

Uurimisrühma tutvustus TalTech T&A 2022. aasta ülevaate koostamiseks

Rakenduskeemia uurimisrühm

Research group overview for TalTech 2022 R&D review

Applied chemistry group

Members:

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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.

Activities

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 is investigated.

Recent publications

1. 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](https://doi.org/10.1021/acsomega.1c05965).
2. Parve, J.; Kudryashova, M.; Shalima, T.; Villo, L.; Ferschel, M.; Niidu, A.; Liblikas, I.; Reile, I.; Aav, R.; Gathergood, N.; Vares, L.; Pehk, T.; Parve, O. (2022). Stereoselective Synthesis of γ -(Acyloxy)Carboxylic Acids and γ -Lactones Features the Switch of Stereopreference of CalB Along Sodium γ -Hydroxycarboxylate Homologues. European Journal of Organic Chemistry. DOI: [10.1002/ejoc.202201329](https://doi.org/10.1002/ejoc.202201329).

Academic Development Plan Priorities

Valorization of environmental resources

Research field according to Frascat Manual

Code 1.4 Natural Sciences/Chemical Sciences and code 2.4 Engineering and technology/Chemical Engineering

Projects owned and participated

LEVEE20069 Applied research into reduction of sulfur containing compounds in shale oil

products.

F19044 Valorization of oil shale products and widening the scope of activities of Oil Shale Competence Centre.

F20057 Startegy of carbon waste utilisation with piloting industrial symbiosis

MINH21089 "Multi-disciplinary knowledge integration for digital manufacturing (Digiman)" (1.11.2021–1.08.2023); Principal Investigator: Mihkel Kahju; Tallinn University of Technology , School of Engineering, Virumaa College.

Additional activities

Head of the team is active member of COST Action 18112 “Mechanochemistry for sustainable industry” core group and as such, responsible for the industrial relations.

Head of EVS technical committee TK80 „Hydrogen technologies“.

Head of Circular Economy Core Lab in TalTech.

Põlevkivi Kompetentsikeskuse kütuste tehnoloogia teadus- ja katselabori uurimisrühm

Laboratooriumi juhataja: OLGA PIHL

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Uurimisrühma liikmed

Hella Riisalu - vanemteadur

Vladimir Khaskhachikh - vanemteadur

Larisa Grigorieva - teadur

Mitteakadeemilised liikmed

Keemiainsenerid Larissa Kruglenkova, Viktoria Petrova, Dmitri Suštšik, Maria Tšepelevitš, Jelena Upan, Olga Kornõljeva - laborant, Aleksandr Nossov - stendikatsete spetsialist, Nadezda Merkulova – spetsialist

Võtmesõnad

Jäätmekütused, jäätmed, koospürolüüs, pürolüüs, hüdrogeenimine, poolkoksistamine, destillatsioon, tahke ja vedelkütused, vee ja gaasi analüüs, fenoolid, standardimine

Uurimissuunad

Orgaanilist ainet sisaldavate materjalide (sh jäätmete, plastikute, rehvide, RDF, SRF) pürolüüs erinevatel temperatuuridel. Saadud pürolüüsi produktide tehnoloogiliste omaduste ja koostise määramine. Erilise tähelepanu all on erinevate materjalide koostöötlemine põlevkiviga. Plastjäätmete koostöötlemine põlevkivi ja põlevkivi tuhaga omab häid eeldusi olla taaskasutatamate plastikute ringlussevõtu tööstusliku tehnoloogia väljatöötamise aluseks.

Labori kompetentside hulka kuuluvad tahkete ja vedelkütuste kvaliteedi määramine

vastavalt standarditele ning gaaside ja vedelike proovide komponentkoostise määramine kromatograafiliste ja massispektromeetria meetoditega.

Labor on akrediteeritud vastavalt standardile EVS-EN ISO/ IEC 17025:2017. Labor on Eesti Standardimis- ja Akrediteerimiskeskuse EVS/TK 57 "Põlevkivi ja põlevkiviproduktide töötlemine" tööühmas.

AAK prioriteetne suund

Keskkonnaressursside vääristamine

Frascati Manuaali teadusvaldkondade ja -erialade klassifikaatori järgi

Loodusteadused 1.4 Keemiateadused

Tehnika ja tehnoloogia 2.4 Keemiatehnika

CERCS klassifikaatori järgi

TEHNIKATEADUSED T350 Keemiatehnoloogia ja –masinaehitus

TEHNIKATEADUSED T370 Süsinikukeemia, naftakeemia, kütuste ja lõhkeainete tehnoloogia

Teadus ja arendustegevus

Rakendusuringud põlevkivi ja plastjätmete koostöötlemise suunal on viinud põlevkivitööstuse pöördeliste muutusteni. Eestis põlevkiviõli tootmiseks kasutatav tahke soojuskandja tehnoloogia lubab pürolüüsida põlevkiviga koos ka vanarehve ja plastjätmeid. Nii on võimalik vähendada põlevkivi kasutust ja toota samal ajal kasulikku toorainet jätmetest mida seni on põletatud või ladestatud.

Tallinna Tehnikaülikool tunnustas uurimisrühma arendustööd esikohaga konkursil Aasta arendustöö 2021. Tänu sellele valiti meid üheks Eesti teaduse esindajaks EuroScience Open Forumil Hollandis – tutvustasime plastjätmete ringlussevõtu võimalust pürolüüsi teel. Sügisel uurimisrühma sai Tallinna linna ettevõtluspäeval eripreemia „Rakenduslik teadustöö 2022“.

Valitud projektid

F19044 Põlevkivi (produktide) väärindamine ja Põlevkivi kompetentsikeskuse tegevusvaldkonna laiendamine.

Valitud artiklid

Study of a Two-Stage Pyrolytic Conversion of Dried Sewage Sludge into Synthesis Gas (2022)

Autorid: Gerasimov, G. Y.; Khaskhachikh, V. V.; Sychev, G. A.; Larina, O. M.; Zaichenko, V. M.
Russian Journal of Physical Chemistry B, 16 (6), 1067–1074. DOI: 10.1134/S1990793122060045

Research Group of the Laboratory of Fuels Technology of the Oil Shale Competence Center

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Research group members

Senior Researchers Hella Riisalu, PhD
Senior Researchers Vladimir Khaskhachikh, PhD
Researchers Larisa Grigorieva, PhD

Non-academic staff

Chemical engineers - Larissa Kruglenkova, Viktoria Petrova, Dmitri Suštšik, Maria Tšepelevitš, Jelena Upan, Olga Kornõljeva - laboratory assistant, Aleksandr Nossov - specialist in bench testing, Nadezda Merkulova – specialist

Keywords

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

Research directions

Organic substances (including waste, plastics, tyres, RDF, SRF) pyrolysis at various temperatures. The analysis of the obtained products. Particular attention is paid to the co-processing of different materials with oil shale. Co-processing of plastic waste with oil shale and oil-shale ash has good prerequisites to be the basis for the development of industrial technology for recycling of non-recyclable plastics.

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".

AAK priority direction-valuation

Environmental resources

Classification of scientific fields and specialties by Frascati manual

- Natural Sciences 1.4 Chemical sciences
- Engineering and technology 2.4 Chemical engineering

By CERCS classification

- TECHNOLOGICAL SCIENCES T350 Chemical technology and engineering
- TECHNOLOGICAL SCIENCES T370 Carbochemistry, petrochemistry, fuels and explosives technology

Research and development

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. The research team's development work was recognised at the Tallinn University of Technology, and received the first prize in the competition "Development work of the year 2021". Thanks to this, we were selected as one of the representatives of Estonian science at the EuroScience Open Forum in the Netherlands – we introduced the possibility of recycling plastic waste by pyrolysis. In autumn, the research group received the special prize "Applied Research 2022" at the Tallinn City Entrepreneurship Day.

Selected Projects

F19044 Valuing oil shale (products) and expanding the field of activity of the Oil Shale Competence Centre

Selected Articles

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