentation

Arnþór Ingi Ingvason - Optimizing the purification of recombinant porcine platelet-derived growth factor (pPDGF) from Barley using enzyme-assisted extraction, size filtration and chromatography

Sonia Nandavara Raviraj - Surfactant-assisted extraction of pigment from fermentation broth: Process development, and scale-up feasibility

Kristian Aleksander Jørgensen - Screening of new hydroprocessing catalysts for hydrodeoxygenation of advanced bio-oils

Helene Rubin Lillelund - Investigating different start-up methods for trickle bed bioreactors for biogas upgrading.

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