

TTÜ TARTU KOLLEDŽ
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2014

1. Struktuur

TTÜ Tartu Kolledž, Tartu College of Tallinn University of Technology
Kolledži direktor Lembit Nei

- Keskkonnakaitse õppetool, Department of Environmental Protection, Mari Ivask
- Maastikuarhitektuuri õppetool, Department of Landscape Architecture, Sulev Nurme
- Säästva tehnoloogia õppetool, Department of Sustainable Technology, Aime Ruus
- Üldainete õppetool, Department of Basic Studies, Ernst Tungel

2. Teadus- ja arendustegevuse (edaspidi T&A) iseloomustus

2.1 Research group of Ecological building materials and energy efficient housing

Uurimisgrupi juht: dots. Aime Ruus

Uurimisgrupi teadustöö kirjeldus:

1. Project: Laboratory testing and research of natural resources potentially applicable in building and energetics by Tartu Rural Development Association and Võrtsjärve Region (Lep13157). Local Activities in Estonia:

- 1) providing an overview of existing studies and technologies, and compile a ca. 30-page booklet on this;
- 2) Selecting pilot areas from the activity areas of the TRDA and Võrtsjärve Association where the following construction and energy related studies are carried out (in cooperation with Soil Biology working group) :
 - Study on hygrothermal properties of building materials, study on indoor climate, microbiological studies;
 - Assessment of the caloric value and humidity content of natural materials in a laboratory,
 - mapping out pilot areas and a cost-benefit analysis, on the basis of which 3 energy solutions will be proposed

2. Within the doctoral studies of Jane Peda (**Microbial community and indoor air quality in Estonian straw bale houses** - supervisors Mari Ivask and Aime Ruus) five houses were selected and are monitored for microbiology in the air and boards. Also indoor climate (air temperature, relative humidity and carbon dioxide). Air temperature and relative humidity in the boarder is monitored for evaluating the mould growth risk.

2.2 Ülikoolidevaheline uurimisgrupp **Research group for education history**

Uurimisgrupi juht: dots. Epi Tohvri

Project: Enlightenment Educational Ideas applied by Georges Frédéric Parrot and Thomas Jefferson and the Interpretations of these Educational Conceptions in the 21. Century
ETF 9362

Uurimisgruppide 2.1 ja 2.2 kuni 5 olulisemat publikatsiooni aruandeaastal:

1. TINTĚRA, J., RUUS, A., TOHVRI, E., KOTVAL, Z. (2014): Urban brownfields in Estonia: scope, consequences and redevelopment barriers as perceived by local governments. *Moravian Geographical Reports*, Vol. 22, No. 4, p. 25–38. DOI: 10.1515/mgr-2014-0021.
2. V.Karpov, T.Kabanen, J.Resev (2014). A Method for Diagnosing the Condition of Energy Elements, Control And Management Of Energy Efficiency Of Energetic Consumption Systems. *International Journal of Research in Engineering and Science*, 02, 38 - 43.
3. Kabanen, Toivo Karov, Valeri (2014). Dependence Of Energy Efficiency Indices On Individual Energy Technological Processes . *International Journal of Research in Engineering and Science (IJRES)*, 2(2), 25 - 31.
4. Kabanen, Toivo; Karpov, Valeri (2014). Relation between Energy Saving and Economic Indices of Company . *International Journal of Research in Engineering and Science (IJRES)*, 2(1), 30 - 35.
5. Epi Tohvri, Symbol VERITAS as representation of the Enlightenment Scientific Community at the University of Tartu. - *Eesti Ajalooarhiivi toimetised = Acta et commentationes Archivi Historici Estoniae* 21(28) 2014, lk. 93-112.

Teadustulemused

6. Indoor climate parameters in Lake Võrtsjärv Visitor Center indicated in good indoor climate and also number of microorganisms was low,
7. Energetic analyses of the area were carried out and practical suggestions concerning technologies were worked out.
8. Also development plans of district heating network for four local governments were completed

Teadlasmobiilsus:

1. Teaduslik ettekanne – Travelling Knowledge and Instruments – Geroges Frederic Parrot`s international scientific network in the first half of 19th Century. XXXIII Scientific Instrument Symposium, 25–29 August, 2014, Tartu.
2. Ants Soon and Toivo had workshops and meetings in Finland within the project Use of Natural Material for Energy and Construction
3. Ans Soon and Toivo Kabanen organised workshop in Estoania in May within the project Use of Natural Material for Energy and Construction

2.3 Research group for "Nanoparticles applied to sustainable energy and biomedical applications"

Uurimisgrupi juht: prof. Erwan Rauwel

Uurimisgrupi teadustöö kirjeldus:

Project: Ultrastable metal nanoparticles synthesis aimed at applications in nanomedicine (PUT431)

The first year was dedicated to the characterization of the metal nanoparticles (MNPs) and the optimization of the method of synthesis, more particularly for cobalt MNPs. During the first year, more emphasis was put on the study of the structural and physical properties of silver MNPs. The structure of the silver MNPs have been studied by XRD showing pure, highly crystalline cubic silver nanoparticles. Thermal analyses showed that there is no surfactant/organic species on their surface, which should promote the attachment of thiol reactants for functionalization and should allow targeted treatments. TEM study will be performed in 2015. Two main studies were performed on the Ag MNPs: The cytotoxicity of the pure Ag MNPs was tested on HEK (human embryonic kidney) cells and also on cancerous cell lines like PPC-1 (prostate cancer cell line). Different concentrations of MNPs were tested and their toxicity in cells by MTT assay was studied, showing no toxicity to human cells. The functionalization of the Ag MNPs via the encapsulation of the MNPs in pH-sensitive polymersomes has been recently undertaken. The study of the antibacterial and antifungal properties of the silver MNPs started in 2014 and are still under study via a PhD who investigates the potential of these MNPs for applications in Green housing and water purification.

Uurimisgrupi kuni 5 olulisemat publikatsiooni aruandeaastal:

1. Study of the curing mechanism of metal alkoxide liquid threads for the synthesis of metal oxide fibers or microtubes. M. Part, K. Hanschmidt, J. Jõgi, E. Rauwel, G. A. Seisenbaeva, V. G. Kessler and T. Tätte RSC Advances 4, 12545-12554 (2014).
2. Photoluminescent cubic and monoclinic HfO₂ nanoparticles: effects of temperature and ambient. E. Rauwel, A. Galeckas and P. Rauwel Materials Research Express 1, 015035 (2014)
3. A Review on the green synthesis of silver nanoparticles and their morphologies studied via TEM. P. Rauwel, S. Küünal, S. Ferdov and E. Rauwel, Advances in Materials Science and Engineering_Hindawi_Article ID 682749, p1-9 (2014).
4. Silver Nanoparticles Study for Application in Green Housing. S. Küünal, S. Kutti, M. Guha, P. Rauwel, D. Wragg, G. Nurk and E. Rauwel accepted in ECS Transactions issue 64, (2014).
5. Stabilization of higher symmetry HfO₂ polymorphs as thin films and nanoparticles. P. Rauwel and E. Rauwel. Published in "Hafnium: Chemical Characteristics, Production and Applications" edited by Nova Science Publishers, inc. Chap. 4, 35p. (2014).
https://www.novapublishers.com/catalog/product_info.php?products_id=51888&osCsId=3892bf6e3d05091b417ffb8805d87630

Teadlasmobiilsus:

1. 226th ECS and SMEQ Joint International Meeting, **Cancun**, Mexico, October 2014

3 oral presentations:

- ALD Applied to Conformal Rare-Earth Coating of ZnO Nanoparticles for Low Thermal Imaging Applications. E. Rauwel, A. Galeckas, P. Rauwel, P.-A. Hansen, O. Nilsen and H. Fjellvåg

- One STEP Synthesis of Pure Cubic and Monoclinic HfO₂ Nanoparticles: Effects of Temperature and Ambient on the Photoluminescent Properties. P. Rauwel, A. Galeckas and E. Rauwel

- Ultrastable Surfactant Free Silver Nanoparticles Study for Application in Green Housing and Cancer Treatment. E. Rauwel, S. Küünal, P. Rauwel, M. Guha, S. Kutti, D. Wragg

2. 2 stays of 2 days at the University of Oslo (May and September):

Collaboration with researchers of the University of Oslo:

ALD: Prof. Ola Nilsen

XRD: Dr. David Wragg

Photoluminescent study: Dr. Augustinas Galeckas

2.4 Mullabioloogia uurimisgrupp.

Soil biology research group.

Uurimisgrupi juht: Prof. Mari Ivask

Uurimisgrupi teadustöö kirjeldus:

Project: Mesofauna impact on the decomposition processes for soil quality, their significance in the food chain and succession on human affected areas (ETF G9258, project leader A.Kuu). An understanding of ecosystem development must include above- and below-ground components of the developing system and consider a range of biotic and abiotic parameters. “New” environments are rapidly colonized by pioneer-species which may be replaced by others in the succession progress. A major target for below-ground restoration success is the return of the soil microbial biomass. Soil fauna cross a range of trophic levels and they are often allocated to functional groups based on their feeding habit. The knowledge of food web in soil of reclaimed areas is important for improving the application of recultivation technologies on reclaimed land as well as for bioindication of contaminants in soil. The field and laboratory studies for investigation of soil, forest litter and floor layer were carried out to find the relationships between litter characteristics, abundance and diversity of soil invertebrates as well as activities of soil microbial community and litter decomposition.

We focused on problem how to promote the development of soil communities on recultivated mining areas to accelerate the litter decomposition by more abundant decomposer communities. Several substrates (the composts of different waste materials, peat) were used to establish better conditions decomposers. The data were collected (using pitfall traps) for describing and modeling the structure and function of soil communities on areas damaged by human activities by oil shale mining.

Project: Spatial distribution of soil biota and post-flooding recolonization of floodplain and coastal meadows in Matsalu National Park (ETF G 9145, project leader M.Ivask). On flooded area the net of 14 sensors for monitoring the water level, temperature and electroconductivity was established in 2012. (Solinst Levellogger Junior 3001, one hour interval of measurements). Study areas were selected using the altitude- and flooding model by principle that some areas are recolonized more quickly and some are covered by flooding water for very long time. We collected soil samples from 36 study areas to analyse the content of

nutrients in soil, the activity and biomass of microbial community as well as the abundance and diversity of springtails Collembola and the mites Acari (abundance only). We continued and finished the analysis of the taxonomical and ecological structure of soil invertebrates communities sampled in 2013 by pitfall traps.

Project: Laboratory testing and research of natural resources potentially applicable in building and energetics by Tartu Rural Development Association and Võrtsjärve Region (Lep13157). In 2014 the investigations of microbial communities on straw and reed as ecological building material and its potential energetical value were undertaken. The effectiveness of three chemical agents against micro-organisms colonizing straw bales used in environmentally friendly construction was tested. The three chemical agents were boric acid, sodium hypochlorite and commercial fungicide Biotol. Also the major geni of bacteria and fungi colonizing the straw were identified.

The energetical value of straw of different cereal species (straw of wheat, barley and rye) was also analyzed.

Project: Optimization of sewage sludge composting technologies: problems and solutions (project leader prof. L.Nei).

The microbial parameters of the composting process of sewage sludge in a controlled environment at the constant temperature of 20 oC was analyzed. The microbial parameters consisted of basal respiration, substrate induced respiration (SIR) and fungal-to-bacterial ratio. During 2 months of composting the basal respiration value decreased from 3,2 mg O₂/g dw to 0,5 mg O₂/g dw and the SIR value from 15,85 mg biomassC/g dw to 2,58 mg biomassC/g dw. The fungal-to-bacterial ratio shifted from 58,9-41,1 at the beginning to 52,0-48,0 at the end of the experiment.

Urimisgrupi aruandeaastal saadud tähtsamad teadustulemused (*inglise keeles*);

1. New knowledge of diversity, systematics and ecology of soil biota in Estonia.
2. On recultivated mining areas, the activity and abundance of microbial and invertebrate decomposer communities can be accelerated by using different substrates which consist additional nutrients for organisms.
3. In Matsalu wetland, the content of nutrients in soil as well as the activity of soil microbial community and abundance of soil mesofauna (springtails and mites) highly depend on duration of flood and salinity of flooding water. The abundance and activities were the highest in non-flooded areas and significantly lower in flooded soil after withdrawing of flood.
4. The results of investigation of the effectiveness of three chemical agents against micro-organisms colonizing straw bales: the concentrations needed for the inhibition of the microbial population were 2,25 g/l, 0,5 g/l and 1,0 g/l, respectively. The most abundant geni were Aspergillus, Penicillium, Cladosporium for fungi and Streptomyces, Pseudomonas for bacteria. Our study also revealed that the initial content of moisture in straw biomass was unsuitable (too high) for biofuel production. The using of straw as energetical resource is not profitable because of high expenses (for example transport, drying).
5. The microbial parameters of the composting process as well the fungal-to-bacterial ratio of sewage sludge in a controlled environment at the constant temperature of 20

oC, decreased during 2 months of composting significantly; this indicates the higher degree of compost maturity.

Uurimisgrupi kuni 5 olulisemat publikatsiooni aruandeaastal:

1. Leito A., Elts J., Mägi E., Truu J., **Ivask M., Kuu A., Meriste M.**, Ööpik M., Ward R., Kuresoo A., Pehlak H., Sepp K., Luigujõe L. 2014. Coastal grassland waders abundance in relation to breeding habitat characteristics in Matsalu Bay, Estonia. *Ornis Fennica*, 3, 149-165.
2. Melts, Indrek; Heinsoo, Katrin; **Ivask, Mari**. 2014. Herbage production and chemical characteristics for bioenergy production by plant functional groups from semi-natural grasslands. *Biomass and Bioenergy*, 67, 160-166
3. **EGGE HAIBA, MARI IVASK**, Lilian Olle, **JANE PEDA, ANNELY KUU, SANDER KUTTI & LEMBIT NEI**. 2014. Transformation of Nutrients and Organic Matter in Vermicomposting of Sewage Sludge and Kitchen Wastes. *Journal of Agricultural Science*; Vol. 6, No. 2, P.114.
4. **NEI, LEMBIT; HAIBA, EGGE; KUTTI, SANDER;** Kipper, Karin; Herodes, Koit; Lillenberg, Merike (2014). Sewage sludge compost, microbial activity and pharmaceuticals. *Global Journal on Advances in Pure & Applied Sciences*, 3, 30 - 37.

Teaduskorralduslik tegevus:

Mari Ivask – Eesti Maaülikooli Loodusteaduste ja Rakendusbioloogia doktorinõukogu külalisliige (Ave Liivamägi 9.05.2014)

Mari Ivask – ajakirjade toimetuskollegiumi liige (*International Journal of Sustainable Agricultural Management and Informatics*, *European Scientific Journal*, *Acta Architecturae Naturalis*, *Agronomy Research*).

Mari Ivask. IUCN juures tegutseva European Sustainable Use Specialists Group liige (alates 1997).

Teadlasmobiilsus:

1. Mari Ivask – konverents The First Global Biodiversity Conference - Assessing soil biodiversity and its role for ecosystem services, Dec 2-5 2014, Dijon, Prantsusmaa. Posterettekanne (Mari Ivask, Mart Meriste, Annely Kuu. “Flood conditions shape earthworm communities of conjunct floodplain and coastal meadows”).
2. Mart Meriste – Arachnological seminar on evaluation of threatened species in Northern Europe, University of Turku, 14.11.2014. Ettekanne “An overview of spider studies in Estonia after Asta Vilbaste“.