UPPSALA
UNIVERSITET
Materials Science & Engineering
Division of Applied Mechanics

StoraEnso

EXJOBB/THESIS WORK OPPORTUNITY

Atomistic simulations of lignin stabilization in the initial stage of pyrolysis

Background:

There is a growing demand for sustainable and locally sourced carbon material for applications such as carbon fiber for light-weight materials or as electrodes in batteries. These materials are produced by types of pyrolysis, in which a carbon rich material is heated beyond its combustion temperature without access to oxygen, preventing combustion. Among the available biomass resources, lignin is attractive due to its abundance as the most prevalent aromatic biopolymer and its availability as a byproduct of the pulp and paper industry. However, lignin is inherently heterogeneous, and its chemical structure depends on the biomass source and extraction process, and this diversity leads to variations in the properties and performance.

This project focusses on the initial steps of pyrolysis, which occur at temperatures below 500-600 °C, referred to as stabilization and focus on the differences between hardwood and softwood lignin structures.

Goals:

The goal of this work is to study structure-property relations of different lignins on the atomistic level using Molecular Dynamics (MD) simulations.

- Literature study into lignin and its inherent heterogeneous structure, the different stages of pyrolysis with a focus on the initial stage, as well as the theory behind MD simulations.
- Perform MD simulations using the software GROMACS on one of Sweden's supercomputers
- Analyze differences in morphology and interactions between models of hardwood and softwood lignin molecules with varying degree of branching.

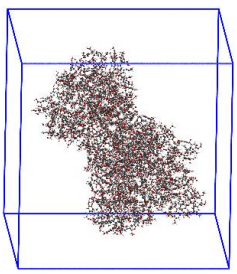


Figure 1: Exemplary snapshot from lignin simulation.

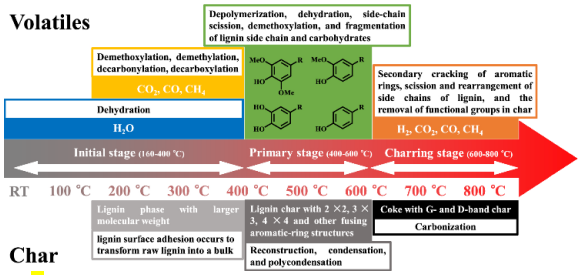


Figure 2: Overview of pyrolysis stages. The focus of the project is on the initial stage. Lu, et al., 2022

Contact:

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Lasse Tolonen, lasse.tolonen@storaenso.com

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HITACHI

EXJOBB/THESIS WORK OPPORTUNITY

A COMSOL app based on a surrogate model for the generation of a curing recipe in the manufacturing of Resin Impregnated (RIP) bushings

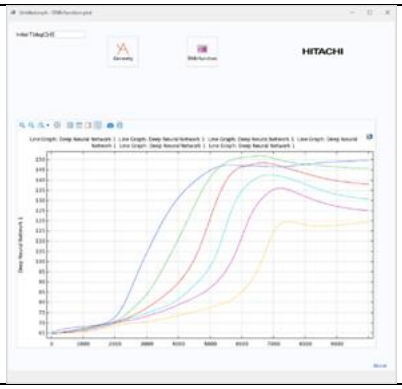
Background:

The Simulation Generated Recipe (SGR) for the curing process of large RIP (Resin Impregnated Paper) bushings has been developed over the last years and successfully tested in production. The recipe (temperature profile of the heaters in an autoclave) is generated through simulation of the heat transfer and the exothermic reaction of the epoxy, resulting from the application of rules (programming code) necessary for the crosslinking of the epoxy, i.e., the hardening. The simulation model in COMSOL takes many days to develop for each geometry and autoclave and many hours to run, making it very difficult for non-expert COMSOL users to conduct.

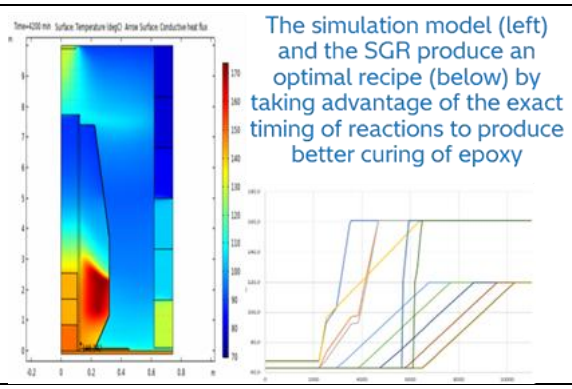
A COMSOL model for a specific type of autoclave will be created with a parametrized geometry for the condenser RIP core (bushing's main insulation). This multiphysics problem will run for several days in the High-Performance Cluster (HPC) and generate a table of the specified results. COMSOL has incorporated such a Machine Learning (ML) feature and understanding its limits and input parameter reduction are relevant for successful training of the model. A COMSOL app will then be created and run using the inference model for evaluating cases other than the training set.

Goals:

Use and further develop a COMSOL thermo-chemical simulation model to train a surrogate model, using the main geometry parameters of a condenser core as input, for one type of vessel geometry and thus generate recipes for various core dimensions. Then create a COMSOL app using a Deep Neural Network (DNN) function including a script that converts the generated recipe to a text file, ready for input to the heaters control system.



A simple GUI in a COMSOL app



Simulated temperature of a RIP core in a autoclave

Contact:

Christos Athanasopoulos, Hitachi Energy and Uppsala U, christos.athanasopoulos@hitachienergy.com
Mahmoud Mousavi, Uppsala U and Hitachi Energy, mahmoud.mousavi@angstrom.uu.se

Your general responsibilities

1. Understanding the performance of a bushing. Literature and technical reports review
2. Development of a simulation model, previous work to be reviewed
3. Emphasis on automated model construction for different types of bushings (parametric model)
4. Exploit COMSOL's features for the creation of a surrogate model and the creation of a Deep Neural Network (DNN) function
5. Create a user-friendly app for design engineers and for design optimization using a DNN

Your background

1. You are a student in engineering towards STEM (Science, Engineering, Technology, Math) related degrees e.g., electrical engineering, mechanical engineering, software engineering, industrial engineering, energy systems engineering or a related discipline
2. Basic knowledge of FEM analysis in a commercial tool, preferably COMSOL
3. Interest in simulations, product design, process control, or other similar topics
4. Excellent knowledge of English (your thesis will be written in English)
5. Great collaboration skills and intercultural sensitivity

About HITACHI

Hitachi Energy is a global technology leader in electrification and power grid technologies, operating as a prominent subsidiary of the Japanese multinational conglomerate Hitachi, Ltd.

Headquartered in Zurich, Switzerland, the company was formerly known as Hitachi ABB Power Grids before rebranding under its current name. It focuses on advancing a sustainable energy future, decarbonizing power grids, and managing rising electricity demand across utilities, industries, transport, data centers, and infrastructure. Hitachi Energy employs more than 58,000 people across 67 countries. We are active in more than 140 countries with a revenue of approximately $16 billion USD.

Official Website: www.hitachienergy.com

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We connect a greener world

Physics-informed prognostics of electrical power cable systems

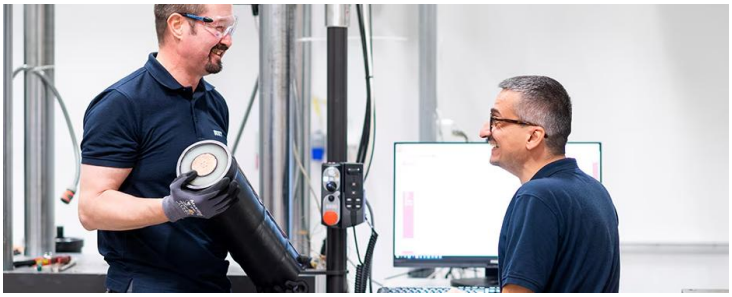
Job Location: Västerås, Sweden

Background:

High voltage cable systems comprise several interacting components, including cables, joints, terminations, and electrical connectors. The service conditions vary with load, ambient and environmental conditions, installation environment, and operating history. Ageing and degradation processes may therefore develop over long timeframes and involve coupled electrical, thermal, mechanical and material effects which also depend on the local environment of the installed parts. The direct measurement of such processes during operation is often limited and available measurement and failure data is generally sparse. The application of different physics-based approaches allows for the generation of a more robust prognostics framework, where uncertainties are considered when approaching the overall component population.

Goals:

The thesis will develop a prognostics framework for a selected component of cable system. Physics-based models are combined with available failure statistics and expert knowledge to predict a components remaining useful life and estimate uncertainty of the given prediction.



High voltage cable with a copper core and PE isolation and jacketing

Contact:

Please submit your application, including your CV and cover letter, **by November 30, 2026**.

Emek Abali, b.emek.abali@angstrom.uu.se

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Viscous fluid to solid transformation in a phase field simulation

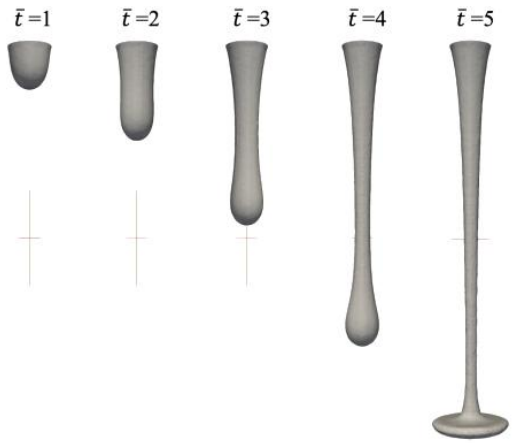
Job Location: Ångströmlab.

Background:

Thermodynamics of viscous fluid flow is captured by Navier--Stokes--Fourier equations for a channel flow or lid driven cavity. Once we need to fill in a domain, a phase field extension is needed to distinguish between fluid and air. At the same time, the material is transforming from a fluid to a solid due to hardening and this transformation is not yet modeled in the literature at the constitutive equation's level. With a collaboration with Karlsruhe Institute of Technology (Germany) and Hitachi Energy (Sweden), we have developed a theory and this master thesis is about the implementation of this coupled and nonlinear equations.

Goals:

By using our existing deployment in Python (by using Firedrake open-source packages), the thesis is to learn and develop together with Emek Abali the abovementioned multiphysics. Learning outcomes are about the equations in a continuum mechanics setting and using our local High Performance Computing (HPC) with all the modern techniques (Docker, Singularity, MPI, Shell, Slurm).



Waterjet under gravity from https://doi.org/10.3390/fluids9110264

Contact:

Please submit your application, including your CV and cover letter, **by November 30, 2026**.

Emek Abali, b.emek.abali@angstrom.uu.se

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Battery chemomechanics in a full cell

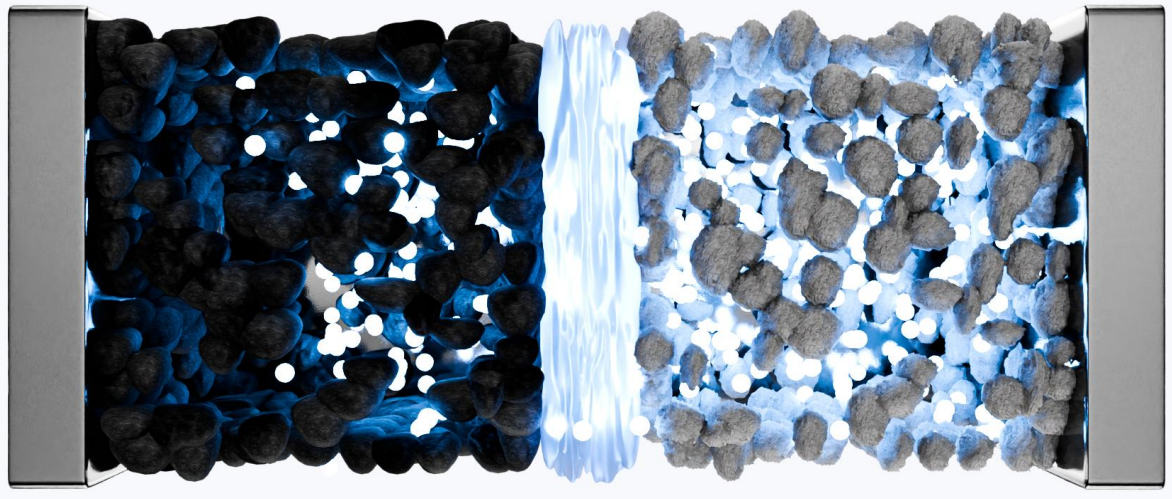
Job Location: Ångströmlab.

Background:

Batteries are charged and discharged where a charge carrier (lithium ion) enters and leaves electrode (active material). Different material compositions increase or decrease the performance of the battery cell, but such experimental tests are tedious and expensive. A general dream is to develop a digital twin by using a multiphysics simulation. With an ongoing project, we have developed a pipeline of taking material parameters from a database and conducting performance tests. Yet only for one electrode (half cell). This thesis will then extend it to both electrodes and an electrolyte to get the full cell.

Goals:

By using our existing deployment in Python (by using Firedrake open-source packages), the thesis is to learn and develop together with Emek Abali the abovementioned multiphysics. Learning outcomes are about the equations in a continuum mechanics setting and using our local High Performance Computing (HPC) with all the modern techniques (Docker, Singularity, MPI, Shell, Slurm).



Animation of lithium ions moving from one electrode to another one in a battery cell

Contact:

Please submit your application, including your CV and cover letter, **by November 30, 2026**.

Emek Abali, b.emek.abali@angstrom.uu.se

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Depth measurement implementation in testing

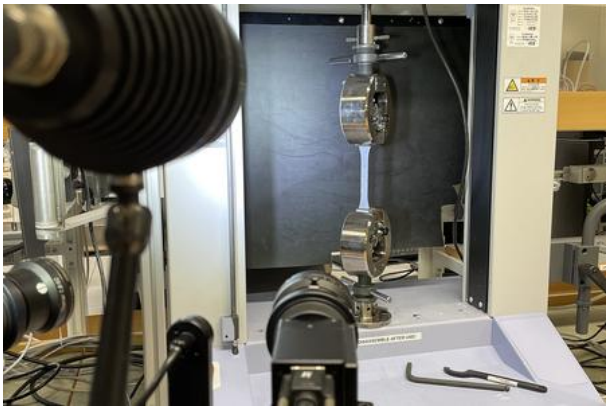
Job Location: Ångströmlab.

Background:

Mechanical tests may provide the whole deformation and strain distribution on a surface with a technique called Digital Image Correlation (DIC). This technique is a camera tracking the deformation by using a machine learning algorithm (openCV) in the background. But the tracking is only possible at a focal length, or in other words, the surface is planar. For depth measurements, we want to test a depth camera instead and write our own algorithm in Python and run on Raspberry Pi as a modular unit to gather data and show the deformation in a postprocessing setup.

Goals:

By using existing algorithms from openCV and potentially ROS drivers (Robotic Operating System) from a depth enabled camera, taking initiative to build the hardware and test it in a real environment with Reza Afshar and Emek Abali. Learning outcomes are about the implementation of machine learning algorithms for RGB and distance at each pixel information, handling big data influx from the camera, and developing benchmarks using Git and versioning for Python based code development.



Camera setup for a standard Digital Image Correlation (DIC) in our lab to use for the hardware installation

Contact:

Please submit your application, including your CV and cover letter, **by November 30, 2026**.

Emek Abali, b.emek.abali@angstrom.uu.se

Autonomous climate chamber using machine learning

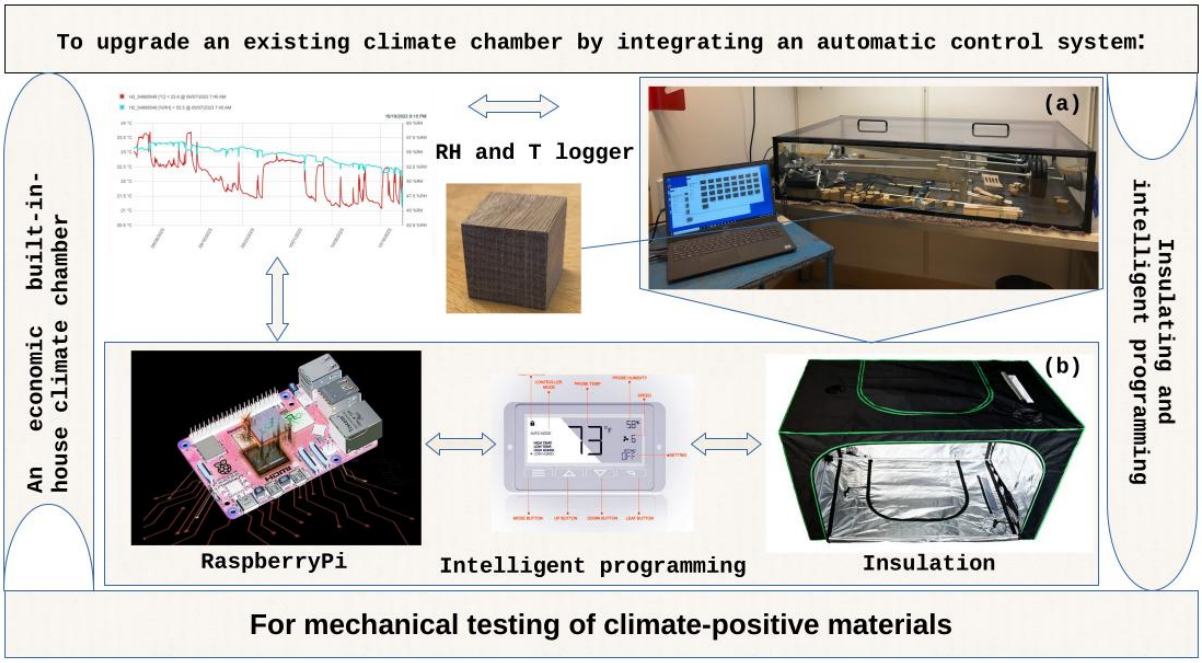
Job location: Ångstrom laboratory

Background:

Preserving cultural heritage connects future generations to their roots, requiring efficient conservation methods. The Vasa Museum—housing the Vasa ship, the world's largest preserved wooden artifact—is collaborating with the National Property Board of Sweden (SFV) to optimize indoor climate control to reduce energy costs while ensuring artifact safety.

Goal:

To answer Research Question 1—how moisture and material traits affect archaeological wood stability—we will upgrade an existing climate chamber with automated controls (Fig. 1) to conduct mechanical testing under precise climatic conditions.



Contact persons:

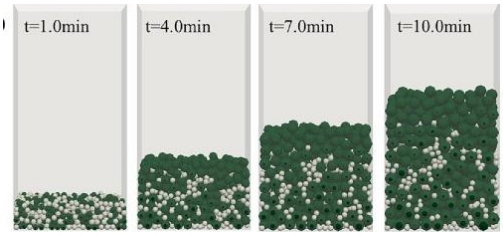
Reza Afshar, reza.afshar@angstrom.uu.se

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Moisture-dependent mechanical behaviour of Chia seeds: experiments and modelling of a bio-based granular material

Job Location: Ångströmlab.





Hu, et al. 2023

Background:

In this project, you will investigate how mechanical properties of Chia seeds depend on moisture content. Chia seeds may be viewed as a moisture-sensitive, bio-based granular material whose outer seed coat contains mucilage. Upon contact with water, the mucilage is rapidly released and forms a transparent gel-like capsule around the seed. This hydrated mucilage layer can strongly affect particle–particle interactions, including friction, adhesion, cohesion, deformation behaviour and flowability.

Understanding the moisture-dependent mechanical properties of seeds provides essential data for storage, handling, equipment design, and processing optimisation. The project combines **experimental characterisation** with **simulations (discrete element method, DEM)**. You will experimentally determine relevant material parameters, such as particle size, shape, density, and at different moisture levels friction, restitution, stiffness, deformation response, and cohesion-related behaviour. These parameters will be used in your simulation models to simulate Chia seed assemblies and study how moisture affects packing, force transmission, flowability, and mechanical stability. This is information that constitutes a starting point for Chia seed processing for e.g. mucilage components to replace artificial food additives.

Goals:

The expected outcome is a validated set of material parameters and a modelling workflow for moisture-dependent Chia seed behaviour.

Contact:

Malin Wohlert: malin.wohlert@angstrom.uu.se
Andreas Lindblad: andreas.lindblad@physics.uu.se
Lina von Sydow: lina.von.sydow@it.uu.se

Hej! Jag (Kris tofer) kommer föreslå 2 exjobb på mässan som är samarbeten med Sara+Joran van Blokland (SLU) och Ilia Katardjiev (Ellära, UU). Joran och Ilia har redan gjort postrar och hand-outs enligt en annan mall, och kommer vara på mässan tillsammans med mig. De handlar om "Cohesive laws in mixed-mode crack growth in adhesive bonds" resp. " Mechanical design of flexible reflectors in solar energy harversting". /Kristofer

We want to be more! The research institute Swerim conducts needs-based industrial research and development concerning metals and their route from raw material to finished product. Swerim has 200 co-workers in two locations in Sweden - Luleå and Stockholm. Our vision is a sustainable and competitive industry.

Master Thesis: Hydrogen trapping and redistribution in martensitic high-strength steels

1 Place

We are looking for a motivated Master's student to join the AITHOS project, AI-based Trapping characterisation & Hydrogen Odelling in Steels.

Hydrogen embrittlement is a major challenge for high-strength steels. One strategy to improve hydrogen resistance is to engineer carbide precipitates that trap hydrogen and reduce its mobility. The AITHOS project combines experiments, modelling and data-driven methods to understand this behaviour and support future development of hydrogen-tolerant steels.

The Master's thesis will be carried out primarily at Swerim and will contribute mainly to the experimental work in WP1 and WP2. Possible activities include:

- microstructural characterisation;
- hydrogen charging of steel specimens under controlled conditions;
- measurement and analysis of hydrogen trapping and release, including TDMS;
- mechanical testing of hydrogen-charged specimens;

You will work at Swerim and collaborate closely with researchers from Uppsala University, SSAB and Ovako. The project therefore offers an opportunity to gain hands-on experience in hydrogen–materials research while developing a professional network spanning both academia and the Swedish steel industry.

The project is suitable for a student who would like to develop expertise at the interface between advanced steel development, hydrogen embrittlement and experimental materials science.

Your profile
We are particularly interested in students with a background in:

- Materials Science and Engineering;
- Applied Physics or Engineering Physics;
- Mechanical Engineering or a closely related field.

Additional Information
The project is planned to be carried out during the spring semester of 2027 at Swerim in Stockholm. Upon successful completion of the Master's thesis (30 ECTS credits), Swerim will provide a compensation of SEK 50,000.

Contact
For further information about the project, please contact: Dr. Birhan Sefer, birhan.sefer@swerim.se

Application

Please apply using the application link below no later than 30 November 2026. Please note that applications will be reviewed on an ongoing basis, and the thesis position may be filled before the application deadline if a suitable candidate is identified.

Application

Apply

Please enter your name

Year of birth

Email

Phone number

Attach cv/cover letter (only word, rtf, pdf)

Choose File No f…osen

Upload more

Upload photo

Choose File No f…osen

Message

I Accept the Personal data processing (GDPR)

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