

Klaipėda University Strategic Research Area

"Towards Sustainable Technologies, Blue and Green Growth and a Healthy Sea"

Postdoctoral Internship Topic Application (2025-2027)

Title of the internship topic	Treating hospital and municipal wastewater with nanofiltration membrane and post-treatment of the concentrate
Field(s) of the internship, implementing unit, start, duration	Technological sciences, Chemical engineering. The traineeship would take place in the Department of Engineering. Start 2025.09. Duration two years
Brief description of the research and the desired results (goal and objectives, keywords)	<p>Increasing concentrations of pharmaceutical residues in surface water threaten humans and ecosystems. Here, we propose the development of novel nanocellulosic nanofiltration membranes applied in combination with other complementary advanced methods to treat wastewater and concentrate. We will investigate the synergy of the technologies to treat complex matrices of hospital and municipal waste discharge. The project will start with the separation of cellulose from the agricultural wastes utilizing a blend of ethanol/water and sodium persulfate. This is followed by isolating nanocellulose using H₂O₂, O₃, and persulfate/UV. Reaction parameters will be varied to find the optimum conditions for both steps. The second phase involves the formation of the metal-organic framework/ferric-hexacyanoferrate complex (Prussian blue analogue) and the polyamide nanofiltration membranes using interfacial polymerization. Finally, the application begins with the pre-oxidation of wastewater using the persulfate activated via complex assisted with ultrasound. Following this, the nanofiltration membranes will be used to remove pharmaceutical wastes from the samples. The membrane will be reused to assess its efficiency. The concentrate formed is treated with sonophotolysis and persulfate. This project will provide critical insight into treating domestic and hospital wastewater before eventual discharge.</p> <p>Objectives:</p> <ol style="list-style-type: none"> 1. Isolation of cellulose from biomass and formation of nanocellulose. 2. Formation of nanofiltration membrane. 3. Characterization of the materials. 4. Treatment of wastewater using membrane technology. <p>Keywords: Oxidized nanocellulose, Nanofiltration membranes, Organosolv pre-treatment, Biomass, Pre-oxidation, wastewater, pharmaceutical residue.</p>
Compliance of the topic with the goals and priorities of the strategic research direction	The proposed research is in line with the sub-theme "Towards Sustainable Technologies, Blue and Green Growth and a Healthy Sea": "Resource-efficient technologies based on the circular economy". The research will develop a technology to remove harmful pharmaceuticals residues from wastewater using nanofiltration technology. This will improve the quality of surface water released will reduce the negative environmental impact of industry.

Planned intermediate and final results (scientific output: publications, reports, etc.)	3 scientific publications will be produced and a conference will be attended.
Requirements for the intern	A PhD, preferably in the natural sciences or technology. Preferably, the candidate should be able or willing to work in a laboratory and have experience in chemical or other research. It would be an advantage if the candidate has mastered modern analytical methods and has experience in evaluating and interpreting data using statistical analysis methods. The candidate should be able to summarise results in reports and present them both internally and at conferences. Experience in preparing manuscripts is required. Strong communication skills, a systematic working style, reliability, commitment and team spirit are desirable. Good oral and written English language skills are required.
Topic provision (infrastructure, link with ongoing projects)	The current ongoing, LMT-funded project NanoBioComp has the aim to develop biocomposites based on cellulose (nano)fibers, nano particles of lignin, and polymeric compounds as chitosan, and alginate. Partner in this project is KTU, represented by Prof. Milasius, who offers further analysis methods. The project consists of experienced scientist of material science. The other South Baltic Interreg-funded project ISMA deals with innovative technology for waste water treatment plants. Both projects involve researchers and the expertise and infrastructure available to them from the KU Marine Research Institute. The team of chemists and chemical engineers from the KU Faculty of Marine Engineering and Natural Sciences has extensive experience in biomass and plastics pyrolysis, as well as product analysis. The existing equipment (pyrolysis reactor, product analyzer, hydrodynamic cavitation, etc.) will be supplemented by membrane technology as a particularly gentle and environmentally friendly separation process.
Intended internship supervisor	The candidate will join a team of chemists and chemical engineers with extensive experience in biomass and membrane technology and product analysis. The existing equipment (Intended internship supervisor) will be complemented which will ensure the trainee's employment. Support from the team in the field will help to ensure the success of the project.
Supervisor's experience in the proposed topic	Dr. Jochen Uebe (jochen.uebe@ku.lt ; tel.: +370 684 08676) has extensive experience in research projects and the development of new technologies, such as the InoBioTech Baltics project (01.2.2-MITA-K-702-11) for the development of natural sorbents using microbes for oil spill cleanup and a project also funded by MITA for the development of a cavitator model for the company INOVTECHNA. He is currently working on the HORIZON-EIC-2024-ACCELERATOR-02 project "INNOAEROGEL: SUSTAINABLE SORBENT FOR AQUATIC OIL SPILLS CLEAN UP," the LMT-funded project NanoBioComp, the South Baltic Interreg-funded project ISMA, and the project "Establishing a Centre of Excellence for Sustainable Coastal Development." In his previous work (at the M. Planck Institute for Polymer Research and the Fraunhofer Institute for Silicate Research, Germany), Jochen Uebe and his colleagues have developed and patented six technologies in the fields of nanoscale layered silicates for lithium-ion batteries and electrochemical capacitors, smart shock absorber fluids for cars, and car headlight housings. He also has extensive experience in renewable energy and the commercialization of scientific ideas. Pyrolysis technologies and their development for the recycling of plastic waste and algae, cellulose aerogels as bioreactors for microbes, and biocomposites are currently of great scientific interest. In recent years, he has authored a total of 34 patents and published papers in journals referenced by Clarivate Analytics DB. The supervisor has extensive experience and expertise in the proposed topic.