EHITUSTEADUSKONNA KESKKONNATEHNIKA INSTITUUDI TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2011

1. Instituudi struktuur

Instituudi direktor Enn Loigu

- Keskkonnakaitse aluste õppetool, Chair of Environmental Protection, Enn Loigu
- Kütte ja ventilatsiooni õppetool, Chair of Heating and Ventilation, Teet-Andrus Kõiv
- Veetehnika õppetool, Chair of Water Engineering, Valdu Suurkask
- Veekvaliteedi teadus- ja katselaboratoorium, Laboratory of Water Quality

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

(NB! punktid 2.1- 2.6 täidab struktuuriüksus)

2.1. struktuuriüksuse koosseisu kuuluvate uurimisgruppide teadustöö kirjeldus ja saadud tähtsamad teadustulemused

Chair of Environmental Protection

2.1.1. One of the research direction focused on climate change impact on hydrological regime and water quality of rivers and development of criterion for assessment of the ecological minimal discharge particularly for salmonide rivers. In addition, we investigated processes determining the water quality in rivers and the impact of changed land cover types and land uses on diffuse load of nutrients. We also assessed measures to control and decrease non-point load of nutrients from agriculture, particularly in nitrate vulnerable areas. Methods for participatory processes when developing long-term socio-economic and water scenarios were elaborated.

2.1.2. Our research indicates that under the current climate change the river´s runoff is seasonally more evenly distributed; increasing water temperature prolongs the vegetation period in rivers and enhance eutrophication processes. Criterion for assessment of the ecological minimal discharge were developed to ensure welfare of water biota in rivers. Diffuse load of nutrients from different land cover types to inland surface water bodies was estimated. List of measures to reduce load of nitrogen and phosphorus from agriculture was developed. Analysis of long-term trends in nitrogen and phosphorus content in rivers revealed both increasing as well as decreasing tendencies. Water scenarios for the Lake Peipsi basin were developed up to 2050.

Chair of Heating and Ventilation

2.1.1 The investigation of ventilation systems with heat recovery in apartment and education buildings has been carried out. Analysis of energy audits of apartment buildings has been studied. The overall objective of OPEN HOUSE is to develop and to implement a common European transparent building assessment methodology, complementing the existing ones, for planning and constructing sustainable buildings by means of an open approach and technical platform.
The scientific and technical objectives of the OPEN HOUSE project are:
- To define the OPEN HOUSE baseline: an open and transparent European platform for building sustainability.
- To widely communicate the baseline concept and outline the mechanism for interaction between the project and stakeholders.

- To build up the OPEN HOUSE Platform: facilitating a pan-European effort towards a common view on building sustainability.
- To pave the way for implementing and evaluating the methodology: selection of case studies and mechanisms for decision-making.
- To evaluate and refine the methodology by the feedback resulting from case studies and real sustainable public procurement cases and other stakeholders inputs.
- To further disseminate and exploit the OPEN HOUSE methodology

2.1.2 The investigation of exhaust ventilation system with heat recovery on the basis of heat pump has been carried out. Ventilation of apartment, classroom and elderly home on the basis of small air handling unit with heat recovery has been studied.

The one of main scientific findings in 2011 were published in paper Utilization of Oil Shale Retort Gas.

Abstract of the paper:

Production of shale oil yields a significant quantity of by-product gas that can have considerable value. The by-product oil shale retort gas (OSRG) constitutes about ¼ of the energy input of the shale that is processed in a Galoter-based retort.

The desirability of producing separate products from OSRG is confirmed. Even one single component - propylene - has a potential market value of up to US$250 million per year if produced on the scale that Estonian Energy is proposing to develop its oil shale project in Utah, USA. Used in its aggregate state as a simple fuel in a power plant, the same amount of OSRG has only about 5% of that value.

Chair of Water Engineering

2.1.1 The first research direction is investigation of landfills leachate water treatment technology. Every landfill has its own unique mix of chemical composition and flow rate. Our investigation focused on Estonian new landfills, the dynamics of waste collection. The challenge is to determine which technology may be economically employed to meet the requirement of the situation. The next research direction is anaerobic digestion of biodegradable waste for gas production. We collected data of biodegradable waste from different sources for the period of 2002-2010. Based on the data of biodegradable waste the laboratory experiments are made and ongoing with different substrates to evaluate their biogas potential. The research on Estonian small-scale wastewater treatment plants (WWTP) focused on their status and treatment efficiency, pointing out design, construction and operation errors. The main task was to work out recommendations and guidelines to select technological and technical solutions for small-scale wastewater treatment plants by different pollution load categories taking into consideration Estonian situation.

2.1.2 We have analysis of Estonian landfills leachate water composition and proposed recommendations for treatment technologies. Landfilled waste quantities and quality are dynamically changing which may have influence to the leachate water treatment process. The extent to which leachate should be treated is determined by the discharged consent that applies. Corresponding overview of EU and Estonian legislation is composed. Database about waste collection in Estonian 15 counties, 48 towns and settlements, agricultural farms, food industry 121 enterprises, commercial sector, greeneries, etc is drafted. Evaluation of changes in quantities and qualities of biodegradable waste from different sources in recent years is made. The laboratory tests liquefaction are made of different substrates. Test results: In batch test best result was 64% CH4 where substrate (sludge) and inoculum (glycerol) ratio was 0,18. In one step continuous test best result was with 68% CH4 where substrate was raw sludge and 2% fish waste. In volumetric tests best result was 47% CH4 where substrate was 23% fermented and centrifuged sludge with 50g glycerol. Tests will continue with raw sludge and different mix of glycerol, fish residues. The new

laboratory equipment enables investigate co-digestion of different substrates. Elaborated guidance, including treatment methods selection principles based (taking into consideration) on the best available techniques, is a basis for designers, constructors, operators and support environmental authorities in decision making processes. WWTPs operators training courses curricula and occupation standard grade were also worked out.

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

Keskkonnakaitse aluste õppetooli ja veetehnika õppetoli tööd on teatud määral läbi põimunud.

Nende tähtsamad publikatsionid:

1.1 Pachel, Karin.; Klõga, Marija.; Iital, Arvo. (2011). Scenarios for reduction of nutrient load from point sources in Estonia (accepted for publication). Hydrology Research, 43(4-5)[ilmumas].´

1.1 Reihan, A.; Kriauciuniene, J.; Meilutyte-Barauskiene, D.; Kolcova,T. (2011). Temporal variation of sprint flood in rivers of the Baltic states. (accepted for publication). Hydrology Research, 43(4-5).[ilmumas].

1.2 Iital, A..; Voronova, V..; Klõga, M. (2011). Development of water scenarios for large lakes in Europe: The case of Lake Peipsi. Journal of Water and Climate Change, 2(2-3), 154 - 165.

1.2 Voronova, V.; Moora, H.; Loigu, E. (2011). Environmental assessment and sustainable management options of leachate and landfill gas treatment in Estonian municipal waste landfills. Management of Environmental Quality: An International Journal, 22(6), 787 - 802.

Kütte ja ventilatsiooni õppetooli tähtsamad publikatsioonid:

1.2 Voll, H.; Seinre, E.; Sööt, P. (2011). Analysis of Passive Architectural Roof Cooling Potential to Decrease the Cooling Demand for Northern European Office Buildings Based on Energy Modelling and Laboratory Tests. WSEAS Transactions an Environment and Development, 7(5), 136 - 145.

1.2 Voll, H.; Seinre, E. (2011). Evaluation and Comparison of Various Calculation Zone Analysis for Dynamic Simulation Software?s. International Journal of Mathematics and Computers in Simulation, 20(419), 54 - 64.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustustest.

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2.4 Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

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2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

Tähtsamad finantseerimise allikad on EL Raamprogramm ning siseriiklkudd lepingud (Keskkonnaministeerium, KredEx).

2.6 Soovi korral lisada aruandeaastal saadud T&A-ga seotud tunnustusi (va punktis 2.3 toodud tunnustused), ülevaate teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

Hinnang tegevusele – **hea**.

2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused *(Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel)*

- Haridus- ja Teadusministeerium

sihtfinantseeritavad teemad:

- T172, Vedeliku ja konstruktsiooni koostoime mehaanika, Kõiv Teet-Andrus

baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):

- B615, Madala energiatarbega hoonete kavandamise uurimis- ja kompetentsikeskus, Hendrik Voll

riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:

- Uurija-professori rahastamine:

- SA Eesti Teadusfond

grandid:
ühisgrandid välisriigiga:
järeldoktorite grandid (SA ETF ja Mobilitas):

- MJD107, Investigation of Grey Water Irrigation and Energy Demand for Greenroofs, Voll Hendrik

tippteadlase grandid (Mobilitas):

- Ettevõtluse Arendamise SA

eeluuringud:
arendustoetused:

- SA Archimedesega sõlmitud lepingud

infrastruktuur (nn „mini-infra“, „asutuse infra“):
Eesti tippkeskused:
riiklikud programmid:
muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:

- KIK10090, Reovee väikepuhastite tehnoloogiliste ja tehniliste lahenduste soovituste ja juhendmaterjalide koostamine kohalike omavalitsuste tarbeks, Loigu Enn

- Siseriiklikud lepingud:
- Lep10046, Reoveesette ja teiste biolagunevate jäätmete koos- ja eraldikäitlemine anaeroobse kääritamise teel Eestis ja digestaadile jäätmelõpu kriteeriumist lähtuvalt soovituslike kasutuskriteeriumide väljatöötamine, Loigu Enn,

- LEP10049, Eesti korterelamutes 2008-2011 läbi viidud energiaauditite analüüs, Teet-Andrus Kõiv
- LEP10063, Soojustagastusega ventilatsioonisüsteemi (Heathcatcher tehnoloogia) arendamine olemasolevatele kortermajadele (I etapp), Kõiv Teet-Andrus,
- LEP10097, Korteripõhised ventilatsioonisüsteemid (I etapp), Teet-Andrus Kõiv,
- Lep11032, Ojamaa kaevandusala ettevõtte pinnavee eneseseire 2011, Loigu Enn,
- Lep11083, Tartu Loodusmaja õppehoone energiatõhususe simulatsioonid ning otsese päikesevalguse analüüs, Voll Hendrik
- LMIN10041, Põhja-Eesti jõgede hüdrokeemiline seire 2010.a., Loigu Enn
- LMIN10117, Põllumajanduse hajukoormuse piiramise meetmete väljatöötamine ja nende tõhususe hindamine. Hinnang pinna- ja põhjavee hea seisundi saavutamise ja veesäästu võimaluste kohta, Loigu Enn
- LMIN10123, Nitraaditundliku ala laiendamisvajaduse analüüs, Loigu Enn
- LMIN11013, Põhja-Eesti jõgede hüdrokeemiline seire 2011.a., Loigu Enn
- LMIN11079, Eesti reostuskoormuse arvutamine ning aruannete esitamine Helsingi Komisjoni PLC-Water töörühmale, Loigu Enn
- LMIN8081, Referentlabori volituste andmine veeuuringut tegevatele katselaboritele, Loigu Enn

- <u>EL Raamprogrammi projektid:</u>

– VFP493, Knowledge transfer and research needs for preparing mitigation-adaptation policy portfolios - PROMITHEAS-4, Reihan Alvina
– VFP536, OPEN HOUSE "Benchmarking and mainstreaming building sustainability in the EU based on transparency and openness (open source and availability) from model to implementation", Voll Hendrik

- <u>Välisriiklikud lepingud:</u>

– VA540, OPEN HOUSE "Benchmarking and mainstreaming building sustainability in the EU based on transparency and openness (open source and availability) from model to implementation", Voll Hendrik
– VA542, OPEN HOUSE "Benchmarking and mainstreaming building sustainability in the EU based on transparency and openness (open source and availability) from model to implementation", Voll Hendrik
– VEU 423, The development of Pay As You Throw Systems in Hellas,Estonia and Cyprus HEC-PAYT, Loigu Enn
– VEU497, CELA - Network of Climate Change Technology Transfer Centres in Europe and Latin America, Loigu Enn
– VIR425, Baltic Sea Region Programme 2007-2013 COHIBA (Control of hazardous substances in the Baltic Sea reagion), Loigu Enn,
– VIR454, Baltic COMPASS - Comprehensive Policy Actions and Investments in Sustainable Solutions in Agriculture in the Baltic Sea region (INTERREG IVA), Loigu Enn
– VIR459, Sustainable utilization of waste and industrial non-core materials (SUSBIO), Loigu Enn
– VIR470, SUBMARINER Sustainable Uses of Baltic Marine Resources, Loigu Enn,
– VIR488, Central Baltic Cooperation in Energy Efficiency and Feasability in Urban Planning (ENEF), Kõiv Teet-Andrus
– VIR522, GAUJA-KOIVA Towards joint management of the transboundary Gauja/Koiva river basin district, Loigu Enn

2.8 Struktuuriüksuse töötajate poolt avaldatud sihtfinantseeritava teadusteema taotlemisel arvestatavad eelretsenseeritavad teaduspublikatsioonid *(ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1).*

1.1

Kurnitski, J.; Saari, A.; Kalamees, T.; Vuolle, M.; Niemelä, J.; Tark, T. (2011). Cost optimal and nearly zero (nZEB) energy performance calculations for residential buildings with REHVA definition for nZEB national implementation. Energy and Buildings, 43(11), 3279 - 3288.

Koiv, T.-A.; Hani, A. (2011). Domestic Hot Water design flow rates in schools, kindergartens, office buildings and shopping centers. Journal of Civil Engineering and Management, 1 - 10. [ilmumas]

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1.2

Kivimägi, J. (2011). A descriptive analysis of post-closedown environmental monitoring and maintenance of the Pääsküla landfill. Management of Environmental Quality: An International Journal, 22(6), 686

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Iital, A..; Voronova, V..; Klõga, M. (2011). Development of water scenarios for large lakes in Europe: The case of Lake Peipsi. Journal of Water and Climate Change, 2(2-3), 154 - 165.

Voronova, V.; Moora, H.; Loigu, E. (2011). Environmental assessment and sustainable management options of leachate and landfill gas treatment in Estonian municipal waste landfills. Management of Environmental Quality: An International Journal, 22(6), 787 - 802.

Voll, H.; Seinre, E. (2011). Evaluation and Comparison of Various Calculation Zone Analysis for Dynamic Simulation Software's. International Journal of Mathematics and Computers in Simulation, 20(419), 54 - 64.

Veidemane, K.; Iital, A.; Gielczewski, M. (2011). Participatory scenarios for regional water management planning: Eastern Baltic case study. Journal of Water and Climate Change (accepted for publication), xx - xx. [ilmumas]

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1.3

2.1

2.2

Kalamees, T.; Arumägi, E.; Just, A.; Kallavus, U.; Mikli, L.; Thalfeldt, M.; Klõšeiko, P.; Agasild, T.; Liho, E.; Haug, P.; Tuurmann, K.; Liias, R.; Õiger, K.; Langeproon, P.; Orro, O.; Välja, L.; Suits, M.; Kodi, G.; Ilomets, S.; Alev, Ü.; Kurik, L. (2011). Eesti eluasemefondi puidust korterelamute ehitustehniline seisukord ning prognoositav eluiga. Tallinn Technical University Press

Loigu, E.; Velner, H.-A.; Iital, A.; Pärnapuu, M. (2011). Hajureostuse dünaamika loodus- ja põllumaadelt (1960-2010). Tallinn: Tallinna Tehnikaülikooli Kirjastus

Voll, H. (2011). Hoonete planeerimine ja fassaadide kujundamine. Tallinna Tehnikaülikooli Kirjastus

3.1

Mikola, A.; Koiv, T.-A. (2011). Indoor Air Quality in Apartment Buildings of Estonia. Nikos Mastorakis jt. (Toim.). Computers and simulation in modern science : selected papers from WSEAS conferences (257 - 261).WSEAS

Koiv, T.-A; Voll, H.; Mikola, A.; Lukjanov, D. (2011). The indoor climate and ventilation of Eldery homes. N.Gavriluta jt (Toim.). Recent Researches in Environment, Energy Planning & Pollution. Proceeding of the 5th WSEAS International conference on Energy Planning, Energy Saving, Environmental Education (229 - 232). Iasi Romania, July 1-3, 2011: WSEAS Press

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Computer Engineering: 5th International Conference on Computer Engineering and Application (CEA'11); Puerto Morelos, Mexico, January 29-31, 2011. (Toim.) Alexander Zemliak, Nikos Mastorakis. WSEAS, 2011, 129 - 134.

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3.2

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3.3

4.1

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2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu *(NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu)*

2.10 Struktuuriüksuses järeldoktorina T&A-s osalenud isikute loetelu *(ETIS-e kaudu esitatud taotluste alusel)*

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

3. Struktuuriüksuse infrastruktuuri uuendamise loetelu

- Biogaasianalüsaator GFM416, 8.02.2011, 5 372 €
- Anaeroobse lagundamisprotsessi seade(ARMFIELD) 12.05.2011, 17 350 €
- Automaatne metaani potentsiaali mõõtur (AMPTS), 23.08.2011, 21 500 €