

VIRUMAA COLLEGE

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MAIN FIGURES 2024

(as of Dec. 31, 2024)

39 Academic staff Incl. 1 professor
15 researchers

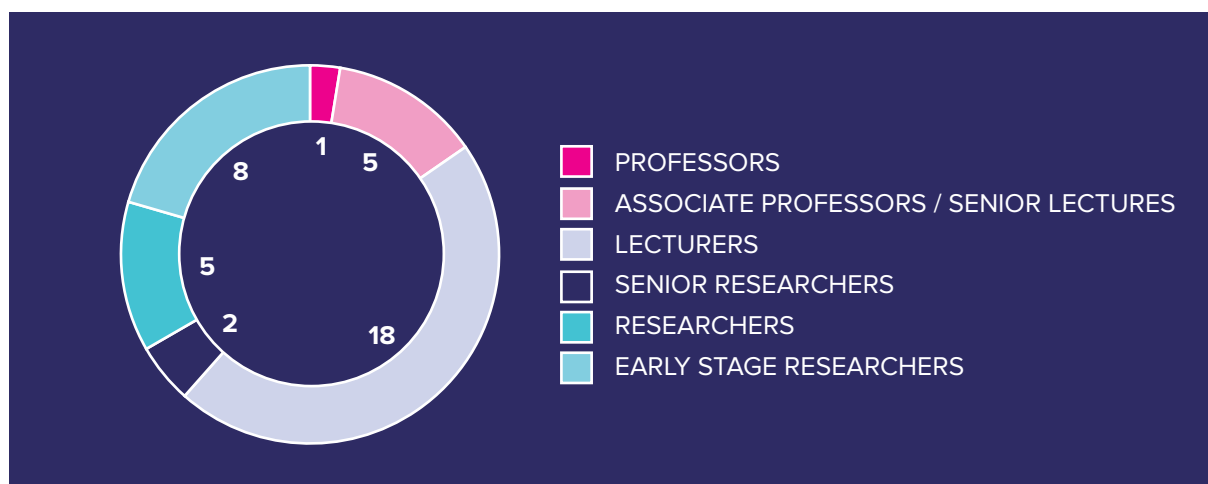
6 Doctoral students

14 Scientific publications*

* Data from the Scopus (as of February 28, 2025)

THE DEPARTMENT CONDUCTS RESEARCH WITHIN FOUR RESEARCH GROUP:

- **APPLIED CHEMISTRY RESEARCH GROUP.**
Head: Tenured Assistant Professor ALLAN NIIDU, allan.niidu@taltech.ee
- **DEVELOPMENT OF ROBOT-HUMAN CO-CREATION WORKING GROUP.**
Head: Senior Lecturer OLGA DUNAJEVA, OLGA.DUNAJEVA@TALTECH.EE
- **LABORATORY OF FUELS TECHNOLOGY AT OIL SHALE COMPETENCE CENTER.**
Head: Laboratory Manager OLGA PIHL, olga.pihl@taltech.ee
- **MECHANICAL ENGINEERING AND ENERGY TECHNOLOGY PROCESSES CONTROL WORK GROUP.**
Head: Senior Lecturer VEROONIKA SHIROKOVA, veroonika.shirokova@taltech.ee



APPLIED CHEMISTRY RESEARCH GROUP

Head of the research group: Tenured Assistant Professor **ALLAN NIIDU**, allan.niidu@taltech.ee

Members: Moonika Ferschel, Anastassia Raag, Martin Jürisoo, Tanel Möistlik

Doctoral students: Bijan Barghi, Diana Berseneva, Dmitri Tsõvarev, Viktorija Mironova

TOPICS AND COMPETENCES

KEYWORDS: metal-organic framework, CO₂ adsorption and utilization (CCSU), heterogeneous and photocatalysis, adsorption, nanomaterials, liquid separation, oil shale as raw material for chemical industry, mechanochemistry

The research group's competencies include:

- Co-valorization of CO₂ and oil shale into catalysts and adsorbents for chemical industry.
- Application of said catalysts to oxidation of organic sulfur and relevant adsorbents to adsorb sulfurous compounds from liquid hydrocarbon streams.



- Extracting added value from mining waste and process waters via selective removal of required metals.

In cooperation with University Montpellier, mechanochemical formation of API-s and metal salts are studied.

IN 2024: The topic of oxidative catalysis was further developed. The first results were achieved in the development of synthesis methods for catalysts with low environmental impact. Greater attention was paid to the assessment of the environmental impacts of chemical processes.

SELECTED PROJECTS

- ÖÜF16 “*Circular valorization of non-fossile CO₂*” (2023–2029)
- LEVEE20069 “*Applied research in reduction of sulfur containing compounds in shale oil products*” (2020–2022)
- F20057 “*Waste carbon utilisation development strategy with industrial symbiosis pilot*” (2020–2022)

SELECTED PUBLICATIONS

Barghi, B.; Möistlik, T.; Raag, A.; Volokhova, M.; Reile, I.; Seinberg, L.; Mikli, V.; Niidu, A. (2024). *Deep Oxidative Desulfurization of Planar Compounds Over Functionalized Metal-Organic Framework UiO-66(Zr): An Optimization Study*. ACS Omega, 9 (22), 23329–23338. DOI: 10.1021/acsomega.3c09971.

Mets, B.; Lopp, M.; Uustalu, J.M.; Muldma, K.; Niidu, A.; Kaldas, K. (2023). *A two-step model for assessing the potential of shale-derived chemicals by oxidation of kukersite*. Oil Shale, 40 (4), 344–362. DOI: 10.3176/oil.2023.4.04.

Barghi, Bijan; Jürisoo, Martin ; Volokhova, Maria; Seinberg, Liis; Reile, Indrek; Mikli, Valdek; Niidu, Allan (2022). *Process Optimization for Catalytic Oxidation of Dibenzothiophene over UiO-66-NH₂ by Using Response Surface Methodology*. ACS Omega, 7 (19), 16288–16297. DOI: 10.1021/acsomega.1c05965.

DEVELOPMENT OF ROBOT-HUMAN CO-CREATION WORKING GROUP

Head of the working group: Senior Lecturer OLGA DUNAJEVA, olga.dunajeva@taltech.ee

Members: Jüri Majak, Žanna Gratsjova, Rivo Lemmik, Sergei Pavlov, Avar Pentel, Oleg Shvets, Sónia Cláudia Da Costa Sousa, Mati Möttus, Mustafa Can Özdemir, Mare Roosileht, Kadri Kristjuhan-Ling

Doctoral student: Siarhei Autsou

TOPICS AND COMPETENCES

KEYWORDS: human-robot interaction; modelling; testing; artificial intelligence; robotisation of production processes; robotic workplace design; risk assessment and analysis; user trust

The working group focuses on the topic of collaborative robotics. Research areas include the study of social and psychological aspects of human-robot interaction (HRI), HRI modeling, assessment and analysis of impact factors and risks, user trust in robotic systems, robotic workplace design. The goal is to develop methodologies and validated human-robot interaction models, impact and risk assessments. The provision of user-centered design services is also considered important.

The main activities in 2024 took place within the framework of the project “Development of robot-human co-creation in Industry”. The aim of the project is to investigate trust properties in human-robot interaction. By increasing trust in robotized systems in industrial environments, the results of the research project will encourage companies and employees in Ida-Virumaa to use more robotization and automation systems.



SELECTED PROJECT

- ÕÜF9 RIKT “*Development of robot-human co-creation in Industry*” (2023–2029)

LABORATORY OF FUELS TECHNOLOGY

Head of the laboratory: **OLGA PIHL**, olga.pihl@taltech.ee

Members: Hella Riisalu, Larisa Grigorieva, Aleksei Penežko, Viktoria Petrova, Maria Tšepelevitš, Larissa Kruglenkova, Dmitri Suššik, Jelena Upan, Olga Suššik, Nadežda Merkulova, Julia Kravetskaja, Aleksandr Nossov, Eduard Pihl, Olga Kornõljeva

TOPICS AND COMPETENCES

KEYWORDS: waste fuels, waste, pyrolysis, co-pyrolysis, hydrogenation, semi-coking, distillation, solid and liquid fuels, water and gas analysis, phenols, standardization

The Laboratory of Fuels Technology at Oil Shale Competence Center (OSCC) offers both direct research and analysis services in accredited areas.

THE LABORATORY'S RESEARCH DIRECTIONS ARE:

- Organic substances (including waste, plastics, tyres, RDF, SRF) pyrolysis (pyrolysis, two-stage pyrolysis, hydrogenation) at various temperatures and conditions.
- The analysis of technological properties and composition of the obtained products.

Particular attention is paid to the co-processing/processing of different materials to produce the desired chemicals. Co-processing of waste with stored oil-shale ash provides good prerequisites to be the basis for the development of industrial technology for the recycling of non-recyclable waste.

The laboratory's competencies include determining the quality of solid and liquid fuels in accordance with standards and determining the component composition of samples of gases and liquids using chromatography and mass-spectrometry methods.



The Laboratory is accredited in accordance with the requirements of the standard EVS-EN ISO / IEC 17025: 2017. The laboratory is in the working group of the Estonian Centre for Standardisation and Accreditation EVS / TK 57 "Processing of oil shale and oil shale products".

Applied research in the direction of co-processing of oil shale and plastic waste has led to pivotal changes in the oil shale industry. The solid heat carrier technology used to produce shale oil in Estonia allows the pyrolysis of waste tyres and plastic waste together with oil shale. Thus, it is possible to reduce the use of oil shale and at the same time produce useful raw materials from waste that has so far been burned or stored in a landfill.

More information: <https://taltech.ee/en/oil-shale-competence-center/services>

SELECTED PROJECTS

- F19044 "[*Valuing oil shale \(products\) and expanding the field of activity of the Oil Shale Competence Centre*](#)" (2020–2023)
- ÕÜF18 "[*Development of a process for chemical recycling of waste non-suitable for mechanical recycling*](#)" (2023–2029)
- F21031 "[*Research on the recycling of plastic residues from lead-acid batteries in pyrolytic processes*](#)" (2021–2022)

SELECTED PUBLICATIONS

Gerasimov, G. Y.; Khaskhachikh, V. V.; Sychev, G. A.; Larina, O. M.; Zaichenko, V. M. (2022). [*Study of a Two-Stage Pyrolytic Conversion of Dried Sewage Sludge into Synthesis Gas*](#). *Russian Journal of Physical Chemistry B*, 16 (6), 1067–1074. DOI: 10.1134/S1990793122060045

Gerasimov, G. Ya.; Khaskhachikh, V. V.; Sychev, G. A.; Zaichenko, V. M. (2023). [*Migration Activity of Heavy Metals During Pyrolysis of Dried Sewage Sludge in a Fixed-Bed Reactor*](#). *Journal of Engineering Physics and Thermophysics*, 96 (1), 112–119. DOI: 10.1007/s10891-023-02667-3.

Jurkeviciute, Ana; Grigorieva, Larisa; Tõnsuaadu, Kaia; Yashicheva, Tamara; Bondarev, Dmitriy (2023). [*Non-aldehyde resins based on resorcinol and natural alkylresorcinols modified with styrene*](#). *Materials Research Express*, 10 (10), #105301. DOI: 10.1088/2053-1591/acfd12.

MECHANICAL ENGINEERING AND ENERGY TECHNOLOGY PROCESSES CONTROL WORK GROUP

Head of the working group: Senior Lecturer VEROONIKA SHIROKOVA,
veroonika.shirokova@taltech.ee

Members: Tatjana Baraškova, Sergei Bereznev, Karolina Kudelina

TOPICS AND COMPETENCES

KEYWORDS: nanocomposite materials; anti-corrosion coatings; renewable energy; solar panels; sustainability measurements; equipment diagnostics

The work group's scientific activities are focused on the following areas:

- Implementation of innovative renewable energy technologies (e.g. solar panels, wind power plants, micro-cogeneration, etc.) in the electricity system;
- Integration of novel storage technologies (e.g. hydrogen technologies, including the production and storage of ammonia and synthesis gas, Li-Ion batteries, etc.) into the electricity system;
- Adoption of advanced flexibility technologies (e.g. examining storage options in industrial processes, including heat and air storage, for offering flexibility services);



- Application of digital and AI-based solutions (e.g., analysis, forecasting, management, protection, security solutions, and monitoring systems for energy production, storage, and consumption) in energy systems;
- Solutions and implementation of small-scale and community-based energy;
- Advanced materials to ensure energy efficiency, specifically researching polymer nanocomposite protective and thermoemission films for solar and hydrogen energy;
- Universal anti-corrosion coatings based on polymer nanocomposites for broad industrial applications;
- Sustainable measurement technologies (LIDAR technologies, object measurement for material consumption and quality assessment, vibration measurements, and analysis);
- Equipment/drivers diagnostics (early fault detection, including in shafts, bearings, belts). Real-time monitoring of technological processes.

SELECTED ARTICLES

Baraškova, T.; Kudelina, K.; Shirokova, V. (2024). *New Opportunities in Real-Time Diagnostics of Induction Machines*. *Energies*, 17 (13), #3265. DOI: 10.3390/en17133265.

Shmagina, E.; Volobujeva, O.; Nasibulin, A.G.; Bereznev, S. (2024). *Fabrication of novel SiOxNy/SWCNT laminate-type composite protective coating using low-temperature approach*. *Ceramics International*, 50, 18, 34312–34320. DOI: 10.1016/j.ceramint.2024.06.250.

Shmagina, E.; Antonov, M.; Kasikov, A.; Volobujeva, O.; Khabushev, E. M.; Kallio, T.; Bereznev, S. (2024). *Structural, Mechanical, and Optical Properties of Laminate-Type Thin Film SWCNT/SiOxNy Composites*. *Nanomaterials*, 14, 22, #1806. DOI: 10.3390/nano14221806. <https://www.etis.ee/Portal/Publications/Display/ba70b019-757c-41e8-a471-3cba035db52e>