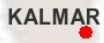
**Linnaeus University**
**School of Natural Sciences**

**8th International Conference on**

*Establishment of Cooperation between Companies and Institutions in the Nordic Countries, the Baltic Sea Region, and the World Conference on Natural Sciences and Environmental Technologies for Waste and Wastewater Treatment, Remediation, Emissions Related to Climate, Environmental and Economic Effects*




# BOOK OF ABSTRACTS

**Linnaeus**
**ECO-TECH 2012**
**26-28 November, 2012**
**KALMAR, SWEDEN**

EDITED BY:

EVA KUMAR, JOACIM ROSENLUND,

FABIO KACZALA, WILLIAM HOGLAND

PROCEEDINGS

# LINNAEUS ECO-TECH 2012

INTERNATIONAL CONFERENCE
ON
NATURAL SCIENCES AND ENVIRONMENTAL TECHNOLOGIES
FOR

**WASTE AND WASTEWATER TREATMENT**
**REMEDIATION**
**EMISSIONS RELATED TO CLIMATE**
**ENVIRONMENTAL AND ECONOMIC EFFECTS**

***The Eighth International Conference on the Establishment of Cooperation between Companies and Institutions in the Nordic Countries, the Baltic Sea Region, and the World***


NOVEMBER 26 - 28, 2012
KALMAR, SWEDEN

ISBN: 978-91-86983-86-4

# SPONSORS AND SUPPORTING INSTITUTIONS

AB Gustaf Kähr

Brofästet Hotel & Conference

E.ON

Flexus Balasystem

IVA – The Royal Swedish Academy of Engineering Sciences

Kalmar Energi

Knowledge Foundation

KSRR

Linnaeus University

Länsstyrelsen Kalmar län

Mindmancer

Purac / Läckeby Water

Ragn-Sells AB

Sida – Swedish International Development Cooperation Agency

STINT – The Swedish Foundation for International Cooperation in Research and Higher Education

Samverkansavdelningen Linnaeus University

Sustainable Sweden Southeast AB

Swedish Institute

The Regional Council in Kalmar County

Tillväxtverket – European Regional Development Fund

Vatten och Samhällsteknik

VINNOVA – The Swedish Governmental Agency for Innovation Systems

# INTERNATIONAL SCIENTIFIC COMMITTEE

# PROGRAMME COMMITTEE

**Amit Bhatnagar**, Linnaeus University
**Ann-Christin Bayard**, Sustainable Sweden Southeast
**Erik Ciardi**, Regional Council in Kalmar County
**Tommy Claesson**, Linnaeus University
**Roland Engkvist**, Linnaeus University
**Åke Erlandsson**, Kährs
**Jan Hagel**, Linnaeus University
**Henrik Hansson**, Linnaeus University
**William Hogland**, Linnaeus University
**Muhammad Asim Ibrahim**, Linnaeus University
**Fabio Kaczala**, Linnaeus University
**Eva Kumar**, Linnaeus University
**Lars Kylefors**, Vatten och Samhällsteknik
**Sawanya Laohaprapanon**, Linnaeus University
**Kerstin Linsved**, Ragn-Sells
**Marcia Marques**, Linnaeus University / Rio de Janeiro State University
**Joacim Rosenlund**, Linnaeus University
**Sirkku Sarenbo**, Linnaeus University
**Henric Svensson**, Linnaeus University

# ADMINISTRATIVE SECRETATRY

**Joacim Rosenlund**, Linnaeus University

# PREFACE

The Baltic Sea catchement area has approximately 1.8 million $km^2$ and encompases 14 countries of which, 9 have borders to the Baltic Sea. By the end of the 1990's, big gaps existed in terms of economic development among countries in the region. Nevertheless, a strong feeling of historical connection established during hundreds of years demanded action to reduce this gap. During the last 15 years (1997-2012), these differences have been smothen out and the distances shortened mainly thanks to the development of new communication systems. In 1997 when City of Kalmar celebrated the $600^{th}$ anniversary of the Union between the Nordic countries and the first Kalmar ECO-TECH Conference was organized, one of the main goals of the University of Kalmar in Sweden was to promote research and education cooperation among the countries around the Baltic Sea towards sustainability. The strategy established by HiK to reach this goal was through close cooperation with trade and industry; Kalmar ECO-TECH embraced both goal and strategy. Since then, Kalmar ECO-TECH, now Linnaeus ECO-TECH, has been held every second year. 15 years passed by and we might have the feeling that we have not done enough. Can we ensure that the pollution load to the air, soil and water is decreasing? If not, what can we do better in the future? How can we improve our message to the new generation and recruit youngsters to become environmental engineers and environmental scientists that will do better in the future?
The main objective of Kalmar ECO-TECH through the years has been to promote cooperation between the academia, trade and industry in the Baltic region and expand clean technology by engaging companies, industries, city engineers and administrators. The main goal has been to solve the existing environmental problems through technological solutions but also through new ways of thinking, producing and consuming. It has been more and more obvious that the environmental issues have rised from local through regional to global concern. Pollution has more and more transboundary nature and affects everyone. As a consequence, Kalmar ECO-TECH themes have changed during the years (**Figure 1**). Particularly since 2005, the Conference has been opened not only to the Baltic region but to the whole world. During the last five years the global warming and $CO_2$ emissions have been a hot topic not only among scientists but also among politicians and the society as a whole. During ECO-TECH' 07 special attention was devoted to gaseous emissions related to climate changes and renewable energy from waste. **Table 1** shows some events connected to Kalmar ECO-TECH with the participation of the Linnaeus University and the previous University of Kalmar. One activity worth to be highlighted is the Youth Environmental Conference ECOBALTICA that has been held in Saint Petersburg every two years since 1996 in cooperation with the Assembly of Young Scientists of St. Petersburg, State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, Russia. This conference is devoted to youngsters by opening possibilities for undergraduate and graduate students from the countries in the Baltic Region to present their theses and academic projects, to meet senior researchers and representatives from trade and industry and develop business and academic skills.

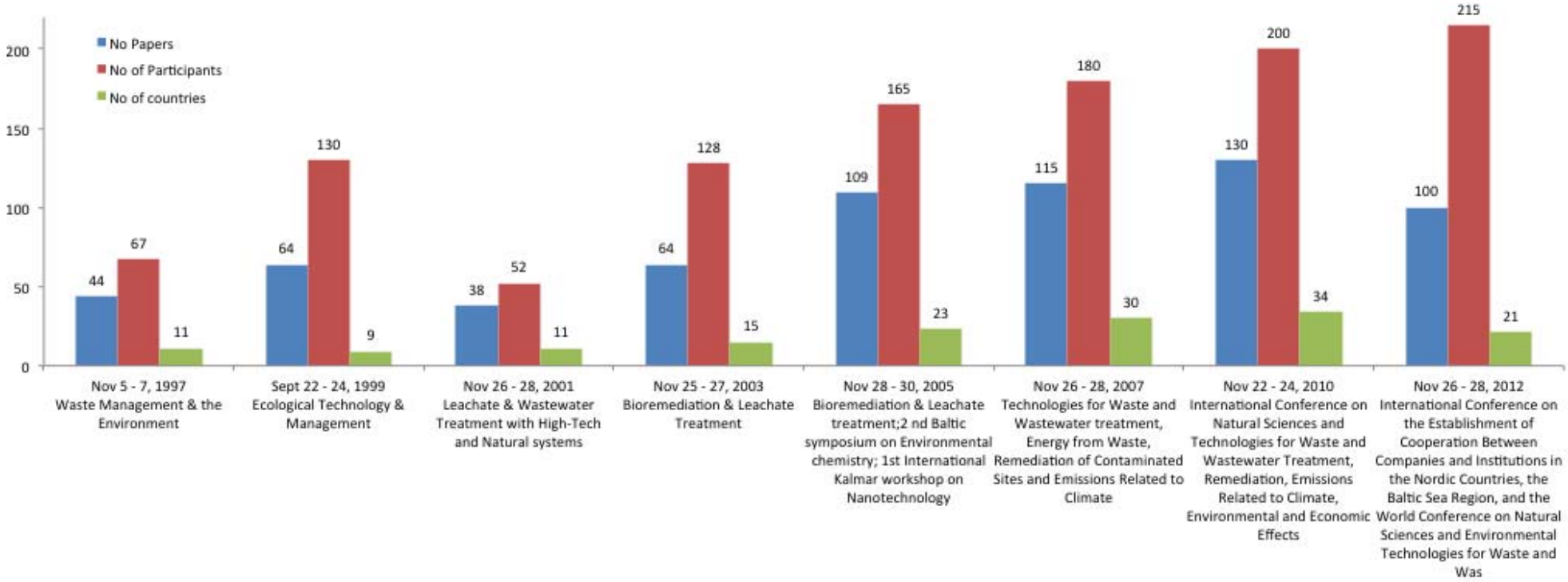



**Figure 1.** Kalmar ECO-TECH' 1997, 1999, 2001, 2003, 2005, 2007, 2010 and 2012. The themes are highlighted and number of papers, participants and countries.

**Table 1**. Events organized during the period of 1996-2006 related to the sustainable development in the Baltic Sea Region

| Year | Activity | Main institutions and persons involved |
|---|---|---|
| 1996 | The idea about Kalmar ECO-TECH arises | Åke Erlandsson AB Gustaf Kähr and William Hogland University of Kalmar |
| 5-7 Nov. 1997 | The 1st Kalmar ECO-TECH Seminar on Waste Management and the Environment was organized, to be held every second year in Kalmar | Head of Department of Technology, Göran Borgö and William Hogland, University of Kalmar |
| 1998 | Cooperation agreement-International Youth Environmental Conference ECOBALTICA to be held every second year in St. Petersburg, Russia | William Hogland University of Kalmar and Vasilii Rud St. Petersburg State Technical University, Russia |
| 5-7 Jun, 1998 | The Ecological Symposium, Gdansk, Oruma, Poland | Piotr Kowalic, the Technical University of Gdansk, Poland |
| 22-26 Jun, 1998 | The Youth Environmental Conference ECOBALTICA´98, 22-26 June 1998, St. Petersburg, Russia | Vaslii Rud and William Hogland. State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, Russia |
| 1998 | Cooperation agreement between Kalmar University and St. Petersburg State Technical University (renewed since then) | Vice Chancellor Örn Taube, Professor William Hogland, Vaslii Rud St. Petersburg State Technical University |
| 2-20 Nov, 1998 11-17 Apr, 1999 | Advanced International Training Programme, Sida Course in "Solid Waste Management in Eastern Europe": Part 1 in Stockholm, SWECO, Sweden; Part 2 in Yalta, Ukraine | SWECO, Stockholm |
| 26-29 Nov, 1998 | The 5th Danish-Polish Workshop on "Biofuels", Ecological Education Center, Starbienino, Poland | Poitr Kowalic the Technical University of Gdansk, Poland, Roskilde University Centre, Denmark and Free University of Berlin, Germany |
| 2-27 Aug, 1999 | International Course Agenda 21: Planning and Management for Sustainability in the Baltic Sea Region | University of Kalmar |
| 22-24 Sept. 1999 | Kalmar Eco-tech´99, The 2nd Seminar on Establishment of Cooperation between Companies/Institutions in the Nordic Countries and the Baltic Countries | Professor William Hogland his Team at the University of Kalmar |
| 2-5 Dec, 1999 | The 6th Danish-Polish Workshop on "Biomass for Energy", Starbienino, Poland | Technical University of Gdansk, Poland, Roskilde University Centre, Denmark, Free University of Berlin, Germany, Poitr Kowalic, William Hogland |
| 14-15 Dec, 1999 | Seminar on "New Environmental Technology for Processing Landfill Leachate", Siauliai, Lithuania | Dr Lennart Mårtensson, University of Kristianstad, Sweden |
| 25-29 Jun, 2000 | The 1st International Workshop of the Baltic Test Team: Global International Waters Assessment-GIWA UNEP/GEF | GIWA UNEP/GEF, University of Kalmar, Marcia Marques and William Hogland |
| 26-30 Jun, 2000 | The Youth Environmental Conference ECOBALTICA´00, St. Petersburg Russia | Vaslii Rud, International Director and co-organizer William Hogland; State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, St. Petersburg, Russia |
| 12-16 Aug, 2000 | The 2nd International Workshop of the Baltic Test Team: International Global International Waters Assessment-GIWA UNEP/GEF | GIWA UNEP/GEF, University of Kalmar, Marcia Marques and William Hogland |
| 7-10 Dec, 2000 | the 7th Danish-Polish Workshop on "Biomass for Energy, Starbienino, Poland | Technical University of Gdansk, Poland, Roskilde University Centre, Denmark and Free University of Berlin, Germany, Piotr Kowalic, William Hogland |
| 18-20 Dec 2000 | The 3rd International Workshop of the Baltic Test Team: Global International Waters Assessment-GIWA UNEP/GEF | GIWA UNEP/GEF together with Professor William Hogland and Marcia Marques |
| 17-18 Sep, 2001 | The First International Symposium: Environmental Problems in the Baltic Region States, Environmental Friendly Treatment Technology for Waste Water in the Baltic Sea Region, Šiauliai, Lithuania | Dr Lennart Mårtensson University of Kristianstad, Sweden |

| | | |
|---|---|---|
| 26-29 Sep, 2001 | The First Baltic Symposium on Environmental Chemistry | Professor Toomas Tenno, University of Tartu, Estonia |
| 26-28 Nov. 2001 | Kalmar Eco-tech´01 Leachate and Wastewater Treatment with High-tech and Natural Systems | Professor William Hogland and his Team at University of Kalmar |
| 21-25 Oct, 2002 | The Youth Environmental Conference ECOBALTICA 02, St. Petersburg | Vaslii Rud, International Director and William Hogland; State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, St. Petersburg, Russia |
| 22 Oct, 2002 | Sustainable Water Treatment and Water Quality Control Systems: Leachate Treatment from MSW and Industry Landfills; The 2nd Workshop "Sustainable Leachate and Waste Water Management using High-tech and Natural Systems" | William Hogland and St. Petersburg State Polytechnical University (SPbSPU), St Petersburg, Russia |
| 11-13 Apr, 2003 | Decision Making in Water Management Network | Institute of Ecology, Tallinn, Estonia |
| 12-15 Jun, 2003 | The 8th Danish-Polish Workshop on Biomass for Energy, Starbienino, Poland | Piotr Kowalic, The Technical University of Gdans, Poland, Roskilde University Centre, Denmark and Free University of Berlin, Germany |
| 28 Nov, 2003 | The gender perspective "Women in Technology with focus on Bioremediation and Leachate Treatment in the Baltic Region" | William Hogland, University of Kalmar |
| 25-27 Nov. 2003 | Kalmar Eco-tech´03 Bioremediation and Leachate Treatment – The 4 th International Conference on the Establishment of Cooperation Between Companies and Institutions in the Nordic Countries and the countries in the Baltic Sea Region | Professor William Hogland and his Team at University of Kalmar |
| 16-18 Jun, 2004 | The 5th Youth Environmental Forum ECOBALTICA ´2004, St. Petersburg, Russia | Vaslii Rud, International Director and William Hogland; State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, St. Petersburg, Russia. |
| 2-24 Sep, 2004 | International Conference "Strengthening Academic Cooperation in Environmental Issues in the Nordic and Baltic Sea Region, Uppsala, Sweden | St. Petersburg State University for Engineering and Economics (ENGECON) and Swedish University of Agricultural Sciences (SLU) |
| 6-10 Oct, 2004 | International PhD course Solid Waste Management in Nordic Countries and St. Petersburg. | Esa Marttila and Mika Horttanianen, Lappeenranta University in Finland, Vadim Chekalin, St. Petersburg State University of Engineering and Economics, Russia and William Hogland University of Kalmar |
| 4-5 Oct, 2005 | Seminar and Study Visit in Kalmar for the Young Scientist Delegation from St. Petersburg Polytechnic University, Russia | William Hogland for the Royal Swedish Academy of Engineering Sciences |
| 2002-2004 | The Baltic Sea Network for Leachate and Wastewater Treatment with emphasis on High-tech in Combination with Nature Based Systems | William Hogland , University of Kalmar and Felix Stolberg at the Kharkov State Academy of Municipal Economy, Ukraine |
| 2004-2007 | The Baltic Sea Region-Ukrainian Network on Bioremediation and Treatment of Leachate from Landfills with Emphasis on Persistent Organic Compounds | William Hogland , University of Kalmar and Felix Stolberg at the Kharkov State Academy of Municipal Economy, Ukraine |
| 2004 | Education cooperation on Master Course in Environmental Engineering with researchers/ teachers at the Danish Technical University in Danmark, Telemark College in Norway; University of Kalmar | Rune Bakke, Telemark University College in Norway |
| 28-30 Nov, 2005 | Kalmar Eco-tech´05 Waste to Energy, Bioremediation and Leachate Treatment,; The 2nd Baltic Symposium on Environmental Chemistry; the First Kalmar Nanotechnology Workshop | Professor William Hogland and his Team at University of Kalmar and The European Association for Chemical and Molecular Sciences, the Swedish Chemical Society and the Trans Regional Network NanoGrowth (together with Dr Bo Carlsson) |
| 26-28 Jun, | The 6th International Youth Environmental Forum | Vaslii Rud, International Director, William Hogland; State |

| | | |
|---|---|---|
| 2006 | of Baltic Region Countries ECOBALTICA 2006, St. Petersburg, Russia. | Committee on Higher Education of the Russian Federation, the City Adm. of St. Petersburg, St. Petersburg State Technical University, Russia |
| 28 Jun, 2006 | Establishment of the "Baltic Scientific Ecological Centre" | Professor William Hogland, University of Kalmar |
| 21-25 Aug, 2006 | SUSBUS project Workshop: European Project _ JEP-23100-2002 “Developing Sustainable Business Patterns in Ukraine” | Felix Stolberg Kharkov State Academy of Municipal Economy, Ukraine; Pekka Peura, Levon Institute, Finland, William Hogland and Marcia Marques, University of Kalmar |
| 26-28 Nov. 2007 | Kalmar Eo-tech 2007 The 6 th International Conference on Technologies for Waste and Wastewater Treatment, Energy from Waste, Remediation of Contaminated Sites, Emissions Related to Climate | Professor William Hogland and his Team at University of Kalmar |
| 26-28 June 2008 | The International Youth Science Environmental Forum ECOBALTICA 2008 | Michael Fiodorov, Vaslii Rud, International Director, William Hogland; St. Petersburg State Polytechnic University (SPbSPU), Ecology Laboratory of Baltic Sea Region, Russia |
| 2007-2009 | **JOCCOW** – joint capacity building concerning waste management, | Partners: the Municipality of Kalmar (Sweden), Kaliningrad City Hall, Municipal Institution Environmental Centre «ECAT-Kaliningrad», Kaliningrad State Technical University, Municipal enterprise «Chistota», University of Kalmar (Sweden), Association for Waste Management (Sweden) |
| 7 Oct. 2008 | Seminar within the JOCCOW Project, Kaliningrad, Russia. Speaker on “Perspective for improving the system of waste management”. | See above |
| 2010-2012 | Sustainable innovations and treatment in industrial wastewater clusters (STInno), 2010-2012, EU FPT- REGIONS 2009 | Regional Council of Kalmar county – Linnaeus University (Prof William Hogland with a consortium research also from Finland, Greece, Italy, UK) |
| 22-24 Nov. 2010 | Linnaeus ECO-TECH 2010 – The 7$^{th}$ International Conference on Natural Sciences and Technologies for Waste and Wastewater Treatment, Remediation, Emissions related to Climate, Environmental and Economic Effects. | Professor William Hogland and his Team at the Linnaeus University |
| Sept 29 – Oct 1, 2011 | The International Youth Science Environmental Forum ECOBALTICA 2011 | Michael Fiodorov, Vasiliy Rud, International Director, William Hogland; St. Petersburg State Polytechnic University (SPbSPU), Ecology Laboratory of Baltic Sea Region, Russia |
| 2011-2012 | NOVA-FoU project – “ Pre-study for Sediment Mining and Remediation in Oskarshamn Harbour” | Professor William Hogland and his team at the Linnaeus University. Partnership with the Municipality of Oskarshamn. |
| 2011-2013 | Strukturfonder - Regionförbundet –EU project – “ Platform for Triple Helix Cooperation on Industrial Water Handling in Småland Region and the Islands” based on the KK-Foundation project “ Integrated Approach for Industrial Wastewatr and Stormwater Management in Wood-Industry sector”. | Environmental Science and Engineering Group under supervision of Prof William Hogland in cooperation with the business sector consisting of 5 companies. The project has the cooperation also Kalmar Municipality and with Ann-Christin Bayard from Sustainable Southeast Sweden AB (network of 21 companies) that has been working as an intermediate between academia and the industries. |
| 2011-2013 | Sida – Project “The Triple Helix Concept applied in the Baltic Sea Region”. | Professor William Hogland with the Environmental Science and Engineering Group. The project aims to teach undergraduate students the Triple Helix concept in the Baltic region and to increase cooperation between countries, focusing on water treatment in wood industry |
| 2012-2015 | Swedish Institute – Project “ Closing the Life-cycle of Landfills – Landfill Mining in the Baltic Sea Region for Future” | Linnaeus University (SWE), Riga Technical University (Latvia), Estonian University of life Sciences (EST), University of Padova (Italy), St. Petersburg State Polytechical University (RUS), Waste Management Association of Latvia, Estonian Waste Management Association, RGS 90 (SWE), Saarema Landfill AB (Estonia), GLT Norway, Waste Management Association of |

| | | |
|---|---|---|
| | | Norway, LundaHydro AB (SWE), Avfall Norge (Norway). |
| 2012-2013 | VINNOVA – Project " Integrated Waste Management Technology for Effective Biogas Production". This project consists of cooperation between the academic sector and industries from Sweden and Brazil. | Linnaeus University (SWE), Rio de Janeiro Federal University (BRA), Rio de Janeiro State University (BRA), Essencis (BRA), Institute of Water Problems and Land Reclamation NAAN (UKR), SP Technical Research Institute of Sweden, Läckeby Water Group, JOAB, Wastec, Kalmar Sund Region Waste Management Company, Sustainable Sweden Southeast, Mindmancer AB, LundaHydro AB, Flexus Balasystem AB |

During these 15 years of Kalmar ECO-TECH, many influential persons have contributed to make the conference possible. I would like to acknowledge Prof. Vasiliy Rud, St. Petersburg State Polytechnical University that has cooperated organizing both Kalmar ECO-TECH in Kalmar and ECOBALTICA in St Petersburg. The idea behind Kalmar ECO-TECH was originally formulated together with Åke Erlandsson, Environmental Manager at AB Gustaf Kähr in Nybro and the first Conference in 1997 was possible thanks to Göran Borgö and Göran Johansson, both former head of the Department of Technology, University of Kalmar. The first conference also received valuable support from the former Mayor of Kalmar Anders Engström and, during the latest conferences, by his successor, Mayor Kjell Henriksson.
The Region Council in the county of Kalmar, represented by Håkan Brynielsson and his colleagues has also embraced the idea behind the Conference, as well as Jan Hagel, Omvärldskommunikation and the Kalmar County Governor Sven Lindgren and later Stefan Carlsson. During the years, Hans Dahl, Kalmar Vatten och Renhållning and Lars Kylefors, Vatten och Samhällsteknik as well as Ragn-Sells plus the Swedish Association for Waste Management have all worked actively to support the Conference. Bernth Norén at the XL-laboratory, University of Kalmar has been a big help with many good ideas to improve the content of the program.
Without the financial support of the following institutions, Linnaues ECO-TECH could not be possible: AB Gustaf Kähr, Brofästet Hotel & Conference, E.ON, Flexus Balasystem, IVA – The Royal Swedish Academy of Engineering Sciences, Kalmar Energi, Knowledge Foundation, KSRR, Linnaeus University, Länsstyrelsen Kalmar län, Ragn-Sells AB, Sida – Swedish International Development Cooperation Agency, STINT – The Swedish Foundation for International Cooperation in Research and Higher Education, Sustainable Sweden Southeast AB, Swedish Institute, The Regional Council in Kalmar County, Tillväxtverket – European Regional Development Fund, Vatten och Samhällsteknik, VINNOVA – The Swedish Governmental Agency for Innovation Systems and others.
In 2007 the memorable 10-year celebration, of what is now Linnaeus ECO-TECH, was held which was the same year as the University of Kalmar celebrated its 30$^{th}$ year Anniversary. Kalmar ECO-TECH' 07 was our humble tribute to it. In the same way Linnaeus Eco-tech 10, 22-24 November 2010 was our tribute to the establishment of the Linnaeus University the 1$^{st}$ January 2010 as a fusion between the University of Kalmar and Växjö University. The Linnaeus ECO-TECH 2012 is an opportunity to strengthen Linnaeus University by moving towards the established goals of internationalization of the Småland Region. In this conference the Triple Helix concept is highlighted but also urban mining, landfill mining, glassmining and harbor mining. On behalf of the Linnaeus University, I would like to thank all participants from different countries who during the years have contributed to this conference, by being active all

these years, with new research ideas and willingness to share experience and knowledge with colleagues.

This year many thanks goes to Joacim Rosenlund, administrative secretary of the conference, colleagues from LNU Malin Bolander and Anna Gustavsson and the Environmental Science and Engineering Research Group: Marcia Marques, Fabio Kaczala, Amit Bhatnagar, Eva Kumar, Henric Hansson, Henrik Svensson, Sawanya Laohaprapanon, Muhammad Assim, and in particular also the Local Programme Committee including among others Erik Ciardi, the Region Council in the County of Kalmar, Ann Christin Bayard from Sustainable Sweden South East, Kerstin Linsved, RagnSells and Lars Kylefors, Vatten och Samhällsteknik.

**William Hogland**
Professor in Environmental Engineering & Recycling (PhD)
The School of Natural Sciences
Linnaeus University

# PARTICIPANTS

| First name | Last name | Organization | Country |
|---|---|---|---|
| Eeva | Aarrevaara | Lahti Univ. of Applied Sciences | Finland |
| Lilliana | Abarca Guerrero | WASTE | Netherlands |
| Shereen N. | Abed | Birzeit University | Palestine |
| Aleksander | Alekseev | Saint-Petersburg State Forest Technical Univ. | Russia |
| Abolghasem | Alighardashi | Power & Water University of Technology | Iran |
| Stina | Alriksson | Linnaeus University | Sweden |
| Rashed | Al-Sa`ed | Birzeit University | Palestine |
| Mohammed | Alsultan | Kristianstad University | Sweden |
| Maduranga | Amaratunga | Telemark University College | Norway |
| Ghazaleh | Amini | Babol University of Technology | Iran |
| Ehsan | Amirabedin | Gazi University | Turkey |
| Andris | Andrusaitis | EU BONUS | Latvia |
| Wesam | Arafat | Birzeit University | Palestine |
| Kjell | Axelsson | Läckeby Water | Sweden |
| Bita | Ayati | Tarbiat Modares University | Iran |
| Rune | Bakke | Telemark University College | Norway |
| Ann-Christine | Bayard | Sustainable Sweden Southeast AB | Sweden |
| Hanna | Begler | STINT | Sweden |
| Daniel | Benatov | Benatov & Partners | Ukraine |
| Ruta | Bendere | Waste Management association of Latvia | Latvia |
| Maryna | Bereznytska | Environmental (Green) Investments Fund | Ukraine |
| Bjorn | Berg | GLT-Waste | Norway |
| Bo | Bergbäck | Linnaeus University | Sweden |
| Tobias | Berger | Linnaeus University | Sweden |
| Johnny | Bergman | RGS90 | Sweden |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Johnny | Berlic | Mindmancer | Sweden |
| Loris | Bernagaud | Kristianstad University | Sweden |
| Rami | Besaiso | University of Palestine | Palestine |
| Mykola | Bezuglyi | Taras Shevchenko National University of Kyiv | Ukraine |
| Amit | Bhatnagar | Linnaeus University | Sweden |
| Jan-Olof | Björklund | Marksanering Sydost AB | Sweden |
| Henrik | Blomberg | Tillväxtverket | Sweden |
| Nils | Boesen | UNDP | USA |
| Irene | Boman | Swedish Water Authorities | Sweden |
| Torleif | Bramryd | Lund University | Sweden |
| Gudrun | Bremle | ChemSec | Sweden |
| Håkan | Brynielsson | Regional Council in Kalmar County | Sweden |
| Dan | Brändström | Chairman of Linnaeus University Board | Sweden |
| Juris | Burlakovs | University of Latvia | Latvia |
| Ivan | Burtnik | Futurussia | Russia |
| Bo | Carlsson | Linnaeus University | Sweden |
| Stefan | Carlsson | Governor of Kalmar County | Sweden |
| Paul | Carroll | Lahti University of Applied Sciences | Finland |
| Fangfei | Cheng | Kristianstad University | Sweden |
| Anatoly | Chubinsky | Saint-Petersburg State Forest Technical Univ. | Russia |
| QIAOYU | CUI | Linnaeus University | Sweden |
| Barbara | Culos | Ragn-Sells Avfallsbehandling AB | Sweden |
| Maheshi | Danthurebandara | KULeuven | Belgium |
| Mirek | Darecki | Polish Academy of Sciences | Poland |
| Gintaras | Denafas | Kaunas University of Technology | Lithuania |
| Mark | Dopson | Linnaeus University | Sweden |
| Minjur | Dorji | Executive Secretary of Thimphu Thromde | Bhutan |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Tatjana | Dovbysheva | International Humanitarian Institute | Belarus |
| Jolanta | Dvarioniene | Kaunas University of Technology | Lithuania |
| A. | El Hari | University of Marrakech | Morocco |
| Pär | Elander | Elander Miljöteknik | Sweden |
| Roland | Engkvist | Linnaeus University | Sweden |
| Åke | Erlandsson | Kährs | Sweden |
| Christina | Esplund | Linnaeus University | Sweden |
| Jonas | Fack | Purac | Sweden |
| Ahmad | Fayaz-Bakhsh | Tehran University of Medical Sciences | Iran |
| Staffan | Filipsson | IVL Swedish Environmental Research Institute | Sweden |
| Jan | Fors | KSRR | Sweden |
| Morgan | Fröling | Mid Sweden University | Sweden |
| Marie-José | Gaillard | Linnaeus University | Sweden |
| Hossein | Ganjidoust | Tarbiat Modares University | Iran |
| Evgenia | Golosova | Saint Petersburg State Univ. of Eng. and Economics | Russia |
| Marcio | Goncalves Franco | Rio de Janeiro State University | Brazil |
| Anders | Gustafson | Ragn-Sells Avfallsbehandling AB | Sweden |
| Anna | Gustavsson | Linnaeus University | Sweden |
| Henrik | Haller | Mid Sweden University | Sweden |
| Sakari | Halmemies | Lahti University of Applied Sciences | Finland |
| Jan | Herrmann | Linnaeus University | Sweden |
| Helena | Hinrichsen | RGS90 | Sweden |
| Michael | Hoffmann | Inst. for Water Problems and Land Reclamation | Ukraine |
| Marika | Hogland | LundaHydro | Sweden |
| William | Hogland | Linnaeus University | Sweden |
| Linda | Holm | Sustainable Sweden Southeast AB | Sweden |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Christian | Hultén | Stena Recycling | Sweden |
| Asim | Ibrahim | Linnaeus University | Sweden |
| Dmitrii | Ivanov | Volga State University of Technology | Russia |
| Martins | Izuogu | Kristianstad University | Sweden |
| Janne | Jarstad | Telemark University College | Norway |
| Anders | Jonsson | Mid Sweden University | Sweden |
| Weine | Josefsson | SMHI | Sweden |
| Chen | Junjie | Kristianstad University | Sweden |
| Fabio | Kaczala | Linnaeus University | Sweden |
| Eduardas | Kamarevcevas | Kaunas University of Technology | Lithuania |
| Viktoriia | Kapustina | Lappeenranta University of Technology | Finland |
| Anna | Karlsson | Kalmar Energi | Sweden |
| Oleksandr | Khokhotva | National Technical University of Ukraine | Ukraine |
| Anders | Kihl | Ragn-Sells | Sweden |
| Johanna | Kilpi-Koski | Lahti SBP | Finland |
| Silja | Kostia | Lahti University of Applied Sciences | Finland |
| Mait | Kriipsalu | Estonian University of Life Sciences | Estonia |
| Eva | Kumar | Linnaeus University | Sweden |
| Lars | Kylefors | VOS | Sweden |
| Marcus | Laaksoharju | NOVA | Sweden |
| Jean | Lacoursière | Kristianstad University | Sweden |
| Sawanya | Laohaprapanon | Linnaeus University | Sweden |
| Elina | Lehmonen | Lahti SBP | Finland |
| Tharchin | Lhendup | Executive Secretary of Phuenstholing Thromde | Bhutan |
| Valdo | Liiv | Kudjape Landfill | Estonia |
| Elin | Lindkvist | Linnaeus University | Sweden |
| Alf | Lindmark | COWI | Sweden |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Kjell | Lindström | Kalmar County Music Org. | Sweden |
| André | Luis De Sá Salomao | Rio de Janeiro State University | Brazil |
| Anders | Lönnermark | SP Technical Research Institute of Sweden | Sweden |
| Sergio | Machado Corrêa | State University of Rio de Janeiro | Brazil |
| Claudio | Mahler | Federal University of Rio de Janeiro | Brazil |
| Nidal | Mahmoud | Birzeit University | Palestine |
| Essi | Malinen | Lahti University of Applied Sciences | Finland |
| Erik | Marnung | Primozone Production AB | Sweden |
| Laurent | Marquer | Linnaeus University | Sweden |
| Leonardo | Marques | University of Manchester | Brazil |
| Marcia | Marques | Linnaeus University | Sweden |
| Marcia | Marques | Linnaeus University | Brazil |
| Maria | Mikhaleva | Russian State Social University | Russia |
| Algirdas | Minikauskas | Kaunas University of Technology | Lithuania |
| Elmira | Mirbahaeddin | Allameh Tabatabaei University of Tehran | Iran |
| Astrid | Morel | Kristianstad University | Sweden |
| Valeriy | Mykhaylenko | Taras Shevchenko National University of Kyiv | Ukraine |
| Lennart | Mårtensson | Kristianstad University | Sweden |
| Irma | Mäkelä | Lahti University of Applied Sciences | Finland |
| Ghasem | Najafpour | Babol University of Technology | Iran |
| Antti | Niskanen | Lappeenranta University of Technology | Finland |
| Olof | Nordström | REVATEC | Sweden |
| Karin | Nygård Skalman | VINNOVA | Sweden |
| Anna | Näsström | Swedish Institute | Sweden |
| John | Ohlson | Linnaeus University | Sweden |
| Peter | Olsson | Joab | Sweden |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Martin | Owen | Oil Pollution Services Ltd. | Sweden |
| Göran | Palmqvist | Oil Pollution Services Ltd. | Sweden |
| Anne-Laure | Parcollet | Kristianstad University | Sweden |
| Mikk-Kaur | Pehme | Estonian University of Life Sciences | Estonia |
| Kshanthi | Perera | Telemark University College | Norway |
| Eva | Pérez Blanco | Linnaeus University | Sweden |
| Johan | Persson | Mayor of the City of Kalmar | Sweden |
| Christer | Persson | Kährs | Sweden |
| Jarone | Pinhassi | Linnaeus University | Sweden |
| Anton | Pogrebnoy | Saint Petersburg State Polytechnical University | Russia |
| Karla Heloise | Preussler | Federal University of Rio de Janeiro | Brazil |
| Mervi | Pulkkinen | Lahti University of Applied Sciences | Finland |
| Andris | Pumpurs | Meliorators-J, Ltd. | Latvia |
| Peter | Randerson | Cardiff University | United Kingdom |
| Helene | Rasmusson | Linnaeus University | Sweden |
| Annika | Rembe | Director General of Swedish Institute | Sweden |
| Kexi | Ren | Kristianstad University | Sweden |
| Mykyta | Riabchynskyi | Kharkiv National Municipal Academy | Ukraine |
| Elson | Rodrigues | ESSENCIS | Brazil |
| Martin | Romantschuk | University of Helsinki | Finland |
| Joacim | Rosenlund | Linnaeus University | Sweden |
| Vasilii | Rud | Saint Petersburg State Polytechnical University | Russia |
| Håkan | Rylander | Sysav | Sweden |
| Michael | Saccullo | Mid Sweden University | Sweden |
| Paula | Salomäki | Lahti Polytechnic | Finland |
| Forough | Samadi | University of Tehran | Iran |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Jacob D | Seconna | Cape Peninsula University of Technology | South Africa |
| Azeddine | Sedki | FSSM, Marrakech | Morocco |
| Tobias | Selin | PRV Swedish Patent and Registration Office | Sweden |
| Yulia | Serdiukova | Siberian Academy of Sciences | Russia |
| Liselott | Sjöholm | County Administrative Board | Sweden |
| Eva | Smith | Deputy Director General of Swedish EPA | Sweden |
| Hadi | Soroosh | Kristianstad University | Sweden |
| Norin | Sultana | Linnaeus University | Pakistan |
| Ola | Svahn | Kristianstad University | Sweden |
| Henric | Svensson | Linnaeus University | Sweden |
| Beata | Szymczucha | Polish Academy of Sciences | Poland |
| Marco | Tadeu Gomes Vianna | Rio de Janeiro State University | Brazil |
| Tetiana | Tairova | Kharkiv National Academy of Municipal Economy | Ukraine |
| Matteo | Tamburini | Cardiff University | United Kingdom |
| Inara | Teibe | University of Latvia | Latvia |
| Banna | Thioubou | Soroptimist Club | Sweden |
| Anna | Tjärvar | Sida | Sweden |
| Enriko | Tooding | Estonian University of Life Sciences | Sweden |
| Anna-Kari | Trondman | Linnaeus University | Sweden |
| Håkan | Tropp | Swedish Water House | Sweden |
| Bruce | Uhler | Kährs | Sweden |
| Yuriy | Vergeles | National Academy of Municipal Economy in Kharkiv | Ukraine |
| Mikael | Westin | Swedish Wood Protection | Sweden |
| Nayani K | Vidyarathna | Linnaeus University | Sweden |
| Carsten | Wieger | Södra cell | Sweden |
| Raine | Vihelmaa | Lahti University of Applied Sciences | Finland |

| First name | Last name | Organization | Country |
|---|---|---|---|
| Anna | Wilhelmsson | COWI AB | Sweden |
| Lena | Vought | Kristianstad University | Sweden |
| Sanita | Vukicevic | NSR | Sweden |
| Yuliya | Vystavna | National Academy of Municipal Economy in Kharkiv | Ukraine |
| George | Yerousis | Birzeit University | Palestine |
| Jian | Zhang | Kristianstad University | Sweden |
| Qi | Zhang | Kristianstad University | Sweden |
| Qing | Zhao | Kalmar Vatten | Sweden |
| Bengt | Åstrand | Formpress | Sweden |
| Anna-Stina | Örnerstig | Linnaeus University | Sweden |

# CONTENTS

# SPEAKERS AT THE OPENING CEREMONY (DAY 1)

| SPEAKERS | AFFILIATION | COUNTRY |
|---|---|---|
| **Bo Bergbäck** | Linnaeus University | Sweden |
| **Vasiliy Rud** | St. Petersburg State Polytechnical University | Russia |
| **Nils Boesen** | United Nations Development Programme | USA |
| **Håkan Brynielsson** | Regional Council in Kalmar County | Sweden |
| **Tharchin Lhendup** | Phuenstholing Thromde | Bhutan |
| **William Hogland** | Linnaeus University | Sweden |
| **Weine Josefsson** | Swedish Meteorological and Hydrological Institute (SMHI) | Sweden |
| **Andris Andrusaitis** | The Joint Baltic Sea Research and Development Programme (BONUS) | Latvia |
| **Karin Nygård Skalman** | VINNOVA- The Swedish Governmental Agency for Innovation Systems | Sweden |
| **Minjur Dorji** | Thimphu Thromde | Bhutan |
| **Anna Tjärvar** | The Swedish International Development Cooperation Agency (SIDA) | Sweden |
| **Henrik Blomberg** | Tillväxtverket | Sweden |
| **Anna Näsström** | Swedish Institute | Sweden |
| **Ann Häger** | Swedish Institute | Sweden |
| **Hanna Begler** | The Swedish Foundation for International Cooperation in Research and Higher Education (STINT) | Sweden |
| **Tobias Selin** | The Swedish Patent and Registration Office (PRV) | Sweden |
| **Marcus Laaksoharju** | NOVA-Research and Development | Sweden |

# SPEAKERS AT THE OPENING CEREMONY (DAY 2)

| SPEAKERS | AFFILIATION | COUNTRY |
|---|---|---|
| ***H.M. King Carl XVI Gustaf*** | | Sweden |
| **Dan Brändström** | Chairman of Linnaeus University Board | Sweden |
| **Stefan Carlsson** | Governor of Kalmar County | Sweden |
| **Johan Persson** | Mayor of the City of Kalmar | Sweden |
| **Minjur Dorji** | Thimphu Thromde | Bhutan |
| **Nils Boesen** | United Nations Development Programme | USA |
| **Eva Smith** | Swedish EPA | Sweden |
| **Annika Rembe** | Swedish Institute | Sweden |
| **William Hogland** | Linnaeus University | Sweden |

# KEYNOTE SPEAKERS

| SESSION | KEYNOTE SPEAKERS | AFFILIATION | COUNTRY |
|---|---|---|---|
| *Triple Helix, Education And Cooperation* | **Marcia Marques** | Rio de Janeiro State University-UERJ, Linnaeus University | Brazil, Sweden |
| | **Anders Kihl** | Ragn-Sells | Sweden |
| *Environmental Modelling And Measurement* | **Weine Josefsson** | Swedish Meteorological and Hydrological Institute (SMHI) | Sweden |
| *Remediation And Mining* | **Mark Dopson** | Linnaeus University | Sweden |
| | **Martin Romantschuk** | University of Helsinki | Finland |
| *Harbor Mining* | **Pär Elander** | Elander Miljöteknik | Sweden |
| | **Alf Lindmark** | COWI | Sweden |
| *Solid Waste Management* | **Håkan Rylander** | Sysav | Sweden |
| | **Jan Fors** | KSRR | Sweden |
| | **Christian Hultén** | Stena Recycling | Sweden |
| *Biological Treatment* | **Ghasem Najafpour** | Babol University of Technology | Iran |
| *Energy Aspects* | **Claudio Mahler** | Federal University of Rio de Janeiro | Brazil |
| | **Anna Karlsson** | Kalmar Energi | Sweden |
| | **Jonas Fack** | Purac | Sweden |
| *Wastewater Treatment* | **NN** | Läckeby Water | Sweden |
| | **Hossein Ganjidoust** | Tarbiat Modares University | Iran |
| *Waste And Water Management In Developing Countries* | **Håkan Tropp** | Swedish Water House | Sweden |
| | **Tharchin Lhendup** | Phuenstholing Thromde | Bhutan |
| *River Basins And Coasts* | **Irene Boman** | Swedish Water Authorities | Sweden |
| *Wastewater Treatment In Wood Industry* | **Åke Erlandsson** | Kährs | Sweden |
| | **Bruce Uhler** | Kährs | Sweden |
| | **Olof Nordström** | REVATEC | Sweden |

# TRIPLE HELIX, EDUCATION AND COOPERATION

# TODAY'S RECYCLING INTO CONSTRUCTION MATERIALS –THE CREATION OF TOMORROW'S REMEDIATION PROJECTS?

***Anders Kihl**
**Graham Aid**
*Ragn-Sells AB, Sweden*

**ABSTRACT**

Recycling of waste in to materials for construction has potential for huge savings of natural resources by replacing virgin materials used for production of aggregates. Within this article, barriers for increasing such recycling are discussed. If not done properly, recycling may not be sustainable for society due to the fact that the conception of what constitutes 'hazardous' changes over time. Recycling today may well be a costly remediation project tomorrow. Holding this risk in mind, new principles for defining sustainable recycling are proposed.

**KEYWORDS**

Recycling, Risk Assessment, Contamination, Remediation

**Keynote Speaker*

# ENVIRONMENTAL PRACTICE AND SOCIAL SCIENTIFIC RESEARCH IN A TRIPLE HELIX PLATFORM

***Joacim Rosenlund***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

**ABSTRACT**

The Environmental Science and Engineering Group at Linnaeus University have traditionally done research in a Triple Helix manner, working with the industry. In the Triple Helix platform project this collaboration takes a new level introducing goals for both entrepreneurship and networking. This means first of all expanding the current Triple Helix to extend beyond the current industries and companies involved to a new industry important for the region with the help of current knowledge, demonstration plant and students working with the companies. Linnaeus Eco-Tech have is part of this development as an important forum for the different sectors involved in a Triple Helix collaboration. Secondly the project includes an interdisciplinary study in the area between social science, natural science and engineering. Using methodology from action research gives an opportunity to both study and develop the Triple Helix platform to assess its current potential and issues to solve and improve these for the future Triple Helix collaboration. The potential of action research in addition to theories of Triple Helix and innovation systems have been evaluated, partly by a literature review, for use in further research and in a developed research plan.

**KEYWORDS**

Triple Helix, Environmental science, Collaboration, Industry, Action research, Social science.

# VOLGA STATE UNIVERSITY OF TECHNOLOGY - RUSSIA'S LEADING UNIVERSITY IN RATIONAL NATURE MANAGEMENT

***Dmitrii V. Ivanov***
*Volga State University of Technology, Republic of Mari El, Russia*

**ABSTRACT**

Volga State University of Technology was established in 1932. It's Russia's leading university in such areas as: predicting the use and protection of natural resources in order to prevent the negative effects, and methods of evaluation of the biological productivity of forest plantations using remote sensing data, the development of new energy-saving technologies and equipment for harvesting and processing of timber and non-timber forest resources; aerobic , anaerobic and vermitechnological organic waste, use only renewable resources, the creation of new technological installations for production and purification of biogas, the creation of modern technological solutions for greenhouses with autonomous energy supply based on local renewable energy, the creation of device-analytical systems for the study and modeling of membrane contactor and gas separation membrane-sorption processes in relation to the processes of organic waste and produce biogas fuel, new technologies of organic waste and non-fertilizer in green building, new technologies reclamation of disturbed areas, reforestation, creation of objects in areas of intensive logging and taken out of use of agricultural land under the Kyoto Protocol. The strategic development program of the University received funding of the Ministry of Education and Science of the Russian Federation. To improve the efficiency of research in 2001, the University established the Center for collective use "Ecology, biotechnology, and the processes of generating clean energy" with unique equipment, which is funded under the Federal Target Program "Research and development on priority directions of scientific-technological complex of Russia in 2007-2013 ". To concentrate educational resources for the training of skilled workers, vocational training specialists, specialists with higher education in the forestry sector at the university was established resource center of professional education, funded by the Federal Program of Education Development for 2011-2015. The main focus is on the development of innovation infrastructure in the University of the , favorable conditions for the development of small innovative companies. In 2011, the University has won the competition for funding under the decree of the Government of the Russian Federation № 219 "On state support of innovation infrastructure in the federal educational institutions of higher education." The university holds a lot of projects funded under the Federal Target Program "Scientific and scientific-pedagogical personnel of innovative Russia in 2009-2013", including a project to develop a high school student self-management.

**KEYWORDS**
Rational nature management, Biotechnology, Ecology, Energy saving technology, Forestry, Environmental engineering, Water management.

# STUDENT'S PROJECT COMPETITIONS AS AN IMPORTANT COMPONENT IN POLICY OF IMPLEMENTATION OF THE TRIPLE HELIX CONCEPT IN RUSSIA

***Anton V. Pogrebnoi***
***Vasiliy Yu. Rud***
***Maxim Pasholikov***
***Gennady Podolsky***
*St. Petersburg State Polytechnical University, St. Petersburg, RUSSIA*

## ABSTRACT

Saint-Petersburg's government in recent years implements many projects that work on the intersection of science, education and business in cooperation with the city administration. One of the projects implemented by youth in the SPbSPU was a competition of student projects, entitled "Laboratory of my dreams." At this competition student teams were able to show that the expert committee as they see a modern laboratory for teaching and research, which is fully equipped to perform complex and interesting problems.
The prize was an obtaining of financing for the purchase of equipment required for laboratory, which is purchased by sources of the Ministry of Education and Science by the Program of National Research University SPbSPU and by city's sources. Projects submitted to the competition were different, but all have been aimed at creating important laboratory facilities for educational, scientific problems with the possibility of business applications.
Noticeable part of the project was focused on solving environmental problems and environmental protection. One of the winners presented a project about the environment and improvement the efficiency of energy systems working with the processed products - "Efficiency research of the energy complex with direct using converter hydrogen (containing $CH_4$ 2 ÷ 7%) obtained from biogas of municipal solid waste (MSW) by methods of thermodynamics and electrochemical kinetics ". After the purchase of equipment, theoretical and experimental results will be the basis for radically new solutions and for the progress of perspective ways of producing fuel and electricity using energy-saving and energy-efficient technologies. All of these results may be very attractive to create new educational programs, international researches and innovative projects.

## KEYWORDS

Triple Helix, Competition, Business, Project, Energy-saving, Efficient, Science, Laboratory, Modernization, Administration, Government, Innovative business.

# "YOUTH INTELLECTUAL CLUB" IS A WAY TO REALIZE THE TRIPLE HELIX IDEA IN RUSSIA

***Maria N. Mikhaleva*[1]**
***Alexey I. Andreev*[2]**
[1]*Russian State Social University, Moscow*
[2]*M.V.L. Moscow State University, Faculty of Global Processes, Russia*

## ABSTRACT

The idea of a triple helix for Russia is very attractive, especially at this time, when the government wants to realize the "Knowledge" Economics. The "Knowledge" Economics is effective communication with proven scientific results and real business opportunities with the support of the municipalities and state laws. First, the State's efforts are aimed at young scientists for innovation and business. "Youth Intellectual Club" (YIC) was made to solve these problems. The objectives of the YIC put the active involvement of Fellows of the President of the Russian Federation with the participation of the President of the winners of the Russian Federation for young scientists and grant recipients of the President of the Russian Federation and members of other government programs, and the most promising representatives intellectual youth in the modernization of the Russian education system and economy through the creation of an effective peer-community, uniting the future intellectual elite of the Russian Federation for the development of science and industry of the country.
YIC forms the reserve for the development of science, education and innovation at all levels creates an extensive network structure across the country develops in contact with municipalities and businesses information environment for interaction and exchanging of information between intellectual youth, business and public authority, creates and maintain bank of best ideas and initiatives of students and young scientists for modernization and innovative development of Russia. That will help to create and promote an attractive image of a scholar and teacher in the youth environment. YIC also holds conferences, forums, seminars for the formation of students and youth leadership and management skills to work effectively in the knowledge economy. Currently, under the auspices of YIC successfully held two All-Russian competition of innovative projects and ideas of young scientists. Developing an educational program of the club (holding schools, seminars, webinars, constant discussion of youth projects) and proposing many innovative youth projects for businesses are going to be planned. The club is interested in new partners in various areas of science and business and in integration into the European environment. One of the directions of development may be creation of the Youth Intellectual Club of the Baltic countries under the auspices of country's leaders. This Club will work closer with students and young researchers. It will form the single control system of research and education programs. One of the major steps will be creation of international system of experts for scientific, educational and innovative activities for young people aimed at the problem formulated business communities of the Baltic region.

## KEYWORDS

"Knowledge" Economics, "Youth Intellectual Club" (YIC), Triple helix for Russia, Youth, Modernization, Innovative development, Education.

# COORDINATING COUNCIL FOR YOUTH IN SCIENCE AND EDUCATION UNDER THE RUSSIAN PRESIDENT'S COUNCIL FOR SCIENCE AND EDUCATION -BRING TOGETHER COMPANIES AND UNIVERSITIES FOR MODERNIZATION OF RUSSIA ECONOMICS

***Yulia Serdiukova***
***Alexey Andreev***
***Boris Korobets***
***Vasiliy Popov***
***Vasiliy Rud***
***Dmitry Ivanov***
*Siberian Academy of Sciences, Russia*

**ABSTRACT**

Coordinating Council for Youth in science and education under the Russian President's Council for Science and Education began its work in 2007. In 2011, the leadership of the country was given the task of creating youth innovation center (YIC) for large companies, which would attract young scientists from universities and research institutes and created them certain conditions for the implementation of their ideas and developments in practice. Company, which responded to the offer of the President of Russia, was "IDGC Holding» (http://www.holding-mrsk.ru/) JSC IDGC Holding. As a result, half past year a number of youth innovation centers were created. Such cooperation with the Coordination Council was born and practically embodied the very constructive idea of the first National Youth Competition intensive innovative ideas and projects titled "Future Energetics". This competition was attended by over 180 participants from more than 81 regions of Russia. Now our task is to invite all the leaders of the Russian economy. There already exists a preliminary agreement to hold similar competitions industrial grants to other major Russian companies. In the future, we want these competitions, but rather a system of working with young scientists, not only with universities and institutions, but also with some promising innovators and their teams have been stated in the program of innovation development of any company, not necessarily belong entirely to the state. And it's not so distant future, it may seem, but rather an imperative.

**KEYWORDS**

Coordinating Council, Youth, Youth innovation centers, SIC, Small businesses, Public corporations, Innovation, Triple Helix.

# INNOVATION STRATEGY OF SAINT-PETERSBURG POLYTECNIC UNIVERSITY BASIS ON THE MULTIDISCIPLINARY TEAMS WORKING IN THE FRAMEWORK OF THE "TRIPLE HELIX" PHILOSOPHY

***Alexey I. Borovkov***
***Andrey I. Rudskoy***
***Milena P. Melnikova***
***Vasiliy Yu. Rud***
*St. Petersburg State Polytechnical University, St. Petersburg, Russia*

**ABSTRACT**

Polytechnical University is a leading university in Russia and in the status of national research university. The University has more than 2 thousand experts in different scientific research areas, including 26 academicians and corresponding members Russian Academy of Sciences, more than 500 professors, doctors. Educational process is provided 147 departments. The new status demanded to work more intensive on the development of the university foresight structure, which works at the intersection of orders from the leadership of the country and region and also from real industry. The United Scientific and Technological Institute (USTI) was created specially to solve these objects. It consists of research teams working in priority areas of the university. These areas are researching of materials with special properties, nanotechnology, energy, resource and environmental technologies, information and communications technology, intelligent, research and multi-disciplinary high-tech computer technology. In fact, these platforms are not only for communication. These are the embodiment of the classic triad "Brainware - Software - Hardware", a meeting place of intellectual resources, technology and equipment to ensure the current level of research and development for each priority. We will have a convergence of various schools, creating of new curriculums to prepare students and retraining of engineers through new solutions of complex scientific and technical objectives of the real industry. Before most of all problems solved by many creative teams from different university departments in common were very certain. After time when USTI was created they started to do many complex projects for major engineering and fuel and energy industries, as well as transportation, information, communication and construction sectors. Among them, "Gazprom", "Rosenergoatom", "RusHydro", "Power Machines" RSC "Energia", "Severstal", "KAMAZ" and others. Besides them, one of the strategic partners include major Russian STU State Corporation "Russian Technologies" and "Rosatom", the Federal Grid Company Unified Energy System, a number of leading companies, academic institutions, and Of course, local and foreign universities. As a result we can see new knowledge and new products on the market, training of new professionals is based on this new knowledge.

**KEYWORDS**
St. Petersburg State Polytechnical University, Scientific research areas, Knowledge.

# WASTE MANAGEMENT AND ECONOMY

# ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS OF LANDFILLS

***Maheshi Danthurebandara*[1]**
***Steven Van Passel*[2]**
***Karel Van Acker*[1]**
*[1]KULeuven, Belgium*
*[2]Uhasselt, Belgium*

## ABSTRACT

A modern landfill is an engineered method for depositing waste in specially constructed and protected cells on the land surface or in excavations into the land surface. Despite the fact that an increasing amount of waste is reused, recycled or energetically valorized, a significant amount is still landfilled. The degradation of wastes in the landfill results in the production of leachate and gases. These emissions are potential threats to the quality of the environment. Landfill sites contribute 20% of the global anthropogenic methane emissions. Although landfill gas consists mainly of methane and carbon dioxide, it can contain a large number of other gases at low concentrations some of which are toxic. Leachate can migrate to groundwater or even to surface water through the damages of the liners and this results a serious problem as aquifers require extensive time periods for rehabilitation. Construction of landfills have the capacity to damage the ecology of the site causing landscape changes, loss of habitats and displacement of fauna. Apart from the environmental impacts, landfills are sources for several socio-economic impacts like public health issues due to exposure to landfill gas and to the groundwater contaminated by landfill leachate. Potential hazards such as flies, odor, smoke, noise and threat to water supplies are cited as reasons why the public do not want to reside close to the landfills. Various researchers conclude that landfills likely have an adverse negative impact upon housing values depending upon the actual distance from the landfill. The present paper reviews the potential environmental and socio-economic impacts of landfills and presents existing modeling approaches to assess the impact of landfills. Moreover, the time dependency of the emissions is also addressed. Furthermore, this review will be complemented with suggestions to minimize the potential risk and environmental burden of landfills and to re-introduce the buried resources to the material cycle.

## KEYWORDS

Landfill, Landfill gas, Leachate, Environmental impacts, Social impacts, Material cycle.

# ASH PRODUCTS AND THEIR ECONOMIC PROFITABILITY

***Helene Rasmusson***
***Sirkku Sarenbo***
***Tommy Claesson***
*School of Natural Sciences, Linnaeus University, Sweden*

**ABSTRACT**

Sustainable whole-tree harvesting practice requires that nutrient removal from the forest is compensated. Wood ashes contain all the nutrients, except for nitrogen, that are found in unburned fuel and can also increase soil pH, which makes ash recycling a natural way to stabilize the nutrient balance and counteract the acidification of forest soils that occurs due to intensive forest management. Several methods for processing ashes into spreadable products have been developed. The aim of this paper is to compare these methods. The study mainly focused on an economic evaluation of production, transportation and the spreading of self-hardened ash, ash pellets and ash granules. Self-hardened ash is generally considered to be the cheapest alternative to manufactured ash products, but these results imply that the most cost effective alternative is ash pellets. Around 27% of total costs could be earned from recycling the ash by producing pellets and 8% if granules are produced instead of self-hardened ash. This partly depends on the higher density of the pellets and granules and a significant reduction in the number of transportation operations. The reduction in transportation operations and diesel consumption also has major environmental benefits. Furthermore, it is more efficient to produce granules and pellets than it is to produce self-hardened ash and it is also easier to produce a reliable product of an appropriate size, shape and texture for a market that has well defined requirements.

**KEYWORDS**

Ash recycling, Ash products, Economic valuation.

# TOWARDS BETTER UNDERSTANDING OF SUSTAINABLE LIVING IN SPARSELY POPULATED AREAS – A CASE STUDY OF NORDERÖN ISLAND

***Michael Saccullo***
***Joakim Lanker***
***Morgan Fröling***
*Department of Engineering and Sustainable Development,*
*Mid Sweden University, Sweden*

## ABSTRACT

Much effort presently goes into research regarding 'sustainable cities'. This is reasonable in light of the rapidly increasing population in cities globally. Much less research is directed to understand how to achieve a more sustainable situation in rural areas, but a substantial number of the world population will live in sparsely populated areas also in future. This study contributes to the understanding of environmental impacts and sustainability issues in sparsely populated areas. The island of Norderön in Jämtland, Sweden, is used as a geographically well-defined case study object. Activities on the island has been screened and green house gas emissions from these activities been estimated using LCA methodology. Special interest was given transportation, since it is often argued that this is a significant sustainability issues in rural areas. It is concluded that to develop sparsely populated or rural areas in a more sustainable direction solutions adapted to each location are needed, and that solutions developed for cities will often not be applicable or efficient if directly transferred to sparsely populated areas.

## KEYWORDS

Rural areas, Screening life cycle assessment, Transportation, Green house gases.

# SEQUESTRATION OF ORGANIC MATTER IN MSW LANDFILLS – A PROCESS TO BALANCE ANTHROPOGENIC $CO_2$ EMISSIONS

***Torleif Bramryd***
***Michael Johansson***
*Department of Environmental Strategy, University of Lund, Sweden*

## ABSTRACT

The annual, global emissions of greenhouse gasses are estimated at about 49 billion tonnes of carbon dioxide equivalents. In Sweden domestic road transports account for the most pronounced share of emissions, approx. 34%, while only 3 percent come from the waste sector (uncontrolled landfilling, waste incineration, sewage treatment, a.s.o.). The annual accumulation of organic carbon in the World´s landfills has been estimated to be around 100 x $10^6$ metric tons of C. During landfilling most of the carbon in lignin (from paper or wood) and all organic carbon in fossil derived products, like plastics, synthetic rubber, synthetic textiles, a.s.o., will be brought back to long-term accumulation. If more than about 60 % of the produced landfill gas is collected, the sequestration of resistant organic matter in landfills has a net positive effect to counteract global warming. In a well-controlled bioreactor landfill around 90 % of produced biogas can be collected.
Today in Sweden, landfill gas is extracted from about 50 of the landfills in operation. This generated over 310 GWh of which 24 GWh in the form of electricity. This clean and non-polluting bio-fuel can substitute fossil fuels and thus counteracts emissions of fossil derived carbon dioxide. A landfill reactor cell, treating approximately 100 000 tons of waste per year, and where the fermentation residues are left in the landfill, a persistent organic fraction corresponding to about 45 000 tons of carbon dioxide remains long-term accumulated each year. This compensates for the annual carbon dioxide emissions from 15 000 cars, provided that each car runs 15 000 km per year with fossil fuel. With another comparison, the deposition of organic matter in a medium sized controlled landfill (100 000 tons per year) equals the total amount of carbon in approximately 65 hectares of grown-up spruce forest, or approximately 45 hectares of deciduous forest.
Energy forests within a landfill area, planted as receptors for leachates, also immobilize organic carbon in standing biomass, corresponding to about 10 metric tonnes /ha which can be stored in plant biomass or soil organic matter each time unit.
Reliable techniques to measure actual emissions of methane from landfills must be introduced and limits for uncontrolled emissions must be introduced instead of e.g. bans on landfilling of organic matter.

## KEYWORDS

Reactor landfill, Bioreactor cell, Biogas, Climate change, $CO_2$, Carbon sink, Carbon sequestrating, Leachate.

# ECONOMIC MODELING IN WASTE MANAGEMENT

***Jan Stenis*[1]**
***William Hogland*[2]**
[1]*LundaHydro AB, Sweden*
[2]*Linnaeus University, Kalmar, Sweden*

## ABSTRACT

Money is an efficient tool for steering of solid waste management. If there's just an economic incentive to have something made, it will take place. The versatile EUROPE model based on the equality principle invented by Jan Stenis is a so called economic instrument that facilitates necessary economic incentives for most kind of industrial and public actors to at the same time improve their profitability, their technology and the environment by employing so called shadow costs. Also, the EUROPE model is useful as a tool for monitoring the performance of the activity in question and for evaluation, meaning that management obtains a device for in quantitative terms measure the improvement of, for example, the resource-efficiency of companies. The equality principle has successfully been applied on, for example, mechanical work-shops, construction industry, pulp and paper, i.e. bulk industry and baling plants plus ore mining. Now, the authors work on applying the equality principle in the cosmic context in order to optimize the resource economy when the galaxy within reasonable time is to be exploited. The future of mankind lies in space and the EUROPE model is most useful for optimizing the industrial economy including the flow of future currencies in space and the global perspective. In doing so, this novel model promotes the long run sustainability of industrial and other human activities as regards optimization of the flows of material as well as energy. Thereby, the equality principle also promotes the harmony of society.

## KEYWORDS

The equality principle, The EUROPE model, Resource economy, Waste management.

# THE DEVELOPMENT OF SUSTAINABILITY ORIENTATION AS A STRATEGIC CAPABILITY BASED ON SUPPLY CHAIN MANAGEMENT

***Leonardo Marques***
*Manchester Business School, University of Manchester, UK*

## ABSTRACT

It took humanity 10,000 generations to reach 2 billion people, but only 1 single lifetime to grow from 2 to 5 billion people. The exponential needs of an increasing population that will reach 10 billion by 2050 before stabilizing impose a huge burden on the planet and question the traditional view of economic development. In this scenario, leading firms must rethink their approach to the subject and move beyond legislation compliance towards market differentiation. Companies will be ahead of competition by focusing on product redesign, life cycle management, social and eco-innovation. Moreover, the road to success will include joint initiatives with the supplier base in order to develop the strategic capabilities to ensure sustainability becomes embedded into products and business processes. While this trend becomes clearer in the horizon, we still miss a comprehensive framework to point out the pathway for this transformation.
Some questions lie before us. How does a firm develop such a capability? How to measure sustainability orientation, both at the level of the firm and its supply chain? How does this orientation impact the decision-making process? How to involve suppliers in such a process?
Within this context, a key trade-off contrasts supplier development and supplier selection: in order to achieve sustainability orientation should a leading firm invest on supplier development or identify suppliers which already possess sustainability-related capabilities?
Above all, this process must culminate in tangible benefits for the firm. How to leverage value from these initiatives? How to ensure a higher sustainability orientation leads to market differentiation?
By exploring sustainability-oriented initiatives undertaken by leading companies, this research will unveil the drivers and barriers to sustainability development, helping the firms to structure an assessment tool of sustainability orientation along its supply chain and a roadmap to drive sustainability as a source of competitive advantage.
This work has been financed by Scholarship BEX 1048-12-0, CAPES Foundation, Ministry of Education of Brazil, Brazil

## KEYWORDS

Sustainability, Supply chain, Strategic capabilities, Competitive advantage, Innovation.

# TECHNICAL AND ECONOMIC FEASIBILITY OF BIOSOLIDS-AMENDED CONCRETE BRICK PRODUCTION

***George Yerousis***
***Rashed Al-Sa'ed***
*Institute of Environmental and Water Studies, Birzeit University, Palestine*

## ABSTRACT

As stringent environmental control mandates are introduced and enforced, the traditional disposal routes of land application, land-filling, and incineration for processed biosolids will come under increasing pressure and may no longer be viable and cost-effective disposal outlets for sanitary engineers to capitalize on.
This research paper investigates the technical viability of incorporating dehydrated biosolids and sewage sludge ashes into concrete raw material mixtures to produce pre-cast bricks that can be utilized in general-purpose outdoor building of non-load bearing structures.
The approach was to experiment with the addition of various sludge quantities to concrete mixtures – (making use of both sun-dried biosolids and incinerated sewage sludge ashes) - and then to evaluate and analyze the corresponding physical properties of the concrete mix paste and of the produced concrete bricks – mainly those properties affecting structural integrity. Results showed that there is a general inverse relationship between the amount of dried sludge or ashes added and the compressive strength development of the cured blocks. However, the addition of as much as 10% of biosolids' ashes to the raw ingredients of a concrete mix did not affect the general physical properties of concrete (i.e. the workability of the concrete mix and the compressive strength, water absorption, and density of the cured bricks). On the other hand, the addition of an equal quantity of sun-dried biosolids decreased the compressive strength of the cured concrete by about 20% - which can be attributed to the presence of organic material in the dried biosolids. Moreover, results showed that there is no significant change in the relative strengths of the tested concrete blocks when sludge is used in small quantities (i.e. 10% ashes or a combination of 2.5% dried biosolids and 7.5% ashes) as sand replacements in the concrete mixture.

## KEYWORDS

Sewage sludge-amended bricks, Biosolids in concrete, Sewage sludge ash, Biosolids management.

# WETLANDS AND PHYTOREMEDIATION

# THE INFLUENCE OF EVAPOTRANSPIRATION ON WASTEWATER CONSTRUCTED WETLAND TREATMENT EFFICIENCY

***Peter Randerson*[1]**
***Antonio Albuquerque*[2]**
***Andrzej Białowiec*[3]**
[1]*School of Biosciences, Cardiff University, Cardiff, U.K.*
[2]*Department of Civil Engineering and Architecture, University of Beira Interior, Edificio 2 das Engenharias, Covilha, Portugal*
[3]*University of Warmia and Mazury in Olsztyn, Department of Environmental Biotechnology, Olsztyn, Poland*

## ABSTRACT

The presence of plants (reed, rush, cattail, willow, etc) in constructed wetlands (CW) for wastewater treatment brings several benefits, including enhanced removal of pollutants (N, P, heavy metals) from treated wastewater, creating micro-aerobic conditions and providing carbon compounds in the rhizosphere, hence supporting a diverse subsurface microbial community. Helophytes are also of great importance in evapotranspiration (ET), especially during hot periods, in both natural and constructed wetlands. ET increases the concentration of dissolved compounds due to decreasing water volume in a CW. This may result in zero-discharge from the system. Where ET is high, removal efficiency (calculated as the difference between influent and effluent concentrations) is lower than expected from mass balance (based on pollutant loadings). Case studies from Poland (lab scale) and Portugal (field scale) illustrate the influence of ET on volume reduction and on the calculation of pollutant removal efficiencies. Conclusions:

- Removal Efficiency (RE) values calculated from pollutant concentrations may be unreliable in conditions of high evapotranspiration (ET) due to water loss within the CW system
- ET can cause substantial reduction in volume of an effluent stream in a well vegetated CW, leading to reduced flow and increase in hydraulic retention time
- This may lead to problems estimating pollutant loads and removal rates in field systems
- Where ET is high (warm dry climate, high biomass), RE values based on concentrations may be greatly underestimated
- Inflow and outflow rates (hydraulic flux), should be measured so that pollutant loads can be used as the basis for calculating RE
- In warm dry climates where ET is high, can we increase the HLR of vegetated CWs?

## KEYWORDS

Constructed wetlands, Evapotranspiration, Treatment efficiency, Concentration, Load, Water balance.

# MODELING TREATMENT PERFORMANCE OF CONSTRUCTED WETLANDS RECEIVING MUNICIPAL WASTEWATER EFFLUENT IN TEMPERATE CLIMATES

***Yuri Vergeles***
***Felix Stolberg***
*Department of Urban Environmental Engineering & Management,*
*National Academy of Municipal Economy in Kharkiv, Ukraine*

## ABSTRACT

The basic Stritter-Phelps equation was applied to model decomposition of pollutants in constructed wetlands receiving domestic wastewater effluent in temperate climates. More than 360 laboratory measurements were done for BOD5 and COD, 350 - for suspended solids content, 230 - for ammonia nitrogen and ortophosphate contents in the wastewater at different treatment stages in experimental constructed wetland system (capacity of 40 $m^3$/d) and different seasons in 1998-2001 in Kharkiv region, Ukraine. Hydraulic residence time was calculated following the Dupuit's equation. Decomposition coefficients for each of the substances have been derived. Differences between decomposition coefficients derived at different scenarios were analyzed with use of Fisher's F-criterion and Student's t-criterion. The Principal Component Analysis of decomposition coefficients carried out for series obtained at vertical, horizontal flow and free-surface systems separately have shown that more than 95% of explained variance is attributed to joint influence of season and temperature. Differences in input concentration did not significantly influence decomposition coefficients. It should be noted that mean values of pollutant content at different units and the coefficients derived both data reorganized according to the calculated hydraulic residence time, i.e. true time series, and data taken without such sorting, i.e. 'pseudo'-time series, were not significantly different (t- and F-tests). Model has been validated with the use of data on treatment performance of similarly designed constructed wetlands in the Great Britain, Sweden, Denmark, and Estonia from published sources.

## KEYWORDS

Constructed wetlands, Modelling, Domestic wastewater effluent, Temperate climates.

# PHYTOREMEDIATION OF LANDFILL LEACHATE AND PEAT FILTER TREATMENT IN CONSTRUCTED WETLAND: AN INITIAL STUDY AT ØDEGÅRD LANDFILL, NORWAY

***Marika Hogland*[1]**
***Bjørn E. Berg*[2]**
***Jan Stenis*[1]**
[1]*LundaHydro AB, Sweden*
[2]*GLT-Avfall, Norway*

## ABSTRACT

It's universally known that landfills leaking emissions into surroundings have negative environmental impacts and in response to the EC Landfill Directive (1999/31/EC) and later the Waste Directive 2008/98/EC of 19th November 2008, many landfills sites have been forced to close down and many needs remediation. The landfill operator is responsible for the final coverage and after-care control of the site for a period of at least 30 years after the closure. In this case study, Ødegård landfill in Norway (associated member of EU), has received total 600 000 tons of solid waste from automobile shredder and contaminated soil during the period 1992-2009. The leachate is pumped from the collection tank up to a SBR Byggingenjörerna reactor plant for chemical and biological treatment. The residual sludge from the SBR plant is collected in the sludge pit and then returned to the landfill and the treated leachate discharged into the river Drogga. Most of the organic compounds in the raw leachate have concentrations over the emission limit before lead into the SBR treatment and in particular high of pesticides. To investigate the ability of peat to uptake pollutants from the leachate from Ødegård, column tests with ash mixed with peat as filter media were performed. Chemical analyses show a high metal concentration and the discharge of Cu, Ni, Cr and Zn reaching high level over emission limits for the recipient. The aim of the study is to compose purification and treatment steps for leachate in a natural based constructed wetland. The steps include:

- Sedimentation basin, straw filter, peat filter, irrigation area of *Salix* (energy crops),
- Wetland pond with plants for assimilation of contaminants, sand/stone filter,
- Aeration in a water wheel and meandering water into planted wetland pond,
  From the waterfall the leachate is lead into a sedimentation pond (excavation started summer 2012).

## KEYWORDS

Landfill, Leachate, Treatment, SBR, Phytoremediation, Artificial wetland.

# WHAT CAN SMALL ANIMALS TELL US ABOUT, AND BENEFIT FROM, INDUSTRIAL / URBAN DIRTY WETLANDS?

***Jan Herrmann***
*Linnaeus University, Freshwater Ecology Group, School of Natural Sciences, Kalmar, Sweden*

## ABSTRACT

Manmade wetlands and ponds are increasingly recognized being important for storm and effluent waters, both for lowering various pollutant levels and offering habitats for aquatic biodiversity. However, also the opposite perspective is worth considering; water organisms, like plants, but also bottom-living invertebrates can be valuable for the industry. Firstly, today much knowledge exists about how invertebrate community assemblages (species composition) can tell about the pollution situation, and thereby integrating the impact over time, mainly considering oxygen or pH conditions. Secondly, instead of using the standard bioassay organisms (e.g. daphnids and algae), often not occurring in the focused water bodies, it is recommended to use "indigenous" species, when either simultaneously monitoring e.g. water quality, or performing ecotoxicological assessments of acceptable loads to the recipient. Thirdly, in the suburban industrial landscape, often with much impervious surfaces, open water bodies are increasingly rare, so wetlands and ponds will facilitate the local biological diversity. Well-kept wetlands and ponds, even "the bad ones", might also be appreciated by employees and residents, and also contribute to a better image for the industry. These different values with water bodies, and their ecology, will be illustrated with good examples, and problems commented.

## KEYWORDS

Bottom-living invertebrates, Wetlands and ponds, Biological diversity, Ecology.

# NATURAL WETLANDS AS AN ALTERNATIVE TREATMENT OF LEACHATE FROM LANDFILLS

***Karla Heloise Preussler*[1]**
***Leila Teresinha Maranho*[2]**
***Claudio Fernando Mahler*[1]**
*[1]Geotecnical Laboratory, Federal University of Rio de Janeiro, Brazil*
*[2]Environmental Management Department, Positivo University, Brazil*

## ABSTRACT

The leachate generated in landfills is a major environmental problem due to its high pollutant load. If not treated effectively it can cause water and soil pollution. The treatments used by many landfills do not reach compliance levels due to the complex composition of leachate. Thus, it is important to develop new ways to treat leachate that are feasible within the technical and economic reality of sites. One of the alternatives is the use of natural wetlands. Within this context, the Caximba landfill in Curitiba, Paraná, Brazil, uses natural wetlands for the post-treatment of leachate. This study aimed to evaluate the effectiveness of this post-treatment after a period of one year. For this purpose, we surveyed the vegetative covert to identify plants in the wetlands and evaluated the efficiency of leachate treatment through analysis of BOD, COD, ammonium-N, total nitrogen, and phosphorus. After one year we found three species with greater presence: Eichhornia crassipes, Pistia stratiotes and Echinochloa polystachya. The results of the average efficiency of the post-treatment were 84% for BOD; 74% for COD, 86% of ammonium-N, 91% for total nitrogen, and 90% for phosphorus after one year of monitoring. The results show that this natural wetland can be effective in post-treatment of leachate. However, it is necessary to monitor the physical and chemical parameters and control plant growth on an ongoing basis.

## KEYWORDS

Leachate, Natural wetlands, Plants, Landfills.

# POTENTIAL OF CONSTRUCTED WETLANDS FOR FURTHER POLISHING OF PRE-TREATED WASTEWATERS

***Shereen N. Abed*[1]**
***Nidal Mahmoud*[1]**
***Saroj K. Sharma*[2]**
*[1]Institute of Environmental and Water Studies (IEWS), Birzeit University, Birzeit, the West Bank, Palestine*
*[2]UNESCO-IHE Institute for Water Education, Delft, The Netherlands*

## ABSTRACT

Treated wastewater effluent quality in Palestine is very stringent, that vary with the final disposal, (10,10,10) of BOD, TN and TSS values for discharge in wadi. This is the reason that makes treated effluent in need for further polishing to meet those stringent requirements. The Constructed Wetlands are promising technologies for further treatment of treated effluents, but the performance of these systems depend on the site characteristics, sources water quality and the process conditions applied. Three horizontal subsurface flow constructed wetlands were operated in parallel outdoor for almost seven months and fed with different water influents. Wastewater were collected from Al-Mazr'a anaerobically pre treated grey water, Al-Bireh tertiary treated effluent and Birzeit secondary treated effluent. After 98 days of starting operation the system, effluents were analyzed for DOC, BOD, COD, $NH_4$, $NO_3$, TKN, TDS, TSS, pH, EC and FC.

Average DOC removal of 31.8%, 34.4% and 30.8%, COD removal of 36, 27 and 35, BOD removal of 43.4, 18.7 and 47.2, Ammonia removal of 94, 87 and 96, Nitrate removal of 84, 92 and 90, TKN removal of 53, 35 and 50, phosphate removal of 51, 49 and 44, sulphate removal of 15.2, 15.5 and 18.8, TSS removal of 16.4, 21.9 and 23.3 were achieved by the constructed wetlands with Al-Mazr'a greywater, Al-Bireh tertiary treated wastewater and Birzeit secondary treated wastewater, respectively.

The constructed wetland was efficient in terms of $NH_4$-N, $NO_3$-N and BOD and achieved the Palestinian standards for using treated effluent for reuse and discharge to wadis. But, in terms of $PO_4$-P, TSS and fecal coliform the constructed wetland didn't achieve those standards In general, constructed wetlands technology has the capacity for removing organic matter and nutrients and to less instant pathogenic micro-organisms and TSS from the different source water.

## KEYWORDS

Constructed wetlands, Treated effluents, Organic matter, Nutrients.

# COMPARING PERFORMANCES BETWEEN TWO ORNAMENTAL PLANTS AND TWO COMMON MACROPHYTES OVER TWO YEARS IN TERTIARY TREATMENT CONSTRUCTED WETLANDS

***Matteo Tamburini*[1]**
***Gianumberto Caravello*[2]**
***Marco Carrer*[2]**
***Marco Bonato*[2]**
***Paolo Valerio*[3]**
***Peter Randerson*[1]**
*[1]School of Biosciences, Cardiff University, Cardiff, U.K.*
*[2]University of Padua, Italy*
*[3]Etra Spa, Italy*

## ABSTRACT

This study investigated the performance in two years (2010/11), of two horizontal sub-surface flow tertiary treatment beds, similar in size and fill medium. The first bed was planted with Phragmites australis and Scirpus sylvaticus. The other was unplanted as a control in the first year of study, but in the second year it was planted with two ornamental aquatic species: Canna indica and Iris pseudacorus. Wastewater from a municipal activated sludge plant (secondary treatment outflow), was pumped to each bed (0.14 $m^3/m^2/d$ in year 1; 0.7 $m^3/m^2/d$ in year 2). Removal rates for oxidized nitrogen and other chemical parameters, and microbiological parameters (e.g. Escherichia coli), were compared between beds, with respect to differences due to season, years and vegetation. In the first year of study, oxidized nitrogen (ox-N) concentrations in both planted and control bed effluents were significantly lower than influent. In the second year ox-N was again greatly reduced, especially during the summer. However, after planting ornamental plants in the former control bed, the difference in performance between the two beds disappeared. Effluent concentrations of all microbiological parameters were significantly reduced relative to influent, in both years for both beds. Relative to the unplanted control bed of year 1, the presence of aquatic plants (Canna indica and Iris pseudacorus) improved ox-N removal due to plant uptake and, most likely, also due to denitrification. The two ornamental species showed good removal performance, comparable to that of the more commonly used Phragmites and Scirpus. Comparing data between the two years indicated also that the reduced flow rate improved the performance of ox-N reduction, especially during the summer season. These results suggest that this type of tertiary treatment could be used to produce ornamental plants for market, without risk of microbial contamination or pollution of receiving waters.

## KEYWORDS
Tertiary treatment constructed wetlands, wastewater, ornamental plants, *Canna indica*, *Iris pseudacorus*, *Phragmites australis*, *Scirpus sylvaticus*.

# ENVIRONMENTAL MODELLING AND MEASUREMENT

# CLIMATE CHANGE – AN EXAMPLE

***Weine Josefsson***
*Swedish Meteorological and Hydrological Institute*

**ABSTRACT**

In the world of science the climate change issue has been a topic for a long time and nowadays the public awareness is high. It will likely be hard to reduce the anthropogenic influence to an insignificant level. Therefore, adaption is necessary. In order to adapt there is a need for more specialized and detailed information on climate change. This work has just begun.
Due to the complex and enormous amount of information available the presentation will focused on one example "the change in precipitation". It will also mention the challenge of how to communicate the uncertainty resulting from various scenarios and differences and shortcomings in the models used.
Extreme precipitation causes damages to our infrastructure every year. The negative effects may be caused by rainfall over several days or by heavy showers during a few hours. The most local and short-lived extreme events are still hard to model. But, on the occurrence of high daily values the models give valuable information.
By running a climate model over many years it is possible to compute return periods e.g. of extreme high daily precipitation. The example presented for "20-years-rain" shows a strong reduction of the return period and thus an increase of the extreme precipitation in northern Europe.

**KEYWORDS**

Climate Change, Precipitation, Extreme precipitation, Return period.

# FROM STATIONS TO GRIDDED DATA

***Weine Josefsson***
*Swedish Meteorological and Hydrological Institute*

**ABSTRACT**

Meteorological data are often needed as input in geophysical models and in technical models for the dimensioning of buildings, bridges and other types of infra-structure.
For many years the typical data set used has been observations recorded at a specific site, a meteorological station. In most cases these observation sites are not even close to the site of interest. Therefore, one has to consider the representativity of the used data. Should one use the most nearby site? Or is there another site with a more representative climate? Or should one use interpolation?
Now, there is an alternative. The so called gridded data set.
In a way, gridded data are created using interpolation of observations. But, it is done using information from meteorological models taking into account the laws of atmospheric physics. Briefly, some available gridded data sets are mentioned, and a new one underway is described in more detail.
The gridded data sets can be a useful complement to the data from observation sites, but they will not replace them. The observations will still be needed.

**KEYWORDS**

Meteorological data, Gridded data, Representativity.

**Keynote Speaker*

# EVALUATING CLIMATE-VEGETATION FEEDBACKS AT 6000 AND 250 YRS BP AT THE REGIONAL SPATIAL SCALE – A NEW DATA-MODEL COMPARISON SCHEME

***Marie-José Gaillard****
***Anna Broström***
***Ralph Fyfe***
***Jed Oliver Kaplan***
***Eric Kjellström***
***Ulla Kokfeldt***
***Florence Mazier***
***Anne Birgitte Nielsen***
***Anneli Poska***
***Mats Rundgren***
***Ben Smith***
***Gustav Strandberg***
***Shinya Sugita***
***Anna-Kari Trondman****
[*]*School of Pure and Applied Natural Sciences, Linnaeus University, Sweden*

**ABSTRACT**

Land surface-atmosphere feedbacks and their impacts on climate are a current priority in the climate modelling community, but reliable records of long-term land-use and land-cover change required for model evaluation are limited. The application of the REVEALS model for quantitative vegetation reconstruction using fossil pollen data makes robust comparisons with dynamic vegetation model outputs and anthropogenic land-cover (ALC) scenarios possible. The LANDCLIM project (sponsored by the Swedish [VR], the Nordic [NordForsk] Research Councils, and the Swedish strategic research area ModElling the Regional and Global Earth system, MERGE) aims at quantifying past human-induced changes in regional land-cover in NW Europe, and to evaluate the effects of these changes on the regional climate. REVEALS model estimates of the percentage cover of taxa and groups of taxa (plant functional types, PFTs) for selected time windows of the Holocene (e.g. 6000 and 250 cal. years BP) at a spatial resolution of ca. 1o x 1o and for the entire Holocene at 10 target sites are compared with the outputs (10 PFTs) of LPJ-GUESS, a widely-used dynamic vegetation model recently coupled to the regional climate model RCA3. The REVEALS estimates, the LPJ-GUESS outputs and the ALC scenarios of Kaplan et al. (2009) are used as 3 alternative land-covers to run RCA3 for the past. The outputs of the climate model are evaluated using a new synthesis of palaeoclimatic proxy records. LANDCLIM is a contribution to the IGBP-PAGES-Focus 4 PHAROS programme.

# A BUOY SYSTEM FOR REAL TIME MONITORING OF MARINE WATER QUALITY AND BIOLOGY

***Roland Engkvist***
*Swedish Institute for the Marine Environment and School of Natural Sciences, Linnaeus University, Sweden*

**ABSTRACT**

A VR (The Swedish Research Council) -grant has enabled the construction of four buoys for near real-time measuring of pelagic water quality and biology. Linnaeus, Gothenburg, Stockholm and Umeå universities will run one buoy each in cooperation with SMHI. The buoy nearest to Kalmar will be anchored outside the island Öland in the Baltic Sea at a position so far manually monitored for two years within the EU-program EcoChange. This time limited effort can now be expanded in both time and resolution.
When trying to trace cause and effect of marine abiotic and biologic factors on the marine system one have seldom had the opportunity to sample for example nutrient concentrations more than once a month. This time resolution is not sufficient to enable inferences on what shapes future scenarios of coastal areas. Coasts are subject to a number of factors that can cause rapid changes of the water column. Typical such factors are wind shifts, upwelling, weather- or tidal driven currents all in combination with a varied coastal morphology. The time scales for such events are rather hours or days than months. Ephemeral macroalgae, phytoplankton- and bacteria-communities react to changes in nutrient concentrations with a time lag of hours, so a monthly sampling is likely to miss the story.
The buoys will monitor several water quality variables and report the results via satellite and GSM to easily accessible databases enabling data to be shared by multiple users. A typical question that may find an answer with the buoys could be: Is it the farmers land runoff, municipal sewage water or the nutrients from upwelling or something else that causes macro- or micro- algal blooms in Baltic coastal waters?
The buoys with possible implications for near real-time monitoring of chemical and physical variables as well as biological entities like phytoplankton and bacteria will be discussed.

**KEYWORDS**

Automatic sampler, Time-series, Nutrients, Bacteria, Plankton, Upwelling, Currents, Climate, Smart buoy.

# BROADENING HORIZONS. THE FMECA-NETEP MODEL

***John Ohlson***
*Linnaeus University, Sweden*

## ABSTRACT

The permit application process for offshore wind farms (OWF) in Sweden conceivably requires a more comprehensive, transparent and quantitative complement within risk assessment. The NETEP framework (Navigation, Economics, Technology, Environment, Politics) has therefore been brought forward as a basis for the application of FMECA risk assessment methodology. FMECA (Failure Modes Effect and Criticality Analysis), particularly widespread within the aerospace and automobile industries, is a well-established, systematic method for the prediction of future failure in a product, part or process, to evaluate the consequences of the failure and to suggest possible measures to mitigate or eradicate the failure. Its use within attitude and acceptance, safety and environmental effect is however undocumented which creates the research gap for this study. Three Swedish OWF projects in the Baltic Sea area (Lillgrund, Taggen, Trolleboda) are evaluated using the proposed FMECA-NETEP method. Representatives (comprising the expert group) from government agencies and the wind energy industry are briefed on the structure and use of FMECA and then attempt to use it to measure risk within their respective NETEP sectors in the three case studies. After this stage the model is refined, and the expert group work in unison on the evaluation of an unplanned site. The level of utilization of FMECA across the NETEP sphere is thereby evaluated. The expected results of the study are a transparent, holistic risk model that can complement OWF permit applications and which;

- illustrates cumulative effects and enables comparison between alternative sites with a more quantitative methodology than that used at present, and
- enables comparative study of similar potential OWF locations i.e. partly enclosed sea areas in or close to Natura 2000 areas (e.g. within the Mediterranean Sea).

## KEYWORDS

Offshore wind farm, Risk, Location, FMECA.

# REMEDIATION AND MINING

# GROUNDWATER REMEDIATION IN CONTAMINATED BALTIC SEA COASTAL AREA NEAR VENTSPILS CITY

***Juris Burlakovs***
***Anete Karklina***
*University of Latvia, Latvia*

## ABSTRACT

Different solutions for groundwater treatment often are needed because of complicated hydrogeological conditions and manifold contaminants demanding distinct approaches for remediation. Various technologies of treatment can be used such as pump-and-treat, reactive barriers, chemical injections and other. A system is projected for treatment of different age and fraction oil product contamination in groundwater of the Baltic Sea coastal area north from Ventspils City.
Remediation should be performed after careful analysis of results of groundwater level and LNAPL fluctuations in the zone of direct influence of the open sea. Series of experiments using vacuum pumping system is performed in this case study in addition to the monitoring as one of the method for estimation of the close-to-sea hydrogeological conditions. Contaminated groundwater flow behaviour is under the strong influence of the sea, therefore common methodology by creating artificial groundwater surface depression by pump-and-treat can be questionable and not very effective. This study gives the opportunity to evaluate efficiency of vacuum pumping system for oil contamination treatment under the strong marine influence conditions.

## KEYWORDS

Groundwater contamination, Remediation, Vacuum pumping, Hydrogeology, Baltic Sea.

# HEAVY METAL POLLUTION OF SOIL AND A NEW APPROACH TO ITS REMEDIATION: RESEARCH EXPERIENCES IN ARID REGION IN MOROCCO

***A. El Hari***
***N. Lekouch***
***M. Chaik***
***S. El Fadeli***
***A Sedki***
*Laboratory of Eotoxicology, Faculty of Sciences,*
*University of Marrakech, Morocco*

**ABSTRACT**

With climate change and water scarcity remarkable for agricultural soils in the countries of North Africa, pollution with heavy metals represent a great danger for aquatic as well as terrestrial ecosystems. Indeed, they're persistent and non-biodegradable in the environment. When in excess, these metals may influence the soil's biochemical and physico-chemical characteristics, or disturb plants' physiology and contaminate alimentary chains. Therefore, a possible action for rehabilitation of contaminated sites would be an original approach: phytostabilisation. This technique, which is used in Europe but not yet in Morocco, consists of using plants in order to stop soil contaminant migration towards the aquifer. The objective of this study is to try to find vegetal species that are both adapted to the arid climate of Marrakech and capable of purifying the soil and the ground water. In addition, we have chosen to study waters and soils of two sites with different sources of contamination, both located in the surroundings of Marrakech, one representing the used water zone, namely the region of "El Azzouzia" and the other being the mining zone called "Draa Lasfar". On the other hand, thanks to germination and growing tests, we have tried to apply the phytostabilisation technique on different soils by selecting varieties, among 15 vegetal species, which can resist the presence of heavy metals the most, especially Cadmium, and accumulate heavy metals in order to play a purifying role. Our study results have shown that among these 15 vegetal species, only three show the highest growth and most important resistance to Cadmium. The three vegetal species in question are Corn, Wheat and Trigonella. The study has also been able to demonstrate that among these three species, Trigonella is the most hyper accumulative of Zinc and Cadmium. It could therefore be suggested to be a means of phytostabilisation on polluted soils of the city and surroundings of Marrakech, especially that Trigonella is a widespread species in Morocco and perfectly adapted to the climate of Marrakech. The addition of complexant of the soil like Humic acids and EDTA accelerates the phenomenon of absorption metals by this plant and consequently the purification of the soil. This is variable according to metals. Indeed, it is very remarkable for cadmium and copper but weaker for zinc and lead.

**KEYWORDS**
Heavy metals, phytostabilisation, Trigonella, Morocco.

# FULL SCALE IN-SITU REMEDIATION PROJECTS OF SOILS AND GROUNDWATER IN SMÅLAND

***Helena Hinrichsen***
***Kristin Forsberg***
***Jonny Bergman***
*RGS 90, Sweden*

## ABSTRACT

RGS 90 is currently undertaking three in –situ remediation projects in Småland. The techniques used include both physical, chemical and biological methods and the contaminants of issue consists of petroleum products as well as chlorinated solvents.
Värnamo Laundry Site. Contaminant of issue: Chlorinated solvents.
Remediation Techniques: Multiphase extraction, Stimulated Reductive dechlorination by injection of HRC products using direct push technique. Total treated volume: App. 6000 $m^3$.
Description: An old laundry site located just outside the city center of Värnamo has been known to be contaminated by chlorinated solvents for quite some time. The project is ongoing, and up to date results will be presented at the conference. Moheda military fuel storage area: Contaminant of issue: Aviation fuels Remediation techniques: Chemical oxidation by injection of RegenOx in areas of high TPH concentrations. Stimulated aerobic biodegradation by direct push injection of the oxygen release compound ORC Advanced. Treated Volume: App. 50 000 $m^3$. Description: In 1950s a large explosion took place at an army base located in Moheda. The explosion happened in a rock storage room holding approx. 14 000 000 liters of aviation fuel and the explosion led to flooding with petroleum products of large areas at a lower level than the rock store entrances. Immediate remediation was carried out at the time of the accident and though some of the fuel masses was collected or burned off on a nearby lake, millions of liter petroleum products were left in the ground. The project is ongoing, and up to date results will be presented at the conference. Kalmar - Active petrol station Contaminant of issue: Petrol. Remediation technique: Mutliphase extraction with catalytic oxidation of VOC, active carbon filtration of extracted water before discharge and finally stimulated biodegradation through hot air injection in areas with low VOC concentrations. Treated volume: App. 3000 $m^3$. Description: In a sewage dam app. 500 m down gradient of the petrol station it was identified a strong petroleum smell. It was through investigations of the sewage pipes identified to originate from the petrol station. It was estimated to be app. 25 $m^3$ petrol in the area. It was estimated to take app. two years to reach remediation target. After app. 18 month, when free product was mostly removed, a new leak occurred, and in one part of the area a lot of petrol was once again present in the wells. After the leak was fixed we had to start over with a new two year period to reach remediation target. The project is expected to be near completion by the time of the conference, and up to date results will be presented.

## KEYWORDS
In-situ remediation, Remediation of chlorinated solvents and petroleum hydrocarbons, Multiphase extraction, Regenox PetroCleanze, Stimulated reductive dechlorination.

# EFFECT OF THE EFFLUENT WASTEWATER QUALITY ON THE PERFORMANCE OF SOIL AQUIFER TREATMENT (SAT) SYSTEM IN AN ARID REGION

***Nidal Mahmoud***[1]
***Saroj K. Sharma***[2]
[1]*Institute of Environmental and Water Studies (IEWS), Birzeit University, Birzeit, the West Bank, Palestine*
[2]*UNESCO-IHE Institute for Water Education, PO Box 3015, Delft, 2601 DA, The Netherlands*

## ABSTRACT

Soil Aquifer Treatment (SAT) is one of the techniques by which wastewater effluent is naturally treated for non-potable or potable reuse. The overall goal of this research was to assess the potential of SAT to attenuate different source water quality, with emphasis on the fate of bulk organic matter (TOC, DOC), nutrients (N and P) and fecal coliform under oxic conditions. The experiments were conducted in two sets of soil columns operated in parallel with a 5 m height each, and filled with silica sand of 0.8-1.25 mm, and operated for 447 days. The "steady state" effluent DOC concentration was 4- 6 mg/L of all influent waters.
The noticeably low DOC concentration of the soil columns fed with grey water (GW) and secondary effluent (SE) despite the relatively high influent DOC concentration proves the robustness and effectiveness of SAT systems for removal of bulk organic matter. The fecal coliforms (FC) were substantially removed within around 1.5 m of column height. However, at 5 m depth along the soil column profile, the average values for FC were still high of 1.4E+04, 1.37E+05 and 6.33E+05 for Birzeit, Al-Bireh and Al Mazra'a waters, respectively. The results revealed that partial denitrification apparently occurred directly within the very top layer of the soil columns. Also, NH4, PO4 and FC were partially removed. The nitrate concentration at 5 m depth in the soil columns fed with the secondary treated effluent of Birzeit water was higher than 10 mg$NO_3$-N/l, which stresses the need for N removal in wastewater treatment plants. As a general rule, it can be concluded that SAT technology represents an attractive natural technology for removing bulk organic matter, partial N removal through, and pathogenic-micro organisms from different waters.

## KEYWORDS

Soil Aquifer Treatment (SAT), Wastewater effluent, Bulk organic matter, Nutrients, Fecal coliform, Oxic conditions, Soil columns.

# HARBOR MINING

# SEDIMENT MINING: A SUSTAINABLE STRATEGY FOR CONTAMINATED SEDIMENTS

***Homayoun Fathollahzadeh***
***Fabio Kaczala***
***Amit Bhatnagar***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

The main dilemma of contaminated sediments has been the proper management with reduced environmental footprints. Furthermore, by considering the fact that global warming and climate change may complicate the choice of management options, finding appropriate solutions become extremely critical. In the present work, mining of contaminated sediments to recover valuable constituents such as metals and nutrients is proposed as sustainable strategy, both through enhancing resilience of ecosystem and remediation. Contaminated sediments in the Oskarshamn harbor, southeast of Sweden were collected and analyzed through a modified sequential extraction in order to evaluate the feasibility of metals recovery. The results have shown that among different metals present in the sediments, Cu and Pb can be initially considered as economically feasible to recover. The shifting in the concept of dredging and further remediation of contaminated sediments towards sediment mining and recover of valuable metals can be considered in the near future as a sustainable strategy to tackle contaminated harbor/ports areas. However, it must be highlighted that short and long-term environmental impacts related to such activities should be addressed.

## KEYWORDS

Sediments mining, Sustainable, Valuable metals, Recovery, Speciation, Environmental footprint, Harbor.

# TRIBUTYLTIN (TBT) CONTAMINATED SEDIMENTS

***Amit Bhatnagar***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

Tributyltin (TBT) is an aggressive biocide that has been used in anti-fouling ship paints since 1970s. However, TBT leaches from the paint and enters into the marine environment. The tin-organic compounds can be adsorbed onto sediments; thereby separating TBT from the sediments is more problematic than the water. TBT accumulates in sediments, especially in areas with a high density of ship movements such as harbors and ports. TBT is one of the most common contaminants of dredged harbor sediments. Past shipyard practices have caused local contamination problems and there is concern for aquatic life. Possible biological effects of TBT as paint-derived material include endocrine disruption, e.g. imposex; shell thickening in Pacific oysters, benthic community change, acute mortality e.g. larval mussels and water quality problems. From 1 January 2003, the use of TBT in anti-fouling systems on ships was banned, following a decision taken by the International Maritime Organization (IMO) and Commission Directive 2002/62/EC of 9 July 2002 on organostannic compounds. However, there are still gaps in our knowledge when addressing the issue of environmental harm of TBT (in the form of waste paint material entrained in dockyard sediments), environmental impact (in terms of its fate and behavior) and options to remove/remediate TBT in sediments. The fate of TBT in sediments and in dredged material when disposed within environmental systems is unknown. In order to prevent desorption from sediments reintroducing TBT into the marine environment, effective removal and treatment methods for TBT contaminated sediments need to be implemented.

## KEYWORDS

Tributyltin (TBT), Sediments, Dredged harbor sediments, Environmental impact, Desorption.

# FLY ASH – A POTENTIAL BINDER COMPONENT FOR STABILIZATION AND SOLIDIFICATION OF DREDGED MATERIAL

***Anna Wilhelmsson***
*Cowi AB, Sweden*

## ABSTRACT

Over the next few years, more than one million m3 of contaminated sediments, with a muddy texture, high water ratio and low strength, shall be dredged annually in the development of ports and maintenance dredging of navigable waterways in Sweden. Dumping at sea is limited since the dredged materials are contaminated. Land disposal requires transports and land area and is thus high in costs. In the construction of new port areas, large volumes of crushed rock, etc. are normally used as construction filling materials. These materials can be replaced by stabilised and solidified dredged materials, with modified geotechnical properties. The method of stabilising / solidifying (s/s) contaminated dredged materials has been used internationally for a long period of time and in more recent years, even in the Nordic countries. In Sweden, for instance, the Port of Gävle and the Port of Oxelösund have received permissions to reuse s / s-treated contaminated dredged materials in the port structures. The Municipality of Oskarshamn have applied for permit and permission are expected in autumn 2012. The Municipality of Oskarshamn will receive funding from the Swedish Environmental Protection Agency for remediating the polluted sediments within the harbor basin. Reuse of the stabilized / solidified masses in a geotechnical structure is supported by the new Framework Directive (2008/98/EC) on waste where great emphasis is placed on recycling. Within some of the projects mentioned the potential of using fly ash as a complementary binder has been investigated. In the presentation some of the most interesting results will be presented.

## KEYWORD

Fly ash, Binder, Stabilization, solidification, Dredged material.

# FROM URBAN MINING TO HARBOR MINING

***Amit Bhatnagar***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

**ABSTRACT**

Urban mining includes the process of reclaiming compounds and elements from products, buildings and waste. During the last decades, urban areas sometimes have been considered as dumps or compared to landfill containing different materials of high value that can be reused after recycling. The electronic scrap has through the years been considered as a treasure appearing in the form of computers, cell phones, and other different electronic equipments. It is well known that electronic goods contain 40 to 50 times the amount of gold, silver and precious metals than ores mined from the deep ground. For a circular sustainable economy, material loops are closed by recycling of pre-consumer manufacturing scrap/residues, urban mining of End-of-Life products and landfill mining of historic (and future) urban waste streams. However, in the past decades landfill mining was not performed with a focus only on resource recovery but also making available new landfill volumes and land free for other use as for construction of new industrial areas or townships as well as for the protection of ground and surface water resources and environmental protection in general terms. The mentioned gap is now being addressed by introducing the concept of Enhanced Landfill Mining, defined as the safe conditioning, excavation and integrated valorization of landfilled waste streams as materials and energy, using innovative transformation technologies and respecting the most stringent social and ecological criteria. An increased interest has been given to glass mining and to transfer toxic glass masses to a useful product. Special focus is also being directed towards harbor mining and economical and environmentally friendly ways are being examined to remediate contaminated sediments and convert them to a valuable resource for the society. Remediation of metal loss and leakage should be achieved through the recovery of valuable resources in a sustainable and resource-efficient manner in order to return them to the loops. More information about the leaking systems is required and new innovative methods for returning already lost metals must be developed and implemented. There has not been any significant interest in investigating the possibilities of mining and recovering of valuable contaminants such as metals (Zn, Cu, Pb, Cd etc.) and nutrients (phosphorus and nitrogen). Therefore, it is necessary that contaminated sediments must be seen as a resource and more sustainable approaches for the remediation of harbor sediment must be developed. It has been estimated that about 45% of the waste could be recycled as Waste to Materials (WtM), either directly or after a controlled treatment process. Furthermore, in waste management policy, combining landfill practices with a Waste to Energy (WtE) approach is important. A decision tool to determine whether a recuperated fraction goes towards the WtM or the WtE process has been developed. WtM targets glass, ceramics, ferrous and non-ferrous metals, plastics, paper, wood, textiles, aggregate fractions and fines. A very limited amount of the waste, for which no valorization potential is yet identified, will have to be restored to a state-of-the-art landfill. This renewed storage will only be temporary, as it is envisaged that further development of recycling and energy technologies will enable the restored waste to be

valorized in the future. Collaboration with strategic knowledge partners and research institutes will assist in generating a major shift in both waste management technologies and national and European waste management visions, contributing to the transition from linear to circular economies. Industry has traditionally been blamed to be highly responsible creating environmental problems. LNU is now working on development of the Triple Helix concept to reduce above mentioned environmental threats and is inviting the industry as partner solving problems in cooperation and coproduction. This way of running the project is in direction of effective resource management rather than waste disposal. Existing leakages from the loops through the years has caused deterioration of harbors and sea by purpose, diffuse or point source discharge. The size of anthropogenic leakage to the environment as well as the price for environmental/health and socio- economic consequences is not known currently. This type of study is a first step to find best practice to reach and to achieve the result by putting less pressure on the environment and simultaneously recovering and recycling more material and substances in a sustainable and environmental friendly manner.

# LANDFILL MINING

# CLOSING THE LIFE CYCLE OF LANDFILLS - LANDFILL MINING IN THE BALTIC SEA REGION FOR FUTURE†

***Amit Bhatnagar*[1]**
***Fabio Kaczala*[1]**
***Mait Kriipsalu*[2]**
***Marika Hogland*[3]**
***William Hogland*[1]**
*[1]School of Natural Sciences, Linnaeus University, Sweden*
*[2]Estonian University of Life Sciences, Dept. of Water Management, Estonia*
*[3]LundaHydro AB, Sweden*

## ABSTRACT

Landfilling of municipal wastes has a great impact on environment. The main risks from landfills are water pollution from leachates and global greenhouse effect from methane emissions as well as effects on human health. Just in the Baltic Sea Region, there are about 75,000 to 100,000 closed or abandoned landfill/dump sites. Landfill excavation and land remediation are potential methods for treatment of waste from old landfills. Excavation of a landfill might be interesting in order to recover valuable materials from the landfill. One of the most valuable materials gained from landfill excavations is soil. This can be used for capping. A new project will start up disseminating knowledge related to safe and environmental friendly landfill mining approach, for the initiation of new landfill mining projects in the region and for EU-cooperation in this area of research. By transforming successful pilot and demonstration projects into full-scale actions, the proposed collaboration will cover the policy of **EUSBSRHA8**. Under **ENP-4**, the project is covering the requirement of partnership with other EU countries to address the issue of landfill mining in the BSR. The project also goes in under the theme of **HELCOM-BSAP1** i.e. working towards a Baltic Sea undisturbed by hazardous substances. Promotion of people-to-people links and enhancing dialogue with civil society is well covered under **EU-RPM5**. Furthermore, the 16 Swedish Environmental Objectives will be also addressed as follows: (1) Good-Quality Groundwater (2) A Non-Toxic environment (3) A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos (4) A Good Built Environment (5) Reduced Climate Impact. Through the proposed approach, solutions for the remediation/prevention of water and soil pollution and for land reclamation will be achieved. The initiation of new full scale projects will also be a milestone for this project as it would act as a building block for exhibiting the sustainability of the approach applied. Finally, as the project aims and objectives address the Swedish environmental objectives by working towards the sustainable development of the environment.

## KEYWORDS

Landfill mining, Leachates, Excavation, Soil and water pollution, Land reclamation.

*Note: This paper has also been presented at Gin2012, 22-24 October 2012, Sweden.*

# STARTING UP FULL SCALE LANDFILL MINING IN ESTONIA – LESSONS LEARNED

***Mait Kriipsalu*[1]**
***Mihkel Paljak*[2]**
***Vlado Liiv*[2]**
[1]*Institute of Forestry and Rural Engineering,*
*Estonian University of Life Sciences, Tartu, Estonia*
[2]*Saaremaa Prügila OÜ, Estonia*

## ABSTRACT

Landfills have been excavated throughout the world during the last fifty years for various purposes. The technology of landfill excavation involves excavation, transfer and processing of material, and backfilling of unwanted masses. Although landfill excavations are conducted using techniques similar to those used in open face mining, Landfill Mining (LFM) contains technical, environmental, economical, legal, safety and health issues, which may complicate excavations beyond feasibility limits. Some technical guidelines are available for performing LFM, and at least 39 peer reviewed papers are published in scientific journals during the period 1995–2008. In recent years, LFM has become a subject for active discussions, partly because of increasing built-up of alternative waste treatment capacities, e.g. incineration. The experience in starting up full scale LFM projects is still limited. The main shortage is lack of knowledge in economic benefits, and most important, legal and environmental warrants.
In this paper, the experiences in starting-up activities of 80 000 m3 LFM in Kudjape, Estonia, are described. The objectives of the particular LFM project were: a) production of cover material fit for use as methane-oxidation cover; b) recovery of ferrous metals; c) production of refuse-derived fuel (RDF); and d) removal of hazardous wastes. Inert reject materials were subject to backfilling. The LFM in general was performed as an integral phase of closure procedures, as every single incompliant landfill had to be closed for disposal by 17 July 2009, and capped by 17 July 2013 in Estonia. The LFM project was initiated in 2005, conducted through stringent and time-consuming procedures of designing, environmental impact assessment, selection of equipment, and legal tendering. In August 2012, the excavation works actually commenced.

## KEYWORDS

Landfill excavation, LFM, Capping, Methane-oxidation cover, Tendering, Environmental impact assessment.

# LANDFILL MINING IN LATVIA: STATUS, PROBLEMS AND CHALLENGES

***Elīna Dāce*[1]**
***Rūta Bendere*[2]**
[1]*Institute of Energy Systems and Environment, Riga Technical University, Latvia*
[2]*Waste Management Association of Latvia, Latvia*

## ABSTRACT

A lot of effort and scientific research has been done in the field of material and energy recovery from waste, offering source separation and recycling of waste, landfill gas extraction from landfill cells, composting of biodegradable waste etc. Nevertheless, depositing of waste in dumpsites and landfills has been and still is the most widely used waste management method throughout the world, including Latvia. In recent years a concept of a landfill as an endpoint of waste is slowly changing to a concept of landfill as a place for temporary storage of waste. According to Hogland et.al., there are up to 500 000 landfills and dumpsites in Europe, that contain valuable resources which can be recovered and used in production of new products.

In Latvia, since implementation of the Council Directive of April 26, 1999 on the landfill of waste more than 500 dumpsites have been closed and 11 new sanitary landfills have started operating. Largest part of the dumpsites are re-cultivated, however the rest are still waiting for re-cultivation projects. The process of project development is slow, therefore other solutions for minimization of impacts to surrounding environment have to be found. During the last twenty years practical examples of waste excavation from dumpsites and landfills have been carried out, showing that resource recovery from deposited waste can be a solution, especially in cases of high land value or scarcity of covering materials.

The aim of the paper is to assess the existing status of non-re-cultivated dumpsites to identify the problems and challenges potentially faced for conducting the mining projects in Latvia, as well as to show the existing practice on landfill mining in Latvia.

The results of the paper show that some of the most challenging problems are issues of the ownership of dumpsites, the unknown content of the waste deposited, the lack of appropriate treatment technologies for excavated waste, as well as the lack of legislative acts concerning landfill mining. The case of excavating Kekava landfill near Riga city is analyzed in the paper.

## KEYWORDS

Dumpsites, Excavation, Landfill mining, Latvia, Treatment.

# SOLID WASTE MANAGEMENT

# SEASONAL CHANGES OF MUNICIPAL WASTE GENERATION AND CONTENT: CASE STUDY FOR KAUNAS CITY, LITHUANIA

***Gintaras Denafas*[1]**
***Lina Vitkauskaitė*[1]**
***Dainius Matruzevičius*[1]**
***Andrius Kavaliauskas*[2]**
***Dalius Tumynas*[2]**
***Christian Ludwig*[3]**
[1]*Kaunas University of Technology, Lithuania*
[2]*JSC "Kauno švara", Lithuania*
[3]*École Polytechnique Fédérale De Lausanne, Paul Scherer Institute, Switzerland*

## ABSTRACT

The scientific objective of this study is to develope a methodology for the investigation of municipal solid waste (MSW) composition in Lithuania. Investigations have been performed in Kaunas, which is the second large city of Lithuania. The obtained results are a contribution to assess, evaluate, and predict possible development scenarios of the municipal waste management sector in east European countries. Possible scenarios consider improved separate collection systems in combination with landfilling, mechanical-biological treatment and/or incineration.
Further the results provide scientific knowledge which is necessary to understand waste generation and composition. This information is crutial to avoid future emissions to the environment resulting from current waste treatment practice. A further aim is to better understand the interplay of natural, social and economic factors influencing the quality and quantity of MSW in Eastern Europe. In this paper we present the preliminary results of consecutive MSW analysis at the waste collection and transfer station in Kaunas City over a period of two years.

## KEYWORDS

Municipal solid waste, Mixed waste, Separate collection, Waste content, Seasonal factors.

# WEB USABILITY EVALUATION TO PROMOTE PUBLIC RESPONSIBILITY FOR MUNICIPAL WASTE AND RESOURCE-EFFICIENCY

***Norin Sultana*[1]**
***Muhammad Asim Ibrahim*[2]**
***William Hogland*[2]**
[1]*School of Business and Economics, Linnaeus University, Kalmar, Sweden*
[2]*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

The main elements of any communication process are source, message and recipient. In order to promote public responsibility for municipal solid waste and resource efficiency, national municipal waste management (MWM) association being reputed and trustworthy source of information could play a central role to educate recipients (general public). The internet technology can be employed as an effective source for mentoring due to its; tremendous growth rate, popularity, cost effectiveness and flexibility to divulge information in multiple forms such as videos, blogs, pictures etc. In this study websites of 4 national MWM associations of Nordic countries were studied. These associations were member of Municipal Waste Europe (MWE), a non-profit organization with prime objective to promote public responsibility for resource efficiency.
The purpose of the study was to perform the real time scenario-based usability testing of the above mentioned website, especially for the Nordic countries in order to determine the ease with which people are able to find the information on these websites.
The features of National MWM association of Finland, to promote public responsibility, were found to be most promising compared to that of other Nordic MWM organization. The study has also highlighted promising examples of use of the internet technology employed by various MWM associations that others can follow to develop sustainable societies.

## KEYWORDS

Municipal Waste Management, Public awareness, Resource efficiency, Source separation, Web-usability.

# WASTE MANAGEMENT PROFESSIONAL TRAINING IN SOUTH AFRICA

***Jacob Daniel Seconna***
*Cape Peninsula University of Technology, Cape Town, South Africa*

## ABSTRACT

Five years ago on the University of Cape Town campus, I made a presentation to a group of experts in waste management and presented the very first thoughts of how a Diploma in Waste Management should look like. The presentation was very well received and I recorded everyone's positive and negative comments. The same programme was sent to Professor Linnington in the Department of Agriculture and Environmental Management at Unisa.
Their comments to me were outstanding. Their reply expressed their overall satisfaction with the content of the course, and that the programme had been well thought through. Today, 31st May 2012, I made a presentation to a banker, seeking financial support for this venture. In conclusion, he commented that he will support the programme, as it is a well thought through programme. In between these two significant and surprisingly similar comments, the thoughts had come and gone, time had moved on and my age had catch up with me. Suddenly, I realized that I am going to lose these heart-warming compliments, if this waste management programme is not going to be offer to students across the globe. We then, myself and a few enthusiastic young environmental scientists in 2007 started offering short courses in the CCE at the Cape Peninsula University of Technology, with the aim of building a cohort of persons interested in waste management as future students.
This well-established short course programme, and the call for further education and training in waste management from its graduates, inspired me to establish an institution called the Environmental Leadership Academy, in which the aims of having a waste management programme that speaks to the needs of the entire waste management community is addressed.
This Environmental Leadership programme will produce the leaders in waste management training and shall capacitate any institution who wishes to offer this training. Our staff is very well equipped to deliver quality training in waste management and our stakeholders and graduates will be proud to be associated with this institution and our International Partners.
The National Diploma in Integrated Waste Management will meet the needs of three distinct stakeholders, local and international students, the South African government and the international research community. It will firstly equip undergraduate students with the fundamental knowledge, skills and tools to design, implement and monitor integrated waste management practices. They will have insight into the local, national and international perspectives regarding waste management. The National Diploma in Integrated Waste Management will prepare them to deal strategically with the moral complexity of environmental decision making in a developing country such as South Africa.

## KEYWORDS

Waste management, Environment, Cape Peninsula University of Technology, South Africa.

# ENVIRONMENTAL COOPERATION OF UKRAINE WITH BALTIC COUNTRIES IN WASTE MANAGEMENT PROJECTS

***Valeriy Mykhaylenko*[1]**
***Michael Hoffmann*[2]**
***Denafas Gintaras*[3]**
***Ivan Alekseyevets*[4]**
***Christian Ludwig*[5]**
***Stanislav Ogorodnyk*[6]**
***Garry Martin*[7]**
[1]*Taras Shevchenko National University of Kyiv, Ukraine*
[2]*Institute of Water Problems and Land Reclamation NAAN, Ukraine*
[3]*Kaunas University of Technology, Lithuania*
[4]*"Clean City", National project under auspices of President of Ukraine,Ukraine*
[5]*Paul Scherrer Institute, Switzerland*
[6]*Kyiv University of Management and Entrepreneurship, Ukraine*
[7]*Association of Ukrainian Cities, Kyiv Regional Office, Ukraine*

## ABSTRACT

Ukraine is one of the largest countries in Europe that has numerous environmental problems due to backward technologies and strong influence of the former totalitarian system. The article seeks to consider the current status of Ukrainian environmental policy and disclosing the idea of "environmental cooperation" with Baltic countries in scope of MSWM. The strategic route of Ukraine towards sustainable society and joining the EU determined the relevance of MSWM as one of the most substantial environmental impacts. Foreign experts note a significant backlog of Ukrainian MSWM compared to EU standards. Engineering studies that are the basis for decision-making authorities are in a very early phase of development. Household landfills are a significant source of greenhouse gases. The authors are outlining benefits of environmental cooperation to Ukraine and BSR countries at both international and local levels. Examples of donor assistance that Ukraine already obtained from Poland, Lithuania, Denmark, Sweden, Finland and Norway are discussed. Unfortunately, collaboration with Western countries very much depends on the political will of Ukrainian authorities. To the date, Ukraine does not meet a sufficient progress in obtaining the status of an associate EU member in spite of the announced cooperation strategy. In view of this, environmental cooperation at the regional and local level seems to be a key issue for Ukraine on its way towards sustainability and developing principles of democracy and market economy. Strong relations with Baltic countries are creating a good basis for overcoming environmental problems at regional and community level and may form a first pilot model of ecological security.

## KEYWORDS

Environmental cooperation, Baltic countries, Solid waste management, Landfill, Sustainable development, Recycling, Technical assistance, Ukraine.

# ESTIMATION OF ENVIRONMENTAL IMPACTS FOR ALTERNATIVE GAS MANAGEMENT SYSTEMS AT CASE LANDFILL

***Antti Niskanen***
***Mika Horttanainen***
*Lappeenranta University of Technology,*
*LUT Energy, Environmental Engineering, Finland*

## ABSTRACT

Landfilling of MSW generates landfill gas (LFG) and can lead to several harmful environmental burdens. In modern engineered landfills the negative effects are mitigated through LFG management systems. In this study, the environmental impact potentials of a LFG management system are evaluated for a Finnish landfill site. The normalized environmental impact potentials are estimated by means of life cycle assessment (LCA) method for global warming (GW), stratospheric ozone depletion (SOD), photochemical ozone formation (POF), acidification (AC), and nutrient enrichment (NE) impact categories based on site-specific data. The environmental impact potentials are estimated for the current gas management, the gas management scenario without any gas control, and three gas management scenarios with enhanced management.
The evaluation results show that the highest magnitudes of normalized environmental impact potentials with current gas management system were observed for the GW impact category, due to fugitively released LFG. On the contrary, without any gas control, the magnitude of GW potential would be extremely higher compared to the current situation. The results illustrate that the environmental impact potentials, particularly the GW impact, can effectively be mitigated through the adequate gas management. According to the evaluation results, the gas collection rate is the major factor on the mitigation of environmental impacts due to LFG.

## KEYWORDS

Life-cycle assessment, Environmental impact, Landfill gas management, Landfill gas utilization.

# BIOLOGICAL TREATMENT

# EVALUATION AND CHARACTERIZATION OF BIOLOGICAL PROCESSES: AEROBIC VERSES ANAEROBIC PROCESSES

***Ghasem D. Najafpour*[1]***
***M.H. Sadeghpour[2]***
*[1] Biotechnology Research Center,*
*Babol Noshirvani University of Technology , Iran*
*[2]Department of Civil Engineering, Islamic Azad University, Qaemshahr Branch,*
*Qaemshahr, Iran*

## ABSTRACT

Aerobic and anaerobic processes are discussed. Aeration of wastewater may easily resulted in formation of floc; the fine suspended and colloidal mater of sewage forms aggregated and designated biosolids known as floccules. If floc is allowed to settle and then added to fresh sewage that is gained vigorous aeration, flocculation occurs in a shorter time than the usual process. This process is effectively used for treatment of wastewater known as activated sludge process. The process is known as suspended cells while attached growth such as RBC and NRBC were evaluated. Monod rate equation was applied in a 30 liters aerated and agitated vessel, to predict the biomass growth. The projected data for the kinetic model used to estimate the large scale aeration tank for efficient mass transfer. Several types of anaerobic process such upflow anaerobe and fluidized bed reactors are discussed. The organic load and methane productions are also discussed. In evaluation of Kinetic model COD and HRT were examined for the desired rate of COD removal. The kinetic parameters for anaerobic digestion and methane production rate were determined.

## KEYWORDS

Kinetic parameters, Activated sludge process, Sludge blanket, anaerobic process, Wastewater treatment.

** Keynote Speaker*

# BIOREACTOR CELLS AS WASTE PRETREATMENT METHOD – STARTING STATEMENTS, MAINTENANCE, FINAL RECOVERY AND LANDFILLING

***Ruta Bendere*[1]**
***Ruslans Smigins*[2]**
***Dace Arina*[3]**
[1]*Waste Management Association of Latvia, Latvia*
[2]*Institute of Physical Energetics, Latvia*
[3]*Latvia University of Agriculture, Latvia*

## ABSTRACT

Bioreactor landfilling, with the acceptance of landfill Directive in EC in 1999, loosed its actuality in EC, but this method can still be used for acceleration of bio-waste degradation and biogas production. Now large gas collection facilities are built and millions of EUR are invested for biogas treatment and production of electricity in the new constructed sanitary landfills in Baltic States. One of the perspectives for saving the investments is to realize the pretreatment of waste before landfilling, especially, in Baltic States, where acceptance of biowaste (content in municipal waste are more than 40-50%) was limited only starting year 2010. The idea of constructing and usage of the separate closed bio cells for providing the pretreatment of waste is not new, but practical realization of such bio cells are revealing a lot of problems, especially, selection of appropriate daily covering material.
The paper shows the investigations of the offers of the daily covering materials. Provided analyses of selected materials shows how the composition of covering materials effects on anaerobic bacteria and facilitated or limited the processes of anaerobic bio-waste decomposition and biogas production. Provided analyses of municipal waste in 4 largest sanitary landfills of Latvia shows that disposed waste consists of 6-8% paper/carton; 5-12% plastic; 50-52% organic; 2-3% wood; 2-9% textile, leather, rubber; 7-9% inert (stones, ceramic); 11-19% glass; 2-4% metal. The biodegradable part of it is 60-72%. The results of waste sorting lines installed in Valmiera and Broceni reflects that partly sorted material can be used for preparation of RDF or can be incinerated for energy production. The particles with small size are mainly biomass, glass and stones. Provided calculation of biogas gain shows that anaerobic digestion of the sorted household wastes must be supplemented by bio-waste from industrial or municipal branches. A previous researches show that such bio-activated degradation prolongs 5-7 years. The final stage of such cells includes sorting of material, recovering and landfilling of non-usable part. This procedure is equal to the landfill mining stage.

## KEYWORDS

Containers availability, Modeling, Natural resource tax, System dynamics, Waste sorting.

# EVALUATION OF VARIOUS CARBON AND NITROGEN SOURCES FOR LIPASE PRODUCTION IN TRAY-BIOREACTOR USING *RHIZOPUS ORYZAE*

***Zahra Vaseghi***
***Ghasem D. Najafpour***
***Samaneh Mohseni***
*Biotechnology Research Center,*
*Babol Noshirvani University of Technology , Iran*

## ABSTRACT

Lipases are well-known enzyme which are able to catalyze wide range of reactions including trans-estrification, thioestrification and aminolysis. These enzymes are produced through fermentation techniques including submerged fermentation (SmF) and solid state fermentation (SSF). Solid state fermentation is defined as fermentation process which occurs in absence of free flowing water; while in submerged process the fermentation is taken place in liquid media. In this research, solid state fermentation (SSF) was used for mass production of lipase in a tray bioreactor with automatic controlling of temperature and humidity using *Rhizopus oryzae* PTCC 5176. The influence of particle size of the solid substrate and its initial moisture content were investigated. It was found that the optimum conditions for lipase activity were identified with particle size in the range of 0.335-1mm and initial moisture content of 80% (v/w) for the top tray and 70% (v/w) for the middle tray. Maximum lipase activities under these circumstances were 99.77 and 121.07U/gds for the top tray and 99.57 and 99.37U/gds for the middle tray, respectively. In addition, the effect of various carbon and nitrogen sources was investigated for maximum lipase production. It was observed that in contrary to nitrogen sources, supplementation of bagasse with carbon sources did not result in enhancement in lipolytic activity. Among the nitrogen supplements tested urea led to maximal lipase production with an average of 253.55 and 205.16U/gds activities for the top and middle trays, respectively.

## KEYWORDS

Lipase, Enzyme activity, Nitrogen sources, Tray bioreactor, *Rhizopus oryzae*.

# ENERGY ASPECTS

# ASSESSMENT OF THE SELF-HEATING POTENTIAL OF WOOD PELLETS

***Ida Larsson***
***Anders Lönnermark***
***Per Blomqvist***
***Henry Persson***
***Michael Rahm***
*SP Technical Research Institute of Sweden, Fire Technology, Borås, Sweden*

## ABSTRACT

The use of biomass pellets is increasing. As a consequence, large indoor storage facilities are needed along the transportation chain. The increased production volumes, transportation, handling and storage of pellets result in increased risks. A number of fire incidents due to spontaneous ignition in wood pellets have been reported. Increased efforts concerning safety and quality assurance are, therefore, important. The aim of the present work is to provide methods for estimating risks for self-heating from pellets stored in bulk quantities. The experimental work ranges from small-scale characterizations to medium-scale storage tests and includes several different types of pellets. One aim has been to develop small scale screening methods to assess the propensity for self-heating, thereby trying to define the specific type of "activity" occurring in the pellets as well as characterising it.
Isothermal calorimetry (micro calorimeter) has been used as small scale screening test method and the results has then been validated with crossing point tests and in medium scale tests (1 $m^3$). Thirteen samples from different types of pellets have been ranked relative to each other in micro calorimeter tests and two pellet types; one "reactive" and one "less reactive" were also tested for validation in crossing point and medium scale. The results clearly reveal that different activity levels of the pellets can be measured using small scale screening methods.

## KEYWORDS

Pellets, Self-heating, Safety, Storage, Biomass characteristics, Micro calorimeter, Medium scale test.

# ASSESSMENT OF PRESENT WASTE OIL MANAGEMENT IN NORTHWEST RUSSIA AND IN COOPERATION WITH FINLAND

***Viktoriia Kapustina***
***Mika Horttanainen***
*Department of Energy Technology, Environmental Technology,*
*Lappeenranta University of Technology, Lappeenranta, Finland*

## ABSTRACT

This study examines the current situation of waste oil management practices in Russia and the environmental impacts from it. The review of present state of support mechanisms for waste oil management in EU counties is carried out in order to find out more appropriate mechanism to support waste oil management in Russia. The investigation of environmental benefits from the theoretical integration of waste oil management between the Northwest Russia and Hamina, Finland is presented.

The waste oil being a hazardous waste is subjected to the proper collection, treatment and in some cases disposal. The waste oil management has not comprehensive strategy in Russia. There is no subsidy for the waste oil collection or processing that would support the waste oil management. The waste oil collection in practice is poor organized.

Finland has good experience in waste oil collection practice and treatment as fuel for heat and power production. With new strict legislation in 2008 on waste there was a need for new treatment technology that would help to meet new environment regulations. And since 2009 year, there is new re-refinery plant in operation in Hamina, Finland.

The closeness of the plant to the Russia border gives the possibilities to improve waste management practice in Northwest Russia by first organizing waste oil transportation to the re-refinery plant. It will be possible by increasing interest of waste producers to improve quality of waste oil collected. Thus, it will improve the waste oil collection practices and environmental representatives of the waste oil management.

In this paper the results of studies related on investigation of the present practices of waste oil management and environment impacts associated with it in Northwest, Russia are presented. And also as one option for waste oil management improvement in Northwest, Russia in cooperation with Hamina, Finland is examined.

## KEYWORDS

Waste management, Waste oil, Northwest Russia.

# EFFECTS OF LIGHT INTENSITIES AND NITROGEN SOURCE ON *SCENEDESMUS SP.* MICROALGAE ISOLATED FROM CASPIAN SEA

***Ghazaleh Amini*[1]**
***Ghasem D. Najafpour*[1]**
***Ali Asghar Ghoreyshi*[1]**
***Reza Hejazian*[2]**
***Zeinab Hatami Takami*[2]**
[1] *Biotechnology Research Center,*
*Babol Noshirvani University of Technology , Iran*
[2]*Faculty of Foodstuff Technologies, Armenian State Agrarian University,*
*Yerevan, Armenia*

## ABSTRACT

This investigation examined the effect of light intensity and nitrogen content of medium on biomass concentration of Scenedesmus sp. microalgae which was isolated from Caspian Sea, Mazandaran province, Iran. Furthermore, fatty acid methyl esters of the microalgal oil were identified by gas chromatography method. Obtained data supported the selection of Scenedesmus sp. as a potential feedstock for biodiesel production. About 81.84% of the algal oil was occupied by main components of biodiesel which are known as C16:0, C18:1, C18:2 and C18:3. At the end of cultivation period, for the light intensity of 1000 lux, the biomass concentration in TMRL media contained 30, 50 and 70 g/l of $KNO_3$ was 0.8, 0.285 and 0.25 g/l, respectively. At desired illumination, the fact was revealed that the excessive amount of nitrogen source may waste the chemical and financial resources.

## KEYWORDS

*Scenedesmus sp.*, Microalgae, Biodiesel, Light intensity, TMRL media.

# COMPETITIVENESS OF HUMAN URINE FOR CULTIVATION OF MICROALGAE *SCENEDESMUS QUADRICAUDA* FOR BIODIESEL PRODUCTION

***Hadi Soroosh***
***Lena B. -M. Vought***
*Kristianstad University (HKR), Sweden*

## ABSTRACT

Biodiesel is one of the most promising forms of renewable energy because it is based on carbon sequestration through photosynthesis. Microalgae biodiesel is recognized as the most productive way to generate biodiesel through solving problems such as eutrophication, carbon emission and water shortages. Using nutrients in wastewaters for microalgae cultivation causes problems in terms of contamination of heavy metals, predation and grazing by other organisms, and competition with other undesired species existing in wastewaters.
Human urine (HU) constitutes the main proportion of nutrients available in municipal wastewater and can support microalgae growth, thereby overcoming the disadvantages of municipal wastewater. In this study, HU is used for semi-continuous cultivation of microalgae *Scenedesmus quadricauda* and the results are compared with the biomass yield obtained from an optimized chemical fertilizer (Bold formula). The chlorophyll-a generation was used as the index of biomass production in phototrophic conditions. The light intensity was 42 μmol photons $m^{-2}$ $s^{-1}$ lx (16h:8h photoperiods) and the temperature was in the range of 29±1°C. The amount of urine was adjusted to provide an equivalent concentration of phosphorus as available in Bold formula (530 μg $PO_4$-P $L^{-1}$). The biomass level after 3 days was about 2 times higher in Urine (with dry mass of 39.98 mg/L) compared to Bold series (22.95 mg dry mass/L). The total biomass achieved in urine series was consistently higher than what was attained in Bold solution throughout the entire experiment. Up to 96% of the phosphorous and 60% of the nitrogen was removed by microalgae. Conclusively, urine is determined as a proper sustainable source of nutrients for microalgae biomass growth for promoting biodiesel production.

## KEYWORDS

Microalgae Biodiesel, Biomass growth, Growth rate, Nutrients removal, Human urine, *Scenedesmus quadricauda*, Carbon fixation, Nutrients recycling.

# IMPORTANCE OF CLIMATIC AND ENVIRONMENTAL COST ON SUITABILITY OF POLYMERIC MATERIALS IN SOLAR THERMAL COLLECTORS

***Bo Carlsson*[1]**
***Helena Persson*[1]**
***Michaela Meir*[2]**
***John Rekstad*[3]**
[1]*School of Natural Sciences, Linnaeus University, Sweden*
[2]*Aventa AS, Oslo, Norway*
[3]*Department of Physics, University of Oslo, Oslo, Norway*

## ABSTRACT

To assess suitability of solar collector systems with polymeric materials versus those with more traditional materials such as metals a case study was undertaken within the framework of Task 39 of the IEA Solar Heating and Cooling Programme. In this study one solar heating system with polymeric solar collectors were compared with two equivalent but more traditional solar heating systems, one with flat plate collectors and one with evacuated tube solar collectors. In the comparison made, a total cost accounting approach was adopted. Life Cycle Assessment (LCA) results obtained in this analysis clearly indicated that the polymeric solar collector system is the most favourable as regards climatic and environmental performance. In terms of climatic and environmental costs per solar heat collected, the differences between the three kinds of collector systems, however, are small when compared with existing energy prices. With present tax rates on carbon dioxide emission it is seems not likely, that those differences will have any significant influence on the choice of which system is the most favourable. In the choice between a renewable heat source and a heat source based on the use of a fossil fuel, which was also analysed in the present study, the conclusion was that for climatic performance to be an important economic factor, the rate of carbon dioxide emission must be considerably increased above the level given by the present EU carbon dioxide emission trade rate. The rate would be at least of the same order of magnitude as the general carbon dioxide emission tax rate employed in Sweden. An alternative to an increase in the EU carbon dioxide emission trade rate would be to introduce a tax system based on environmental cost, making use of e.g. Ecoindicator99, to include also other impacts on the environment not just the greenhouse effect.

## KEYWORDS

Polymeric solar collectors, Total cost, Life cycle analysis, Climatic cost, Environmental cost, Viability.

# EMISSIONS AND IMPACTS OF BIOMASS COMBUSTION ON LOCAL AIR QUALITY: TRENDS IN POLLUTANT EMISSION ABATEMENT AND ASSESSMENT OF HUMAN EXPOSURE

***Dainius Martuzevicius***
***Gintaras Denafas***
***Linas Kliucininkas***
***Inga Stasiulaitiene***
*Department of Environmental Engineering,*
*Kaunas University of Technology, Lithuania*

## ABSTRACT

The integrated energy and climate change strategy of EU (2008) provided a prerequisite for increasing the use of renewable energy sources to 20 % of total energy consumption by 2020. Biomass is being recognized as one of the most important fuels of the future. The share of biomass has been increased considerably by evolvement of efficient end-use technologies, such as residential wood stoves and small-scale biomass boiler systems, along with its use in medium-scale heat and power systems. The benefits of biomass combustion include being a renewable resource and not disrupting carbon balance. At the same time, the energy is produced by combustion process, which involves many emissions-related issues. This paper aims to review the available scientific data on complex and toxic emissions forming in the biomass combustion process. The targeted pollutants include nanoparticles, polycyclic organic hydrocarbons (PAHs), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) and others. The available measures to control the emission of pollutants and to minimize the human exposure are discussed, including control of fuel quality, combustion process, and end-of pipe technologies.

## KEYWORDS

Energy production, Biomass combustion, Air pollution, Exposure, Pollution control.

# MICRO-AEROBIC REMOVAL OF $H_2S$ FROM BIOGAS

***Maduranga Amaratunga***
***Kshanthi Perera***
***Wathsala Perera***
***Deshai Botheju***
***Rune Bakke***
*Faculty of Technology, Telemark University College, Norway*

## ABSTRACT

Presence of hydrogen sulfide ($H_2S$) in biogas, even as a trace component in many cases, can seriously hinder the use of biogas as a combustion fuel due to the acidity and corrosivity of $H_2S$. In addition, $H_2S$ is a toxic and odorous gas even at low concentration levels. Most of the ex-situ physical and chemical methods which are being currently used to remove $H_2S$ from bio-gas are not economically sustainable at small to medium scale biogas generation. The use of micro-aeration (controlled and limited supply of oxygen) in anaerobic digestion (AD) is a recently developed technique that can be used to achieve in situ biological oxidation of $H_2S$. Sulfide oxidizing bacteria growing under micro-aerobic conditions can convert H2S into elemental S which can then be precipitated out of the reaction system.
Micro-aeration assisted AD was investigated together with relevant digester design considerations for in situ cleaning of biogas. The standard anaerobic digestion model (ADM 1) was modified to include sulphur chemistry and to simulate biological $H_2S$ generation and oxidation using AQUASIM as the simulation tool. Initial model simulations were used to analyze the effects of different feed and operating scenarios on biological $H_2S$ removal using membrane micro-aeration. Pilot plant data taken from a micro-aerated anaerobic digester were used to validate the model results. It is recognized that a precisely controlled oxygen supply is crucial for the success of this method as low aeration rates lead to inefficient sulfide oxidation and high aeration rates may distort the anaerobic operation. The study also reveals that temperature, inlet COD and inlet $SO_4^{2-}$ concentration are important parameters affecting both sulfate reduction and sulfide oxidation. The continuation of the study is expected to further enhance the understanding of this seemingly favorable in situ biogas cleaning technique.

## KEYWORDS

ADM 1, Biogas, Hydrogen sulfide, Micro-aeration, Simulation.

# SKOLKOVO – RUSSIA'S FIRST ECO-CITY

***Ivan S. Burtnik***
*Community of Innovators "Futurussia Skolkovo", Russia*

**ABSTRACT**

Community of Innovators "Futurussia" works with Skolkovo since its inception and we can better than anyone understand how ambitious and grandiose plans can be combined with environmental friendliness of the project.
Skolkovo city is a unique phenomenon not only for Russia, but for the world. It's completely new and high-tech settlement for innovative companies and their employees, which is built in an open field. Skolkovo is the first eco-city in Russia which is constructed according to LEED standards and Concept 4E combining ergonomics, eco-friendliness, economy and enjoyment. 400Ga of built-up area creates an opportunity for architects and builders to implement the boldest ideas, which will be used in other cities of the future.

**KEYWORDS**

Skolkovo, Futurussia, Innovation, Innovative buildings.

# PYROLYSIS AND COMBUSTION CHARACTERISTICS OF SOME OF THE FORESTRY AND AGRICULTURAL WASTES OF TURKEY

***Ehsan Amirabedin***
***Işıl Erkan***
***Hüseyin Topal***
[1]*Gazi University, Faculty of Engineering, Department of Mechanical Engineering, Maltepe, Ankara, TURKEY*

## ABSTRACT

There are many different conversion technologies for making use of forestry and agricultural waste as energy sources. Direct combustion and pyrolysis are two main thermochemical processes which can in the one hand reduce considerably the mass and the volume of the wastes and on the other hand generate significant amount of energy. Combustion is the easiest thermal treatment option for replacing the landfilling technology with energy conversion process. Pyrolysis is the thermochemical process that can convert the biomass waste into charcoal or liquid fuels in the absence of oxygen at mediate temperature. The purpose of this study is to determine the combustion and pyrolysis characteristics of 12 different types of forestry and agricultural waste of Turkey using a TGA Instruments SCINCO STA-N 1000 model thermogravimetric analyzer. TGA thermo-grams are obtained using oxygen and nitrogen (in case of pyrolysis just nitrogen) at flow rates of 45 mL/min, and the initial weight of the sample is around 10 mg for combustion analysis and 6 mg for pyrolysis analysis, a heating rate of 5°C/min being used.

## KEYWORDS

Pyrolysis, Combustion, Biomass, Agricultural Wastes, Forestry Wastes, TGA.

# TOPICAL ISSUES FOR DEVELOPMENT ENERGY EFFICIENCY OF RESIDENTIAL BUILDINGS IN RUSSIA

***Evgenia V. Golosova,***
*St. Petersburg State University of Engineering and Economics, Russia*

**ABSTRACT**

The article deals with main trends and problems in energy saving and directions to widespread deployment of energy efficient technologies in residential construction.

**KEYWORDS**

Efficient energy supply in urban Russia, barriers to implementing energy efficiency measures in housing, the problems of energy efficiency in the residential environment.

# WASTEWATER TREATMENT

# PARTIAL NITRIFICATION EVALUATION BY USING EXCESS BIOMASS ACCLIMATED IN SBR PARTIAL NITRIFICATION REACTOR

***Hossein Ganjidoust**
***Bita Ayati***
***Ali Dehnoei***
***Gity Emtiazi***
*Department of Civil and Environmental Engineering, Engineering Faculty, Tarbiat Modares University, Tehran, Iran*

## ABSTRACT

In this study, partial nitrification in a main stream reactor has been investigated in different conditions. Excess biomass for adjusting solids retention time (SRT) from a side stream Sequencing Batch Reactor (SBR) which was operated under optimum conditions for BNR via nitrite and biomass acclimation in partial nitrification phase.
After acclimation of biomass in a side stream partial nitrification SBR under optimum conditions (T = 30ºC, SRT = 9±1 days and HRT = 1.2 day) in order to superiority of ammonia oxidizing biomass over nitrite oxidizing biomass, excess sludge for solids retention time regulation was added to another batch reactor which had been performed under different conditions for partial nitrification evaluation.
By using Taguchi method under different conditions including initial ammonium concentration, MLVSS and time, the effects of abrupt temperature changing on partial nitrification and biomass activity which was acclimated in side-stream partial nitrification reactor have been studied.
The results showed that temperature was an important factor affected specific ammonium oxidation rate after cold shock by about 98.5%, but specific nitrite oxidation rate has affected by temperature, time, and initial ammonium concentration by about 71, 21 and 5 percent, respectively.
Results have also illustrated that temperature, time, initial ammonium and MLVSS concentration have affected $NO_2/NO_x$ ratio by about 50, 30, 15 and 3.5 percent respectively.
This study showed that use of excess acclimated biomass could be an effective way to partial nitrification in different conditions for short times.

## KEYWORDS

AOB cultivation, Biomass acclimation, Cold shock, Nitrite accumulation.

**Keynote Speaker*

# INORGANIC AND ORGANIC POLLUTANTS AS INDICATORS OF WASTEWATER INPUTS AND TREATMENT EFFICIENCY

***Yuliya Vystavna***
***Felix Stolberg***
***Yuri Vergeles***
*Department of Environmental Engineering and Management,*
*National Academy of Municipal Economy, Kharkiv, Ukraine*

## ABSTRACT

The research focuses on the monitoring of trace metals and pharmaceuticals as potential anthropogenic indicators of industrial and urban wastewater inputs in surface water and treatment efficiency. The following criteria were proposed for the evaluation of indicators: specificity (physical chemical properties), variability (spatial and temporal) and practicality (capacity of the sampling and analytical techniques). The combination of grab and passive water sampling (i.e. DGT and POCIS) procedure was applied for the determination of dissolved and labile trace metals (Ag, Cd, Cr, Cu, Ni, Pb and Zn) and pharmaceuticals (carbamazepine, diazepam, paracetamol, caffeine, diclofenac and ketoprofen). Samples were analysed using ICP – MS (trace metals) and LC-MS/MS ESI +/- (pharmaceuticals). Our results demonstrate the distinctive spatial and temporal patterns of trace elements distribution along an urban watercourse. Accordingly, two general groups of trace metals have been discriminated: 'stable' (Cd and Cr) and 'time-varying' (Cu, Zn, Ni and Pb). The relationship Cd >> Cu > Ag > Cr ≥ Zn was proposed as an anthropogenic signature of the industrial and urban inputs in the environment from point sources (municipal wastewaters) and the group Pb - Ni was discussed as a relevant fingerprint of the economic activity (industry and transport) mainly from non-point sources (run-off, atmospheric depositions, etc.). Pharmaceuticals with contrasting hydro-chemical properties of molecules (water solubility, bioaccumulation, persistence during wastewater treatment processes) were discriminated on conservative, labile and with combined properties in order to provide information on wastewater treatment plant efficiency, punctual events (e.g. accidents on sewage works, run-off) and uncontrolled discharges.

## KEYWORDS

Trace metals, Pharmaceuticals, Passive sampling, Indicators, Wastewaters.

# THE USE OF FLY ASHES AS A NON-CONVENTIONAL SORBENT FOR THE TREATMENT OF STORMWATER RUNOFF FROM A WOOD STORAGE AREA: CLOSING THE LOOP OF INDUSTRIAL WASTE

***Fabio Kaczala***
***Fadoua Aboubi***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

This current study was focused on investigating in a laboratory scale the feasibility of using wood-based fly ashes to remove pollutants from stormwater runoff generated in wood-storage areas. The studied method followed the main concept of closing the loop of industrial wastes by using a low-cost and environmental friendly waste from the wood industry (fly ash) to tackle diffuse pollution generated from wood-based fuel stockpiles. Removal efficiency was evaluated based on the following water quality parameters: chemical oxygen demand (COD), total organic carbon (TOC), phenols, and color. The use of fly ashes achieved average removal rates of 98.5%, 86%, 89.6%, 79.6% for color, COD, TOC and phenols respectively suggesting that the use of such low-cost material to close the loop of an wood-based industrial waste is very promising to tackle these types of water. The study over the influence of sorbent doses and contact time between aqueous phase and the sorbent has shown that optimum conditions were achieved by using 7g of wood fly ash for 300 ml of storm water with a contact time of 5 hours. To conclude it can be stated that the use of a by-product from wood industry to treat contaminated water from the same sector, following the concept of a closed-loop system, is promising and possible. However, further studies need to be conducted in order to evaluate such system in scaled-up conditions.

## KEYWORDS

Fly ashes, Stormwater runoff, Wood storage areas.

# GHG EMISSIONS FROM WASTEWATER HANDLING IN UKRAINE

***M. Bereznytska*[1]**
***P. Kucheruk*[2]**
***Yu. Matveev*[2]**
*[1]Climate Change Department, Environmental (Green) Investments Fund, Kyiv, Ukraine*
*[2]Institute of Engineering Thermophysics, National Academy of Sciences of Ukraine, SEC "Biomass", Kyiv, Ukraine*

## ABSTRACT

Ukraine, as a Party participated in Annex I to the UN Framework Convention on Climate Change (UNFCCC), has the obligation to develop, periodically update, publish and provide to the Conference of the Parties through the Secretariat, the national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases ("GHG") not controlled by the Montreal Protocol ("the national GHG inventory").
GHG emissions estimations from wastewater handling in Ukraine and description of approaches presented in this paper are based on Ukraine's national 2010 inventory officially submitted in April 2012.
Total GHG emissions from the waste sector amounted 11 004 Gg $CO_{2eqv}$ or 2.9 per cent of national total emission in 2010 (without LULUCF). In particular emissions from wastewater handling (6.B category in accordance to IPCC classification for NIR and CRF tables) amounted 3 562 Gg $CO_{2eqv}$ or 32 per cent of the waste sector. In 6.B category methane emissions decreased by 14 per cent and nitrous dioxide emissions decreased by 34 per cent from 1990 to 2010. This reduction happened mainly due to industry's collapse during the transition period to market economy. Another reason for negative emission trend is Ukrainian population drop.
Emissions sources of $CH_4$ and $N_20$ IPCC 6.B category including processes in Industrial and Domestic/Commercial wastewater treatment are described. Specific for Ukraine methods of emissions estimation, activity data and emissions factors are presented and justified.

## KEYWORD

Greenhouse gases (GHG), Methane, Nitrous dioxide, Emissions, Activity data, Wastewater treatment.

# FLOCCULATION WITH BRANCHED COPOLYMERS IN TERNARY COMPONENT SYSTEM: KAOLIN / POLYMER / $Cu^{2+}$ IONS

***Mykola Bezuglyi***
***Natalia Kutsevol***
***Tetiana Bezugla***
*Taras Shevchenko National University of Kyiv, Ukraine*

## ABSTRACT

Flocculation is one of the generally used techniques for industrial processes of mineral processing, wastewater clarification, sludge dewatering etc. In the last years many investigations are focused on replacing linear flocculants with branched polymers.
Branched polymers Dextran-graft-Polyacrylamide and Dextran-graft-Polyacrylamide/Polyacrylic acid copolymers were tested as flocculation aids in the model ternary component system: kaolin suspension / polymer / $Cu^{2+}$ metal ions in comparison with linear Poleacrylamide and linear Polyacrylamide/Polyacrylic acid.
Two series of branched copolymers with Dextran backbone (Mw=20 000 and Mw=70 000) and different number of Polyacrylamide (PAA) grafts were synthesized. Alkaline hydrolysis was used to obtain anionic derivatives of linear and branched samples. The copolymers were characterized using Size Exclusion Chromatography coupled with Light Scattering and Refractometry, potentiometric titration, IR- and 1H-NMR spectroscopy.
D-g-PAA copolymers and linear PAA of similar molecular weight in non-ionic and anionic forms were tested as flocculants using model kaolin polydisperse suspensions (c=3 g/dl) including systems with $Cu^{2+}$ ions as concomitant component. The kinetics of flocculation process was characterized by suspension sedimentation rate and degree of supernatant clarification as optical density (A540) of supernatant liquid after treatment with dose of the flocculants. Atomic absorption spectroscopy was used for estimation of amount of $Cu^{2+}$ ions in supernatant.
It was established by IR-spectrometry that these copolymers form stable coordination compounds with $Cu^{2+}$ ions (amide and carboxylic groups are donors of electrons).
It was shown that in ternary system kaolin/polymer/Cu2+ removing of metal ions by branched polyelectrolytes is 1.5-2 times better in comparison with linear one. The D-g-PAA in ionic form samples with the lower grafting efficiency, but with long PAA grafts ensured the highest degree of supernatant clarification and the highest rate of the suspension sedimentation. Removing of $Cu^{2+}$ ions is more effective in case of using branched polymers with higher grafting efficiency and short PAA-grafts.

## KEYWORDS

Water purification, Flocculation, Branched copolymers, Polymer/$Cu^{2+}$ complexes.

# COMPARISION OF DIFFERENT IMMOBILIZATION METHODS OF $TiO_2$ NANO PARTICLES ON CONCRETE SURFACE IN TREATING PHENOLIC WASTEWATER

***Mohammad Delnavaz*[1]**
***Bita Ayati*[1]**
***Hossein Gajidoust*[1]**
***Sohrab Sanjabi*[2]**
[1]*Tarbiat Modares University, Civil & Environmental Eng. Faculty, Environmental Eng. Div., Tehran, Iran*

## ABSTRACT

In this study, photo-catalytic efficiency of $TiO_2$ nano particles immobilized on concrete surface for treating phenolic wastewater was investigated. Four techniques containing slurry method (SM), cement mixed method (CMM) and two concrete sealers was applied to fix $TiO_2$ powder on concrete surface. Proper uniformity of coating process was showed by SEM. In the best operation condition, removal efficiency was obtained more than 90% after 4 hr retention time in UV Intensity of 450 $mW/m^2$. Long term use of process showed that increase in removal efficiency is different in any immobilization methods.

## KEYWORDS

Nano, $TiO_2$, Concrete, Photo-catalyst, Immobilization

# ENDOCRINE DISRUPTOR EFFECT OF 17αETHINYLESTRADIOL ON VITELLOGENESIS OF *OREOCHROMIS NILOTICUS*: MICRO-POLLUTANTS MONITORING IN WATER

***André Luís de Sá Salomão*[1]**
***Marcia Marques*[1,2]**
[1]*Rio de Janeiro State University-UERJ, Brazil*
[2]*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

Many chemicals, pharmaceuticals and hormones found in the environment in very low concentrations can interfere with physiological functions of hormones of different species. These micro-pollutants can mimic, antagonize or interfere with hormone's functions, binding to specific receptors, which explain why they are considered endocrine disruptors. Analytical methods such as chromatography can quantify these micro-pollutants in water. However, very seldom such method can be applied widely for monitoring purposes. The vitellogenin (VTG) is a protein synthesized only by fish females (adults) during vitellogenesis (yolk production, which is the food reserves of embryo). Abnormal increase of the content of VTG in immature or male's plasma indicates the presence of endocrine disruptors in the environment. Through the quantification of protein-bound phosphate groups (alkali-labile protein ALP), and due to the well-known good correlation between the ALP and VTG, it is possible to quantify the VTG indirectly by quantifying ALP. The present investigation aimed to quantify and validate a method based on indirect vitellogenin (VTG) measurement used to determine changes in VTG plasma content in immature tilapia (*Oreochromis niloticus*) exposed to different concentrations of the estrogenic hormone 17α ethinylestradiol. For that, a short-term effect investigation was carried out during 15 days in 6 different concentrations (50; 10; 2; 0,4; 0,08; 0,016 μg $L^{-1}$) of 17α-ethinylestradiol in 120 L aquariums. The hypothesis is that even at very low concentrations (ppt), variations in the VTG rates indicate the presence of endocrine disruptors in water. These effects are expected to be associated with the weight of the gonads (GSI) and liver (HSI) of the affected immature fishes. All tested concentrations caused a significant increase on the ALP levels in plasma of immature *O. niloticus* compared to the control. This fish is considered a highly sensitive organism for estrogenic induction and therefore, an excellent candidate as bioindicator monitoring of EDCs in water.

## KEYWORDS

Vitellogenin, Micro-pollutants, Estrogenic hormone, Pharmaceuticals, Endocrine disruptor, Fish.

# RESEARCH OF FILTER MEDIA INFLUENTS ON WATER QUALITY

***Ramunė Albrektienė***
***Mindaugas Rimeika***
***Anželika Jurkienė***
*Vilnius Gediminas Technical University, Lithuania*

**ABSTRACT**

Ground water is the main drinking water source in Lithuania. The main problem of the ground water is enlarged concentrations of iron, ammonium and manganese. Organic compounds have a big influence on the removal of these chemical elements. The coagulation process can be used to remove the organic compounds. While the removal of iron, ammonium and manganese is an easier process. Different kinds of filter medias are used for water filtration. This paper shows the result of the investigation on the removal of iron, ammonium, manganese and organic compounds by using filter medias like quartz sand, zeolite, "BIRM" and "NEVTRACO". After running a number of analyses with water containing enlarged concentrations of iron, manganese, ammonium and organic compounds it was observed that zeolite and "NEVTRACO" is the best for iron reduction. Manganese reduction is about the same rate in all filter medias; however "BIRM" is better at reducing manganese compared to the other filter medias. Investigation showed that zeolite increases manganese concentration but reduces ammonium better than all the rest of filter medias.

**KEYWORDS**

Ground water, Iron, Manganese, Ammonium, Filtration, Coagulation.

# UPSTREAM WORK OF INDUSTRIAL WASTEWATER FOR A BETTER QUALITY OF WATER AND SLUDGE

***Qing Zhao***
*Kalmar Water AB, Sweden*

## ABSTRACT

Kalmar Water Company produces drinking water and treats municipal wastewater for 56 000 inhabitants in Kalmar city. The wastewater treatment plant is located in the southwest part of the city, and the recipient for the treated wastewater is Kalmarsund in the Baltic Sea. Kalmar wastewater treatment plant produces also biogas from anaerobic digester and sells gas to Kalmar Biogas Company to upgrade it into vehicle gas. The digested and dewatered sludge is certified as recycled fertilizer according to REVAQ regulation and spread in the agricultural land in the south part of Sweden. REVAQ is a certification system for nutrient recycling of sewage sludge. This system is owned and administrated by the Swedish Water and Wastewater Association. The purpose is to recycle the nutrients from the sludge, especially phosphorous, as much as possible without introducing harmful substances into the environment. This method is considered to be one of the most suitable and economic ways to handle sewage sludge in Sweden so far. It requires a highly active upstream work for Kalmar Water Company to minimize harmful substances including toxic organic compounds and heavy metals coming into the wastewater treatment plant. Kalmar Water Company has been working actively with Kalmar municipality and different industries in the region for this purpose. It includes setting up clear guidelines for industrial wastewater discharge limits, giving instructions for industrial wastewater pre-treatment before discharging, setting up requirements for regional companies to improve chemical management in order to minimize PRIO substances discharged into the sewage pipelines. More examples will be shown during the presentation.

## KEYWORD

Industrial and municipal wastewater, Wastewater treatment, Sewage sludge, Nutrients, Phosphorus.

# ADSORPTION OF ORTHOPHOSPHATES IN WATER BY CARBONACEOUS MATERIAL OF BIOLOGICAL ORIGIN AS ADSORBENT

***Marco Tadeu Gomes Vianna*** [1]
***Marcia Marques*** [1,2]
[1] *Rio de Janeiro State University-UERJ, Brazil*
[2] *School of natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

The objective of this study was to evaluate the adsorption capacity calcareous skeleton of animal species (CSAS) in powder form compared to the commercial activated carbon (CAC) powder, as adsorbent for orthophosphates (P) removal from water. The experimental design selected was a factorial design with central composite rotational design (CCRD). In order to optimize the sorption process, a number of independent variables and levels were selected including: adsorption time; adsorbent/adsorbate ratio; pH and temperature. The orthophosphate (P) quantification was performed using the 4500-P E method. The P removal capacity with CAC powder varied from 0.15 to 4.86 mg/L. The maximum removal occurred at 1088 min, initial pH of 7.5, adsorbent/adsorbate ratio of 130, and temperature of 27 ºC. With the CSAS, the phosphorus removal varied from 0.70 to 6.11 mg/L. The maximum removal occurred at 735 min, with initial pH of 9.0, adsorbent/adsorbate ratio of 40 and temperature of 32 ºC. The conclusion is that the CSAS powder can become an interesting alternative as adsorbent material, both from economic and technical viewpoints in several applications, such as treatment of urban and industrial wastewaters and phosphorus removal/ retention to prevent eutrophication of recipient water bodies. Additionally, the final product (phosphorus-adsorbed CSAS powder) can be used as fertilizer and as soil pH adjustment.

## KEYWORDS

Adsorption, Phosphorus removal, Factorial design.

# LAB-SCALE COLUMN STUDY ON PHOSPHORUS REMOVAL FROM SYNTHETIC WASTEWATER BY FILTRALITE P AND IRON FILINGS

***Ala Kirjanova*[1]**
***Mindaugas Rimeika*[2]**
***Kristina Zopelytė*[3]**
[1,2]*Vilnius Gediminas Technical University, Lithuania*
[3]*UAB "Sweco", Lithuania*

## ABSTRACT

Column study was performed in order to compare phosphate phosphorus ($PO_4$-P) removal capacity of iron filings and *Filtralite P*. The experiment with two vertical downflow columns (0.05 in diameter and with 0.9 m medium height) feeding synthetic wastewater was carried out over a period of 66 days at wastewater temperature of 17.2–21.8 ºC. The study also aimed to determine the effect of submergence of the medium on *Filtralite P* $PO_4$-P removal potential. During the experiment the submerged *Filtralite P* sorbed almost double amount of $PO_4$-P (1581 mg $PO_4$-P/kg filter material or 662 mg $PO_4$-P/$m^3$ filter material) compared to the unsubmerged (881 mg $PO_4$-P/kg filter material or 369 mg $PO_4$-P/$m^3$ filter material). In both cases $PO_4$-P removal efficiency exceeded 90 % when pH in the effluent was higher than 9.5. Through the experimental period the iron filings removed 2249 mg $PO_4$-P/kg filter material. When evaluating the amount of removed $PO_4$-P per volume of filter material, the iron filings removed 2164 mg $PO_4$-P/$m^3$ filter material, i.e. 3.3 times more than the submerged *Filtralite P* did. In the case of iron filings the largest $PO_4$-P amount was removed in the top layer (0–30 cm) of the filter material. The amount of removed $PO_4$-P decreased and $PO_4$-P removal efficiency increased with depth of the medium: in the top layer (0–30 cm) $PO_4$-P removal efficiency was 27 %, whereas in the bottom layer (60–90 cm) it reached 44 %. The same tendency of $PO_4$-P removal efficiency was observed in the column with the submerged *Filtralite P*; however, the $PO_4$-P removal efficiency in all layers of this filter material was lower in comparison with the iron filings.

## KEYWORDS

Wastewater, Phosphorus removal, Column experiment, *Filtralite P*, Iron filings.

# WASTE AND WATER MANAGEMENT IN DEVELOPING COUNTRIES

# ENVIRONMENTAL PROBLEMS DUE TO CLIMATE CHANGES AND PRODUCTION CHANGES WHICH REQUIRE URGENT SOLUTIONS IN BURKINA FASO

***Eva Traore Dahlberg***
*Africa Link AB, Sweden*

## ABSTRACT

Burkina Faso is located in the so-called Sahel belt, south of Sahara. The country has 274 000 $km^2$, about 2/3 of area of Sweden and a population of 16.8 million people, of which 46% are younger than 15 years old. The climate is subtropical with a long dry season and a nearly 4-month long rainy season. In the south the climate is more humid and there is a dense savanna, but the major part of the country is covered by a so-called sparse savanna and in the very north is the desert.
85% of the people live on agriculture in most cases as subsisting farmers, however producing important export products for the country, such as cotton, sesame, chee nuts, meet and hides. Since only 39% of the arable land is under cultivation and only a very small proportion irrigated, here is a great potential. Unfortunately, climate change resulted in irregular rains at the beginning of the raining season which often shortened up the growing season and resulted in crop failure.
In recent years the mining industry had a greater impact in Burkina Faso. The country has 8 gold mines and produces about 33T Gold 2012, which suddenly makes Burkina Faso the third largest gold exporting country in Africa. Gold deposits provide substantial revenue to the country, but there are also many environmental and socioeconomic problems coming up.
In my speech I will point out the actual environmental problems, that climate changes and production changes have done, what is done, so far to solve these problems and hope that during this seminar find even better environmental technologies than what is currently used in Burkina Faso.

## KEYWORDS

Climate changes, Environmental problems, Burkina Faso, Mining industry.

# TURNING WASTE INTO A RESOURCE FOR REMEDIATION OF CONTAMINATED SOIL IN TROPICAL DEVELOPING COUNTRIES

***Henrik Haller***
***Anders Jonsson***
***Morgan Fröling***
*Department of Engineering and Sustainable Development,*
*Mid Sweden University, Sweden*

## ABSTRACT

Contaminated soil from industrial or agricultural activities poses a health threat to animals and humans and can also have a detrimental effect on economic systems by making land unsuitable for agriculture and other economic purposes. This problem is of particular concern in tropical developing countries where agriculture is the economic base. Traditional methods for soil remediation are often expensive and energy consuming. In-situ bioremediation has been proposed as a cheaper alternative to conventional methods in areas where remediation would otherwise not be implemented. Despite encouraging results in the laboratory, the practice of in-situ bioremediation is limited, partially due to its inefficiency at low temperatures. The objective of this study is to provide an inventory of some waste products that potentially can be used as amendments for in-situ bioremediation in developing countries in tropical climate. Emphasis has been given to map efficient methods that are appropriate to economically marginalized people in such countries. Waste from livestock operations, crop residues and processing waste constitute the major waste flows in many developing countries. A number of organic by-products can potentially be used to stimulate microbial activity for bioremediation purposes. Three amendments; whey, pyroligneous acid and compost teas were selected to be studied in detail due to their liquid nature and documented capacity to stimulate microorganisms with capacity to degrade pollutants. Experiments are needed to determine their potential for in-situ bioremediation in developing countries in tropical climate.

## KEYWORDS

Bioremediation, Organochlorine pesticides, Polycyclic aromatic hydrocarbons, Milk whey, Pyroligneous acid, Aerated compost teas.

# WASTE MANAGEMENT SYSTEMS IMPACT ON HEALTH AND ENVIRONMENT IN DEVELOPING COUNTRIES

***L. Abarca Guerrero*[1]**
***V. Rudin Valverde*[2]**
***Ger Maas*[1]**
[1]*Department Built Environment, PEBE Programme, Eindhoven University of Technology, the Netherlands*
[2]*Asociación Centroamericana para la Economía, la Salud y el Ambiente, Costa Rica*

## ABSTRACT

There is a large body of literature produced in developed countries on the potential adverse health effects of different waste management options but hardly studied in developing countries. On the contrary, the relations between economic issues and the impact of waste management systems on the environment have been studied by different scholars from developing countries. This paper aims to explain associations between some parameters that describe waste management systems at a city level and country parameters in relation to public health and environmental pollution in developing countries. This work reviews waste management systems from more than thirty urban areas in 22 developing countries in 4 continents It describes partly their waste management as answers to 122 questions that include information of public sources and general country characteristics. A combination of methods was used in order to assess the impact of waste management system on health and the environment. Collected data was analyzed using descriptive and inferential statistic methods in order to draw conclusions. The outcomes were unable to provide convincing evidence of an association of waste management and the impact on health. On the contrary, the results show that some of the waste management practices have a negative influence in the environment. The study didn't consider epidemiological evidences concerning public health, economy and pollution of the studied cities due to nonexistence or unreliable reliable information. Instead, data on country performance indicators for public health (perinatal mortality, adult mortality, life expectancy at birth and healthy life expectancy, an economic indicator (Gross Domestic Product/capita) and environmental indicators (ecological footprint / capita and $CO_2$-emission/capita were used. In addition, some other country characterization parameters were chosen (persons/km$^2$, % urban population).

## KEYWORDS

Waste management, Health, Developing countries, Economy, Environment, Pollution.

# THE SOROPTIMIST CLUB IN KALMAR GOES FOR WATER

***Banna Thioubou***
*The Soroptimist Club, Kalmar, Sweden*

**ABSTRACT**

Drinking water is still a big problem in many African countries. The Soroptimist club of Kalmar started therefore in 2008 to finance different water projects in Mali, in West Africa, in order to make water accessible for women who have to walk several kilometers a day in order to get some water. Thanks to the wells we have financed the women can now plant fruit trees and sell the products. The money goes to school fees for their children and to healthcare.

**KEYWORDS**

Drinking water, Water projects, Soroptimist club.

# RIVER BASINS AND COASTS

# MANAGEMENT OF RECREATIONAL ACTIVITIES OF SEA SHORES BY LIMITS OF ACCEPTABLE CHANGE (LAC) METHOD

***Forough Samadi*[1]**
***Afshin Danekar*[1]**
***Hosein Shabanali Fami*[2]**
*[1]Department of Environmental Sciences, Faculty of Natural Resources, College of Agriculture & Natural Resources, University of Tehran, Karaj, Iran*
*[2]Department of Agricultural Development & Management, Faculty of Agricultural Economics & Development, College of Agriculture & Natural Resources, University of Tehran, Karaj, Iran*

## ABSTRACT

The environmental condition of Mazandaran province in Iran has caused that tourism were being the growing activity in this province and Caspian sea shores is one of the activity center of that. There are a large number of tourists in summer in Mazandaran province especially in coastal resorts that are includes managed coastal recreational area. Nevertheless this kind of tourism being encountered with numerous problems, such as lack of a supervisor, shortage of managed coastal recreational area, lack of facilities, lack of paying enough attention to cultural issues, lack of enough supervision to plans that tourism management has trouble in mazandaran shores. In this study, 10 coastal resorts selected in the coast of province that contain 20 managed coastal recreational area from east to west. In this study was used LAC framework for determine the limits of acceptable change for ecological and social variables that are effective upon tourists satisfaction. Thus, 4 step of LAC process was used. In first step, problems and threats that resorts are encountered with them were being identified. In another step were determined the recreational opportunity spectrum of them. The effective indicators were selected and measured and standards determined. Indicators includes: the number of tourist, amount of wastes on beach, distance of natatorium to adjacent river estuary with coliform contamination. That there were correlations between tourist numbers indicators and amount of waste tourist satisfaction. Also there were correlations between distance of natatorium and coliforms contamination in natatorium.

## KEYWORDS

Caspian sea shores, Mazandaran province, Managed coastal recreational area, Coastal tourism, Iran.

# NEGATIVE EFFECT OF HUMAN ACTIVITIES ON SURFACE WATER AS A RESULT OF AGRICULTURAL REVOLUTION

***Tetiana Tairova***
*Kharkiv National Academy of Municipal Economy, Kharkiv, Ukraine*

**ABSTRACT**

It is widely known that the water quality has been changed dramatically due to facilitation of human lives. Besides, the quality of surface water at any point of the landscape reflects the combined of many natural and anthropogenic processes along the water recourses.
In particular, human activities affect the chemical quality and quantity of water bodies in different way depending topography, biology, climate etc. The paper has provoked discussion on land use and water resource impacts.
The question of connection between scientific knowledge and policy has been addressed in the paper.
The management approach "analysis of river bank" by means of geographic information systems (GIS) has been applied for assessment of the impact on natural systems and their structures functioning. Implementation of the proposed mechanism of water protection zones design for small rivers in the current environmental legislation has been suggested.

**KEYWORDS**

Water protection zone, Water erosion, Geoinformation system (GIS), Deposition, Runoff.

# STUDY OF ENVIRONMENTAL STEPS TAKEN IN MANAGEMENT SYSTEMS OF TEHRAN & THE WORLD'S SELECTED METROPOLISES

***A. Fayaz-Bakhsh*[1]**
***S.E. Mirbahaeddin*[2]**
***Sh. Mafi Moradi*[3]**
[1]*School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
[2]*Allameh Tabatabaei University of Tehran, Iran*
[3]*Management School of Tehran University, Iran*

## ABSTRACT

Logical and evidence-based management of the environment is a key requirement for maintaining and improving the health of residents in every town. If measures to improve the environmental health in cities do not have a defined management and organizing to achieve specific strategic goals, like other areas, it causes erosion in resources and delay in benevolent movements of responsible organizations to reach to the national priorities in the area of preservation of the environment.
This study reviews the environmental management system in Tehran, and compares it with the leading cities. With a qualitative approach towards the collected texts and information analysis will be performed deductively (or analogically). In this Framework Approach, an existing pattern of health evaluation in these countries was used. This plan was used by the World Health Organization to assess the management qualities of members in 2000.
It is realized that in order to manage Tehran's developing environment we would need a systematic Environmental Management System which stems of a sound strategic environmental planning. For reaching this goal we would need proper technology, deconcentration via delegation of regional management, support of government financially and politically and a specific coordinating institution which eases mutual relationship among stakeholders who enjoy urban environment.
We hope that this effort would considerably ameliorate the evaluation methods, and it demonstrates influential impact to better the social and environmental health. Evaluation of current conditions and comparing it with the leading cities in this area helps the policy makers and experts offering these guidelines, specialists, health care members, and environmental protection staff to consider themselves as collections and units designed and formed to enhance the current circumstances.

## KEYWORDS

Environmental Management, Tehran, World's Metropolises, Leading Cities.

# WASTEWATER TREATMENT IN WOOD INDUSTRY

# MAIN DIRECTIONS OF WOOD BASED MATERIALS PRODUCTION AND RELATED RESEARCH IN RUSSIA

***Anatoly Chubinsky***
***Alexander Alekseev***
*St. Petersburg State Forest Technical University, Russia*

## ABSTRACT

Russia is one of the biggest forest countries in the world. Wood resources estimated as much as more than 80 billion cubic meters. During few last years in Russia were harvested near 200 million cubic meters of wood per year and were produced more than 20 million cubic meters of saw-timbers, near 2,5 cubic meters of plywood and more than 5 million cubic meters of particleboard and fiberboard. The analyses show that advanced wood based materials industry should make mainly dry constructional saw-timber of the limited number of sizes, carrying out its strength sorting, widely use the technologies of wood gluing and laminating, use technologies of wood protection, increase production of substitutes of saw-timbers, widely use wood based materials in construction.
Domestic production of wood products in Russia characterized by small volume of glued and laminated beams and boards production; low technological level of saw-milling equipment and auxiliary operations, especially sorting; absence of strength sorting of saw-timbers and other means of quality assurance of saw-timber; small volume of waste wood used as a fuel; discrepancy in plywood size and format with requirements of the building industry; high emission of formaldehyde from particleboards and others.
Strategy of saw-mills and plywood enterprises development should be built on the basic principles such as:
1. The analysis of forest resources current state and future development using principles of sustainable forest management.
2. Substantiation of assortment, quality and volumes of the wood based materials production according to internal and international markets demand.
3. Development federal and regional wood based materials industry management support, including substantiation of sizes of mills, legislative assistance to develop of small business; state support of the forest road development; principles of protection of the domestic commodity producers, which are taking into account the necessity of export wood products with deep processing and high value added.

## KEYWORDS

Wood products, Assortments, Quality, Sorting, Gluing, Laminating.

# TOXICITY OF WOOD LEACHATES FROM *PINUS SYLVESTRIS* AND *QUERCUS ROBUR* ON THE MICROALGAE *DESMODESMUS SUBSPICATUS*

***Fabio Kaczala*[1]**
***Paulo Sergio Salomon*[2]**
***Marcia Marques*[1,3]**
***William Hogland*[1]**
[1]*School of Natural Sciences, Linnaeus University, Sweden*
[2]*Federal University of Rio de Janeiro, Brazil*
[3]*Rio de Janeiro State University-UERJ, Brazil*

**ABSTRACT**

Wood-based industries have been responsible for environmental impacts due to the discharge of leachate and stormwater runoff from storage areas into water recipients. In this study, the effects posed by two different species of wood - *Pinus sylvestris* (pine) and *Quercus robur* (oak) - on the freshwater microalgae *Desmodesmus subspicatus* were investigated. The effects on the test organisms were studied based on growth rate inhibition after exposure periods of 24, 48, 72 and 96 h. The leachates were produced through a 24-hour standardized leaching test and physico-chemical characterization was done for chemical oxygen demand (COD), poly-phenols, pH and conductivity. The results have shown that both wood species caused growth inhibitory effects on microalgae, however in general; oak was more toxic than pine. The results have shown that the prediction of toxic effects and environmental impacts based only on physico-chemical parameters (Eg. COD) can be underestimated and not represent the reality suggesting that the use of eco-toxicological data is an important strategy not only to implement new standards and guidelines for the discharge of industrial stormwater runoff but also to design effective management practices.

**KEYWORDS**

Toxicity, Wood-industry, Pine, Oak, Stormwater, Growth inhibition.

# THE START-UP MODE AND PERFORMANCE OF AN ANAEROBIC BAFFLED REACTOR (ABR) TREATING WASTEWATER OF MAZANDARAN WOOD AND PAPER INDUSTRY (MWPI)

***Abolghasem Alighardashi***
*Water & Wastewater Engineering Department,*
*Power & Water University of Technology, Tehran, Iran*

**ABSTRACT**

The applicability and reliability of an ABR with four chambers treating pulp and paper industry is beyond the scope this essay. The pilot was fed from equalizing tank in pulp and paper wastewater treatment plant. The influent of reactor was a low strength wastewater quality with the average COD= 1582 mg/lit. Results of this study show that the ABR could be eliminate of around 60% of COD in mesophilic temperature (37±2 °C) and mean HRT= 15 h. The pulp and paper industry wastewater contain some components such as lignin and related compounds which have inhibitor roles in ABR reactor. The separation of acidogens and methoanogens is observed and the majority of COD elimination takes place in the initial chambers. COD removal depends directly on HRT and OLR, indirectly.

**KEYWORDS**

Anaerobic baffled reactor (ABR), Pulp and paper wastewater treatment, Lignin, COD.

# TOXICITY EVALUATION IN WASTEWATER TREATMENT PROCESS

***Sawanya Laohaprapanon*[1]**
***André Luis De Sá Salomão*[2]**
***Marcia Marques*[1,2]**
***William Hogland*[1]**
*[1]School of Natural Sciences, Linnaeus University, Sweden*
*[2]Rio de Janeiro State University-UERJ, Brazil*

## ABSTRACT

Acute toxicity of industrial wastewater before and after activated carbon sorption was investigated in the present study. The wastewater sample was initially treated with two granulated activated carbons (with different physical and economical characteristics) using a batch sorption study. The organic removal efficiencies by activated carbons were measured in term of $COD_s$, phenol and formaldehyde removal rate and the effects of untreated wastewater (R), untreated wastewater at pH = 7.5 ($R_7$) and treated wastewaters ($AC_1$) and ($AC_2$) were investigated on *Selenastrum capricornutum*. The microalgae were exposed to different wastewater concentrations and the algae growth evaluation was based on the chlorophyll concentration at 96 h of exposure. Results indicated that even though the batch sorption could remove phenol, formaldehyde and CODs with removal rate high as 98%, 78% and 75%, respectively, the toxicity of these wastewaters still remained to a large extent as compared to the untreated wastewater (R). The presence of high toxicity in treated wastewater is likely to be due to inherent toxic compounds in wastewater, which were not effectively adsorbed by activated carbons. In order to provide a safe environment to aquatic organisms, a combined treatment process with aerobic or advance oxidation processes may need.

## KEYWORDS

Growth inhibition, *Selenastrum capricornutum*, Toxic compounds, Cleaning wastewaters, Wood industry.

# PHOTO-FENTON AND FENTON OXIDATION OF RECALCITRANT INDUSTRIAL WASTEWATER

***Henrik Hansson*[1]**
***Fabio Kazcala*[1]**
***Marcia Marques*[1,2]**
***William Hogland*[1]**
[1]*School of Natural Sciences, Linnaeus University-LNU, Sweden*
[2]*Rio de Janeiro State University-UERJ, Brazil*

## ABSTRACT

There is a need for development of on-site wastewater treatment technologies suitable to "dry-process industries", such as the wood-floor industry. Due to the nature of their activities, these industries generate lower volumes of highly polluted and recalcitrant wastewaters after cleaning and washing activities. Advanced oxidation processes, such as Fenton and photo-Fenton are potentially good options for treatment. Wastewater from a wood-floor industry with initial COD of 4956 mg/L and TOC of 2730 mg/L was treated with Fenton ($Fe/H_2O_2$) and photo-Fenton ($Fe/H_2O_2/UV$). The highest removal of COD and TOC (80% and 60% respectively) was achieved using photo-Fenton.

## KEYWORDS

Wastewater treatment, Photo-Fenton, Fenton, Wooden floor industry.

# SORBENT BASED ON LINDEN SAW DUST FOR THE REMOVAL OF COPPER (II) IONS

***Oleksandr Khokhotva***
*National Technical University of Ukraine "Kyiv Polytechnic Institute", Faculty of Chemical Engineering, Kyiv, Ukraine*

## ABSTRACT

The removal of heavy metal ion from water effluents can be a real problem if heavy metal concentration is relatively low but the content of hardness ions is several folds higher. An ion-exchange technique is not acceptable in this case because ion-exchange capacity would be very quickly saturated by calcium and magnesium ions that would require frequent regeneration of cation-exchange resin.
Lignocellulosic materials have been widely used for heavy metal sorption since they are low-cost forest/agricultural residues. Usually a raw cellulosic material, such as saw dust, has relatively low adsorption capacity towards metals and low stability in aqueous media that, however, can be improved by chemical treatment.
An environmentally-sound chemical for saw dust pre-treatment is urea-solution. The present paper studies sorption properties of linden saw dust, treated with urea solution, for its ability to remove Cu(II). The sorption experiments have been conducted in highly mineralized aqueous media in presence of $Na^+$ and $Ca^{2+}$ ions. Treated saw dust showed significantly higher adsorption capacity compared to unmodified material. Parameters of Langmuir and Freundlich isotherms were obtained. The presence of $Na^+$ ions in concentrations up to 20 times more than $Cu^{2+}$ did not influence the sorption efficiency both by urea-treated and non-treated linden saw dust. Sorption efficiency of Cu(II) in presence of $Ca^{2+}$ ions decreased with $Ca^{2+}$:$Cu^{2+}$ concentration ratio increase from 0.5:1 to 12:1 though urea-treated saw dust showed considerably better ability to adsorb and retain copper ions.
Desorption experiments have also been carried out. Possible reasons of better sorption properties of urea-treated saw dust are discussed.

## KEYWORDS

Sludge, Treatment, Technologies, Hazardous pathogens, Limits of chemical organic pollution of sludge used in the agriculture, New EC Directive.

# FIRST YEAR EXPERIENCES FROM PILOT SCALE WETLAND SYSTEM TESTS

***Henric Svensson***
***William Hogland***
*School of Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

This paper aims to evaluation of first year pilot scale wetland systems treating wood leachate from oak wood. The study is focused on degradation of oak wood leachate that is high in polyphenolic compounds as well as on experiences on setting up the system. Oak wood has a high amount of polyphenolic compounds which have never been studied in wetland treatment systems according to the literature. Therefore, 12 pilot scale wetland systems were created that where fed with water contaminated with wood leachate from oak. Each pilot system consists of two separate sections of which one is either aerated or not and another pilot section which is vegetated or not. Parameters followed up are polyphenols and TOC as well as the basic parameters as pH, EC, temperature, oxygen and redox-potential.

## KEYWORDS

Pilot scale wetland systems, Oak wood leachate, Polyphenolic compounds, TOC.

# POSTER SESSION

# ALUMINIUM SPECIATION IN BOREAL CATCHMENTS ENRICHED IN FLUORIDE

***Tobias Berger*[1]**
***Mats Åström*[1]**
***Jon Petter Gustafsson*[2]**
*[1]Linnaeus University, Kalmar, Sweden*
*[2]KTH Royal Institute of Technology, Stockholm, Sweden*

## ABSTRACT

In streams of northern Europe, concentrations of dissolved aluminium (Al) are clearly elevated as compared to corresponding streams in other parts of the continent, which is due to regional geology. Industrial emissions can also be the source of elevated Al in streams. Inorganic monomeric Al, especially as free $Al^{3+}$ or in hydroxide complexes, is regarded as a measure of potential toxicity while organic Al-complexes are generally considered as less toxic or non-toxic. Dissolved fluoride (F) is essential in inorganic Al complexation and might mitigate toxicity of Al, however, the effect on biota by Al-F complexes is still not completely understood. The aim of this study was to assess Al complexation in stream waters in an area where dissolved F and organic matter (DOC) are abundant as a result of natural processes and where annual variations in stream flow are extensive and in pH well recognized. Time-series data were collected and utilized using a speciation modeling software (Visual MINTEQ version 3.0, beta) in order to present the role of F and DOC on Al-speciation during different water regimes. Al was entered as the total concentration (0,45 µm filtration) and was allowed to precipitate when the solubility product for $Al(OH)_3$ was exceeded, representing the colloidal Al-fraction in the streams. There was a strong correlation between model-predicted colloidal Al and increasing pH, which is a result of decreasing water discharge. Furthermore, the model showed that dissolved Al mainly was represented by complexes with organic ligands (i.e fulvic acids). Fluoride-complexed Al was the predominant form of inorganic Al, while concentrations of free $Al^{3+}$ and complexes with hydroxide and sulphate occurred in negligible amounts. Such information is relevant for predicting the ecological and chemical response on increased Al or F discharge both from natural sources (as is the case here) but also from anthropogenic sources, in freshwater settings.

## KEYWORDS

Aluminium speciation, Boreal catchments, Dissolved fluoride, Organic matter (DOC).

# CIGS THIN FILM SOLAR CELLS FABRICATED ON THE VARIOUS SUBSTRATES –NEW POSSIBILITY FOR RESEARCH AND BUSINESS INTEGRATION

***Vasiliy Rud*[1]**
***Yury Rud*[2]**
***Eugen Terukov*[2]**
***Dmitry Arseniev*[1]**
***Igor Shaposhnikov* [1]**
***Alexander Vasiliev*[1]**
***Maxim Dyuldin*[1]**
*[1]St. Petersburg State Polytechnical University, St. Petersburg, Russia*
*[2]Ioffe Physical Technical Institute of Russian Academy of Sciences, St. Petersburg, Russia*

## ABSTRACT

Solar cells which based on silicon or binary III–V semiconductor compounds and their solid solutions successfully fulfilled their role as the first energy sources in outer space in the 1950s–1990s. Concentrator cascade of solar cells formed as heterostructures, based on InGaAsP solid solutions grown on germanium substrates, ensured progress in improving their main parameters, such as power density, the ratio of power/weight, and the solar cells operating time, however, the cost of photoconverters drastically increased as a result of these improvements. Evidently, the observed steady increase in the number of launched artificial satellites and a tightening of requirements for the size, weight, and cost of space technology have stimulated a continuous increase in demand for high efficiency solar cells, which are fabricated by low cost technologies and, at the same time, feature low weight parameters.
The results of measuring the first spectra of relative quantum efficiency for photoconversion in thin film ZnO/CdS/Cu(In, Ga)$Se_2$/Mo solar cells (CIGS solar cells) fabricated on rigid (glass) and flexible (polyimide) substrates are reported. The character of interband transitions has been studied and the values of the band gap for direct and indirect transitions in thin Cu(In, Ga)$Se_2$ films are determined. It is found that a shift of the maximal photosensitivity for the obtained solar cells to shorter wavelengths is observed as rigid substrates are replaced by flexible ones. It is concluded that thin film Cu(In, Ga)$Se_2$ structures can be used as broad band photoconverters of solar radiation with low costs. This study was supported by the contract "Research and Development of Deposition System for CIGS Solar Cell" signed by the Ioffe Physical Technical Institute (Russian Academy of Sciences).

## KEYWORDS

CIGS Solar Cell, Heterostructures, photoconversion, Thin films solar cells (TFSC), Solar cells (SC).

# INTERNATIONAL CONFERENCE "ENVIRONMENT. PERSON. SOCIETY"- 15 YEARS OF COOPERATION BETWEEN SCIENCE, BUSINESS AND GOVERNMENT INSTITUTIONS

***Daniel Benatov***
*National Technical University of Ukraine "Kyiv Polytechnic Institute", Marine Biotechnology Centre, University of Las Palmas Gran Canaria, Kyiv, Ukraine*

**ABSTRACT**

Our conference is the first project of Student Science Association, which was restored in our University in 1998. The main peculiarity of the conference is the student organizing committee. The first conference was initiated by students of our University, and today (15 years later) they're responsible for all stages of the event, starting from publication of reports up to organization of extensive scientific debate. The conference was attended by representatives of Russia, Belarus, Sweden, Poland, Bulgaria, Armenia, Azerbaijan, Czech Republic, Lithuania, Latvia, Georgia, Iran, not mentioning hundreds of Ukrainian participants.
State Environmental Inspectorate of the Ministry of Ecology and Natural Resources of Ukraine has been co-organizer of the conference since the first year of its existence. Civil servants communicate easily with young scientists. Their reports, master-classes, despite dry statistics, which they provide, are very lively thanks to informal lectures concerning approaches and methods of environmental protection and rational use of natural resources. Our conference has been supported by companies, whose activities are related to environmental issues, for a long time now. For example, Siemens - the world-renowned manufacturer of the equipment or the "Obolon" - leading national producer of beverages. Thanks to this cooperation the conference provides participants with great experience of communication with leading experts, attending factories and seeing new technologies and equipment on load. We're happy with the fact that our conference allows students to discover new information, which they wouldn't find in training courses manuals; contrariwise businesses and organizations can get direct access to young and qualified staff. We believe that events like our conference are useful for the young scientists and also for the public authorities and businesses.

**KEYWORDS**

Scientific-practical conference, Environment protection, Rational nature management, Educational programs, Partnership between higher schools and business.

# COOPERATION BETWEEN CITIES KALMAR AND SAINT- PETERSBURG FOR EFFECTIVE INTEGRATION OF SCIENCE, EDUCATION AND BUSINESS TO DEVELOP ENVIRONMENTAL PROTECTION AND GREEN TECHNOLOGY

***Joacim Rosenlund*[1]**
***Marcia Marques*[1,2]**
***William Hogland*[1]**
***Alexander Babkin*[3]**
***Vasiliy Rud*[3]**
[1]*School of Natural Sciences, Linnaeus University, Sweden*
[2]*Rio de Janeiro State University-UERJ, Brazil*
[3]*St. Petersburg State Polytechnical University, St. Petersburg, Russia*

## ABSTRACT

Kalmar and St. Petersburg cities have long friendships in the field of environmental protection and innovation business. Since 1997, when the Agreement was signed between the St. Petersburg State Polytechnic University and the University of Kalmar. The Agreement supports scientific education and business contacts, and includes co-hosting the International Youth Environmental Forum Baltic region "ECOBALTICA" and International Conference on Natural Sciences and Technologies for Waste and Wastewater Treatment, remediation, Emissions related to Climate, Environmental and Economic Effects Linnaeus ECO-TECH .
Great thanks for sponsors and institutes: Saint Petersburg Scientific Center of the Russian Academy of Sciences, City Government of St.-Petersburg, Russian foundation for basic research, “ECOPolytechnik”, St.-Petersburg branch of Russian social organization “Business Russia”, St.-Petersburg State Polytechnic University, Swedish International Development Cooperation Agency - Baltic Sea Unit (Sida), The Swedish Royal Academy of Engineering Sciences (IVA), Sustainable Sweden South East (SSSE), Kalmar Energi, AB Gustaf Kahr, AKZONobel, Beckers-Acroma, Revatec, KK-foundation, STINT, EU- Seventh Framework Programme (STInno), The Swedish Institute , The Regional Council of Kalmar County, Linnaeus University and many other. Special thanks for support are directed towards Member of correspondence of Russian academy of sciences Andrey Rudskoy (the rector of Saint-Petersburg State Polytechnic University), Prof. Albert Bashkarev (Saint-Petersburg State Polytechnic University), Prof. Stephen Hwang (Rector of Linnaeus University), Prof. Orn Taube, Prof. Agneta Bladh (both- former rectors of Kalmar University), Mr. Hakan Brynielsson (The Managing Director of The Regional Council of Kalmar Council).

## KEYWORDS

Cooperation, Environmental protection, Innovation business, Scientific education.

# MICROBIAL FUEL CELL (MFC) FOR USE IN METAL EXTRACTION, RECYCLING AND BIOREMEDIATION

***Zhen Lim Wong***
***Mark Dopson***
*Centre for Ecology and Evolution in Microbial Model Systems (EEMiS),*
*Linnaeus University, Kalmar, Sweden*

## ABSTRACT

Sulphide mineral mining operations produce waste that is rich in metals which are in concentrations which are toxic to most life. They also produce many by-products which are acidic and will lower the surrounding pH when released. Due to high clean-up costs, wastes are usually poorly treated. This has however, created a unique ecosystem with most commonly found microorganisms being are sulphur oxidising and/or iron oxidising acidophiles. Microorganisms found in these environments range from being extreme thermophiles to psychrotolerant.
MFCs offer the potential as a green and sustainable alternative energy technology. Substrates are metabolised by microorganisms which through the electron transfer chain transfer the electrons to the anode directly or through mediators which shuttles the electron to the electrode. This then drives the electrical current. Examples of bacteria used in MFCs are such as Shewanella putrefaciensm, Geobacter sulfurreducens, Alcaligens faecalis and Rhodoferax ferrireducans.
My focus is in selecting for native microorganism that can survive and grow in acid mine conditions that can metabolise native substrate (waste) and then donate electrons to power the MFC. The power generated can then be use to either completely power or subsidise the power needed to precipitate desired metals at the cathode end. Samples from mineral mines are taken and enriched. It is then used in the MFC and microbes that grow are analysed using molecular biology and bio-chemistry methods and optimised to identify the best working conditions for the MFC.

## KEYWORDS

Microbial Fuel Cell (MFC), Microorganisms, Alternative energy technology.

# ECOSYSTEM SERVICE TRADEOFFS WHEN STRIVING TOWARDS A BIOBASED FUTURE

***Morgan Fröling***
***Mohammad Fakhari Rad***
***Erik Grönlund***
*Department of Engineering and Sustainable Development,*
*Mid Sweden University, Sweden*

## ABSTRACT

With increasing demand for bio-based materials and forest biofuels the pressures on ecosystem services from forestry practices will increase. This calls for identification and assessment of tradeoffs between different uses of provisioning and other ecosystem services and establish management practices considering such tradeoffs. Traditional optimization parameters like carbon footprint or life cycle energy use will not be enough; impacts on ecosystem services must also be assessed.
The UN Millennium Ecosystem Assessment concludes that ecosystems and their ability to provide humanity with ecosystem services are under severe stress. Increased use of bio-based materials and biofuels must be furnished in ways not unnecessary worsening the situation, or locally destroy the provisioning of essential ecosystem services.
The Swedish county of Jämtland is used as an example, with 3.4 million ha of forest area and forestry as an important industry. At the same time the county has a large tourism industry - for skiing but also for experiences of undisturbed nature, hiking, hunting, fishing et c. The county is also marketing itself as a "Quality Food Area" having a focus on local food production and food experiences, with the clean and uncontaminated environment for agriculture, game and fish as a cornerstone. More intensive forestry may create conflicts between enterprises related to cultural ecosystem services and those provisioning services pushed for biofuel production.
We need to make possible the inclusion of tradeoffs between different types of e.g. cultural ecosystem services in sustainability assessments of increased forest biomaterial harvesting and production in Jämtland.

## KEYWORDS

Renewable energy, Biobased materials, Ecosystem Services, Tradeoffs, Forestry, Jämtland.

# HOW DO WE KNOW THE ENERGY USE WHEN PRODUCING BIOMATERIALS OR BIOFUELS?

***Rickard Arvidsson*[1]**
***Kristin Fransson*[1]**
***Morgan Fröling*[2]**
***Magdalena Svanström*[3]**
***Sverker Molander*[1]**
[1]*Environmental Systems Analysis, Chalmers University of Technology, Sweden*
[2]*Department of Engineering and Sustainable Development, Mid Sweden University, Sweden*
[3]*Chemical Environmental Science, Chalmers University of Technology, Sweden*

## ABSTRACT

How much fossil energy that is used in the production of biomaterials or biofuels (e.g. fuel used in harvesting) is a parameter of obvious interest when optimizing the production systems. To use more fossil fuels in the production of a biofuel than what will be available as the biofuel product is obviously a bad idea. With increasing interest in biomaterials and biofuels, a shift from a sole focus on fossil energy will be necessary. Optimized use of energy over the whole life cycle is one important parameter to ensure sustainability. However, to report and interpret values on life cycle energy use is not as straight forward as what might immediately be perceived. The impact category 'energy use' is frequently used but is generally not applied in a transparent and consistent way between different studies. Considering the increased focus on biofuels, it is important to inform companies and policy-makers about the energy use of biofuels in relevant and transparent ways with well-defined indicators. The present situation in how energy use indicators are applied was studied in a set of LCA studies of biofuels. It was found that the choice of indicator was seldom motivated or discussed in the examined reports and articles, and five inherently different energy use indicators were observed: (1) fossil energy, (2) secondary energy, (3) cumulative energy demand (primary energy), (4) net energy balance, and (5) total extracted energy. As a test, we applied these five energy use indicators to the same cradle-to-gate production system and they give considerably different output numbers of energy use. This in itself is not unexpected, but indicates the importance of clearly identifying, describing and motivating the choice of energy use indicator. Direct comparisons between different energy use results could lead to misinformed policy decisions.

## KEYWORDS

Fossil energy, Secondary energy, Cumulative energy demand, Primary energy, Net energy balance, Total extracted energy.

# MINIMIZING LOSSES WITH THE HELP OF "REAL-TIME" ALGAL SURVEILLANCE

***Edna Granéli*[1]**
***Christina Esplund*[1]**
***Elin Lindehoff*[1]**
***Andreas Brutemark*[2]**
*[1]LnuC EEMiS, Linnaeus University, Kalmar, Sweden*
*[2]Novia University of Applied Sciences, Ekenäs, Finland*

## ABSTRACT

Cyanobacterial blooms covering almost the entire Baltic Sea is a yearly feature during July-August. For the tourism industry at Öland island, SE Sweden, the economical losses during the summer 2005 amounted to 17-23 million euros. Remote sensing satellite images show that all the Öland beaches are covered with decomposing algae. In reality, these blooms rarely reach the western side of the island. To more accurately assess accumulation, a daily real-time surveillance of the algal densities on the beaches was performed during these months with the help of volunteers. The volunteers (from 15 years old to pensioners) were trained at the Linnaeus University, (former Kalmar University), from simple laboratory techniques, to more complicates ones such as identification and enumeration of the toxic cyanobacteria species. By latest 9:00 AM, the public had access to information on the algal situation on 17 beaches. We could show that: 1) although remote sensing images showed Öland being surrounded by the blooms, our surveillance showed no algal accumulations on the beaches 2) that the real-time warning system boosted public confidence in the local water quality and during the first "Miss Algae"-summer 2006, the economical losses by the tourism industry turned in profits, the gain amounting to 17 million euros, 3) this kind of real-time surveillance is economical feasible due to low-costs involved, but also, the project has a great social value for the volunteers who mostly were pensioners. The volunteers who participated in "Miss Algae" had a good knowledge about the area they monitored (as their houses are located nearby) and could disseminate knowledge to the public in these areas. This kind of project also render a lot of interest regional, national and international, and can be used in advertising campaigns to increase tourism in the areas affected by algal blooms.

## KEYWORDS

Cyanobacterial blooms, Real-time algal surveillance, Algal accumulations.

# ELEMENTAL COMPOSITION OF C, N AND P IN SINGLE CELLS OF THREE FILAMENTOUS CYANOBACTERIA USING NMP (NUCLEAR MICROPROBE) AND TRADITIONAL TECHNIQUES

***Eva Pérez Blanco*[1]**
***Chatarina Karlsson*[1]**
***Jan Pallon*[2]**
***Edna Granéli*[1]**
*[1]LnUCEEMiS – Marine Ecology, School of Natural Sciences, Linnaeus University, Kalmar, Sweden*
*[2]Department of Nuclear Physics, Lund Institute of Technology, University of Lund, Lund, Sweden*

## ABSTRACT

Intracellular contents of carbon, nitrogen and phosphorus in phytoplankton cells are traditionally measured using concentrates containing thousands to millions of cells. In this study we have used a Nuclear MicroProbe (NMP) as an approach for the determination of C, N and P concentrations in single filaments of three cyanobacteria species: *Anabaena* sp., *Nodularia spumigena* and *Aphanizomenon flos-aquae var. klebahnii* isolated from Baltic Sea water. Estimations of C, N and P content per cell have been calculated and compared with the concentrations found with traditional bulk methods. No significant differences regarding the C, N and P cellular content were found between the two methods for each of the species tested. From our results we conclude that the use of NMP can be a useful tool for studying the elemental contents in single phytoplankton cells occurring among several thousands of other cells of different species in field samples.

## KEYWORDS

Baltic Sea, Elemental cellular content, Nitrogen-fixing cyanobacteria, Nuclear microprobe, Nutrients.

# QUANTITATIVE RECONSTRUCTIONS OF LOCAL HOLOCENE VEGETATION IN SOUTHERN SWEDEN: POTENTIALS AND LIMITS

***Qiaoyu Cui*[1]**
***Marie-José Gaillard*[1]**
***Shinya Sugita*[2]**
[1]*School of Pure and Applied Natural Sciences, Linnaeus University, Sweden*
[2]*Institute of Ecology, Tallinn University, Estonia*

## ABSTRACT

With the aim to quantitatively reconstruct the local forest history in Småland Southern Sweden, the fossil pollen from two small bogs was applied by LOVE (LOcal Vegetation Estimates) model. The LOVE-based local vegetation composition was compared with the previous studies by multi-proxy approach. The large discrepancies present in most tree taxa (i.e. *Pinus*, *Betula*, *Quercus*, *Tilia*, *Corylus*, and *Fraxinus*) and anthropogenic indicators (e.g. *Plantago lanceolata*, *Filipendula*). The assumed difference abundance of birch and pine between the two sites was confirmed by the LOVE reconstruction. The higher LOVE-based pine at one site explains the differences in fire history. However, the low value of LOVE-based pine at the other site might be underestimated referring to multi proxies' data. Furthermore, the forest openness (e.g. how to interpret *Calluna*) based on LOVE estimates are also requiring for further proof. Therefore, modern and historical maps containing vegetation information were collected within 3000 m radius circle around study sites. The vegetation information abstracted from the maps by using ArcGIS was harmonized into four land-use types (Forest, Wetland, Grassland, Cultivated-land) and grouped into four time windows (Modern, Enskifte-Lagaskifte, Storskifte and older). Correspondingly, the LOVE estimates (25 taxa) were grouped into four land-use types under our assumption for the comparisons with maps. To gain insights into the *Calluna* distribution in historical landscapes, multi-Scenario approach was used: i) *Calluna* in Grassland; ii) *Calluna* in Forest; iii) *Calluna* in Wetland. The comparisons suggest: *Calluna* represents forest understory when the forest is very close at sites and pine is dominated; *Calluna* represents wetland and grassland when the forest is more open. The test of the LOVE application presented here suggests that the pollen inferred estimates of plant cover obtained with the LOVE model are reasonable and that the model can be applied to Holocene pollen records with a good degree of confidence.

## KEYWORDS

LOVE estimates, Historical maps, Forest history, *Calluna*, Småland.

# INFLUENCE OF LIGHT ON *PRYMNESIUM PARVUM* GROWTH, TOXICITY AND MIXOTROPHY

***Emanuela Fiori*[1]**
***Nayani K. Vidyarathna*[2]**
***Johannes A. Hagström*[2]**
***Rossella Pistocchi*[1]**
***Edna Granéli*[2]**
[1]*Interdepartmental Center for Research in Environmental Science (CIRSA)*
*University of Bologna, Ravenna, Italy*
[2]*LnUCEEMiS – Marine Ecology, School of Natural Sciences,*
*Linnaeus University, Sweden*

## ABSTRACT

The haptophyte *Prymnesium parvum* has a worldwide distribution, with dramatic increase in blooms in the last years. *P. parvum* blooms are often associated with massive fish kills and great ecological impacts and economic losses as a consequence. *P. parvum* is a mixotrophic organism, utilizing organic dissolved substances and particles to support its photosynthetic growth. The ability of *P. parvum* to produce toxic compounds, and being a mixotroph, makes it capable to outcompete other algal species for essential substances. These mechanisms are mostly enhanced when environmental conditions are not optimal for *P. parvum* growth. Here we report results on the growth, toxicity and mixotrophy, from experiments where *P. parvum* cells were grown as monocultures or together with *Rhodomonas salina* and exposed to different light conditions (dark, 100, 700, 2000 µmol photons $m^{-2}$ $s^{-1}$). The results showed that *P. parvum* growth is affected at light intensity of 700 µmol photons $m^{-2}$ $s^{-1}$ and the cells were photo-lysed when exposed to irradiances above this value. An inverse relationship between cellular toxicity and light intensity was observed, i.e. lower light irradiation induced higher cell toxicity. Phagotrophy was observed in all the conditions. *P. parvum* reached significantly higher cell densities when growing together with *R. salina* than in monocultures, while cellular toxicity was significantly reduced in the mixed cultures. Furthermore the presence of prey attenuated the negative effect of the higher irradiations on *P. parvum* growth.

## KEYWORDS

*Prymnesium parvum*, Irradiance, Mixotrophy, Growth, Toxicity.

# SEPARATE COLLECTION IMPACT ON HEAVY METALS FLOW IN MUNICIPAL SOLID WASTE

***Eduardas Kamarevcevas*[1]**
***Christian Ludwig*[2]**
***Gintaras Denafas*[1]**
*[1]Kaunas University of Technology, Lithuania (LT)*
*[2]École Polytechnique Fédérale De Lausanne, Paul Scherer Institute, Switzerland*

## ABSTRACT

Rising mountains of waste have become a major issue of our time. For the effective economic and environmental management of municipal solid waste (MSW), incineration and residues, requires a long-term strategy based on understanding of the source, behavior and fate of trace element occurrences in MSW and incineration waste residues. This reprot reviews the available information on the heavy metals content in MSW. Using this data we summarized heavy metals flows in MSW and quality of incineration residues. Future work has to assess several scenarios to reduce heavy metals and assess the influence on MSWI residues quality: e.g. reducing the amount, separate collection to obtain genuine fractions, and residual MSW fractions which cannot be recycled and need further treatment.

## KEYWORDS

Municipal solid waste (MSW), Heavy metals, Separate collection.

# THE ESTIMATION OF THE ECOLOGICAL RISK OF SOLID WASTE ON THE ENVIRONMENT

***Tatjana Dovbysheva***
*International Humanitarian Institute, Minsk, Belarus*

## ABSTRACT

In result of the technogenic activity of the human there is an environmental contamination, deterioration of the natural environment concerning normative parameters. At the forecasting possible negative and dangerous solid waste environmental impact it is necessary to take into account:

- The quantity of dangerous and harmful materials
- The condition of their storage
- The type of these material
- The depth of probable pollution
- The area of potential pollution
- The duration of activity of dangerous materials
- The time of liquidation of consequences of negative and dangerous action.

In turn at forecasting probable negative and dangerous influence of solid waste for an environment the big value in addition to set forth above factors has such factor, as the economic mechanism of management of influences of solid waste on an environment. This factor is defined as total influence of all set forth factors. However, wide (broad) use of economic methods managing the environmental impacts of solid waste on environment restrains absence of the common methods of a quantitative estimation of ecological danger. One of the tasks of this paper is a development of models of potentially accidents and development of the recommendations for warning and liquidations of consequences. The quantitative estimation of ecological danger is necessary for development of such model. The calculation in relative parameters enables to present in a dimensionless kind a level of ecological danger (including actual damage and expected risk) from solid waste. The paper presents a method of a quantitative estimation of ecological danger influence solid waste on an environment. Two models are considered in dependence of a degree of impact of solid waste on the common impurity of territory: model of equivalent factors; model of inadequate factors. In the paper the factors which are necessary for taking into account are submitted. Major factors of this paper are interconnected among themselves. One of them may be a part of another. So, the factor type of dangerous and harmful solid waste is one of making parts of the following factors: the depth of probable pollution, the condition of their storage, the area of potential pollution, the time of liquidation of consequences of negative and dangerous action, the duration of activity of dangerous solid waste.

## KEYWORDS

Ecological risk, Dangerous solid waste, Pollution.

# BIOLOGICAL TREATMENT OF CAR WASH WASTE WATERS – A REDUCTION SURVEY

***Silja Kostia***
***Nico Id***
***Essi Malinen***
*Lahti University of Applied Sciences, Faculty of Technology, Lahti, Finland*

## ABSTRACT

The purpose of this paper was to examine the functionality of biological wastewater treatment in car washes using water recycling. The main sources of load in the waste water are the anionic and nonionic surfactants and chemical oxygen demand in the detergents. The two Finnish car washes included in the study used same wash detergents and aerobic bioreactors with a carrier substance and they both used 87 % of recycled water per wash. Samples were taken every second week altogether seven times between beginning of February and end of May, 2012. The reduction of total nitrogen, total phosphorus and anionic, kationic and nonionic surfactants as well as chemical oxygen demand (COD) were studied. In addition, the condition of water was examined by parameters like conductivity, pH, oxygen concentration, total solids, and biological oxygen demand (BOD). The reduction of surfactant concentrations was at least 90 % and the reduction of chemical oxygen demand was between 80 and 97 % during the process. The concentration of total nitrogen and total phosphorus in the purified water was caused by excessive use of nutrients in the bioreactor. The examined process reduces levels of input load considerably so the main challenge for the quality of water seems to be optimal nutrient input. For the car washes the purification level is good and the input load of detergents is significantly reduced.

## KEYWORDS

Car washes, Biological waste water treatment, Water recycling.

# IMPROVING THE DEWATERING OF MARINE SEDIMENT USING A COMBINATION OF GEOTEXTILE AND ELECTRO-KINETIC TREATMENT

***Silja Kostia*[1]**
***Janika Tuomi*[1]**
***Martin Romantschuk*[2]**
[1]*Lahti University of Applied Sciences, Faculty of Technology, Lahti, Finland*
[2]*University of Helsinki, Department of Environmental Sciences, Lahti, Finland*

## ABSTRACT

The purpose of this study was to test whether electro-osmosis can be used to increase the effectiveness of dewatering of dredged sediment being drained in geo- textile tubes. The marine sediment used in the study had a high proportion of clay known to be problematic in geo-tube treatment. The laboratory set-ups were performed using sediment-filled sacks (approximately 5-7 liters/sack) sewn from geotextile, and plastic columns (approximately 1.6 liters/column) closed at the bottom with geotextile, both supplied with electrodes for applying direct current. In the sack set-ups, a seven-hour electric treatment led to the same result as the 72-hour control treatment. The volume of the sediment decreased in column set-ups by 32 % due to electric treatment while only a 14 % decrease was obtained in the controls after 189 hours. The water layer on top of the sediment treated with electro-osmosis decreased by up to one-fifth, as compared to the control columns. We can conclude that electro-osmosis is an effective approach to boost the dewatering of the dredged sediment treated in geotextile tubes. When draining sediment with a high clay content, electric treatment can prevent the formation of a water column on top of the sediment. This in turn accelerates dewatering of the dredged material.

## KEYWORDS

Electro-kinetic dewatering, Electro-osmosis, Sediment.

# LOW TECHNOLOGICAL BIOLOGICAL TREATMENT OF SOURCE SEPERATED WASTE IN A BIOCELL

***Janne H. Jarstad*[1]**
***L. Semb Vestgarden*[1]**
***B. E. Berg*[2]**
[1]*Telemark University College, dep. Bø in Telemark, Norway*
[2]*GLT-Waste IKS, Norway*

## ABSTRACT

In 2009 the Norwegian government banned biodegradable waste in landfills to mitigate climate gas production. To be able to stabilize source separated waste before landfilling a constructed biocell has been tested during a four year period. The research is part of a pilot project organized by Avfall Norge. A total amount of 12 000 tons of waste from both industry and households were embedded in the biocell. Before loading, the waste fractions were characterized both in macro and micro scale. Anarobic testing in lab scale documented the methane potential in different waste fractions. Especially car fluff contained toxic components which suppressed biodegradation. To avoid greenhouse gas leakage the biocell was constructed as a closed system with synthetic capping and gas wells coupled to a compressor. While the biogas was flared the leachate was collected and recycled. Leachate contains both nutrients and DOC which is supposed to increase the biological activity. During the first part of the test period the BOD/COD was above 0.5 before it declined. In addition both inorganic and organic environmental harmful components were analyzed in the leachate. Levels of heavy metals decreased during treatment. The methane production was detected on-line with IR. Both the production and gas phase concentration varied during the test period. A total of five gas wells were positioned at different levels in the biocell. Only one of them produced biogas for a considerable period. This presentation will focus on biocell construction and waste degradation related to variation in leachate constituents as a function of time.

## KEYWORDS

Biocell, Anaerobic digestion, Waste, Methane, Leachate, Nutrient recycling.

# TECHNOLOGICAL BASING OF USING PHYTOTECHNOLOGIES IN CLEANING SEWAGE OF SMALL COMMUNITIES

***Mykyta Riabchynskyi***
*Kharkiv National Municipal Academy, Ukraine, Kharkiv, Moscow*

## ABSTRACT

Currently 70% of polluted sewage is coming from minor sources, located in the countryside. This is because the overwhelming majority of small settlements don't have any facilities for cleaning sewage, and existing facilities work unsatisfactorily because of the wrong maintenance and absence of funds for repair.
In many countries during the last decades little villages got rid of traditional ways of cleaning sewage because of unreliability and difficulty in exploitation of cleaning facilities of standard type. Instead of those, widely used are facilities, which are based on intensification of natural process of self-cleaning of water, using microorganisms and highest aquatic vegetation. These methods of cleaning sewage using vegetation components are called phytotechnology.
The report proves information about specifications of construction and show us :

- The construction that based on phytotechnology of BIOPLATO type is an optimal choice for cleaning sewage in cottage settlements, small towns and camps.
- The analysis of monitoring journals of working stations and literature sources gives economic and technological basis of using BIOPLATO complex along with traditional cleaning structures or as stand-alone structures.
- It is absolutely obvious that BIOPLATO, compared to classical cleaning structures, has an esthetic advantage. It can be built with local materials and plants, so it will not stand out against the surrounding nature's complex.
- Phytotechnology structures are also notable for proliferation of the natural self-cleaning principle, which makes the structure safer for the environment and saves workers from contacting hazardous chemical agents and other dangerous substances.
- Also the main schtick of the BIOPLATO construction is the low-cost building operating costs. Which is connected with the natural principles of construction work, and eco – building technologies which are making minimal influence on environment.

## KEYWORDS

Phytotechnology, BIOPLATO, Sewage, Treatment, Purification, Vegetation.

# EVALUATION OF PHOSPHATING SLUDGE IMMOBILIZATION IN CONSTRUCTION CERAMICS

***Algirdas Minikauskas***
***Lina Trečiokaitė***
***Virginija Valančienė***
***Gintaras Denafas***
*Department of Environmental Engineering, Faculty of Chemical Technology, Kaunas University of Technology, Lithuania*

## ABSTRACT

The steel phosphating operations and post-phosphating waste water treatment processes produce sludge containing heavy metals. Chemical composition of three samples of phosphating sludge was analyzed using energy dispersive X-ray analyzer (EDS) and X-ray diffractometer (XRD). The leachability of heavy metals from phosphating sludge was examined using different leaching solutions. The pH of leaching solutions was 2.1, 4.0, 6.2, 8.1 and 10.0. For evaluation of phosphating sludge immobilization in silicate matrixes hydromica clay was mixed with phosphating sludge in different proportions (5 and 10 % wt.) and fired at 900, 1000 and 1025 ºC. The leachability of heavy metal ions and shrinkage of fired samples was analysed. The results demonstrated that all heavy all metals were immobilized in ceramic body. Phosphating sludge in used proportions has no adverse effect on ceramic body.

## KEYWORDS

Phosphating sludge, Immobilization, Ceramics.

# MATHEMATICAL MODELS FOR REGIONAL SOLID WASTE MANAGEMENT DEVELOPMENT

***Inara Teibe*[1]**
***Ruta Bendere*[2]**
***Larisa Perova*[3]**
*[1]University of Latvia, Latvia*
*[2]Waste Management Association of Latvia, Latvia*
*[3]Uzskaites sistemas Ltd., Latvia*

## ABSTRACT

The mathematical methods of waste management assessment and software for various life cycle applications are widely used as one of the decision-making support tools in waste policy. This comparatively new approach to waste management planning offers an option for investigation the life cycle impact of solid waste management processes which generate anthropogenic impact on the environment, of which the most unfavorable is greenhouse gas emission.
In the research a software application called WAMPS (waste management planning system) developed by the IVL Swedish Environmental Research Institute within the Reco Baltic 21 Tech project has been used to create a better understanding about waste management processes and their produced impact on climate changes. It is the first time when WAMPS software is applied for regional domestic waste management planning for the next seven-year period in Baltic states, in this particular case for the Piejura region which is one of the ten waste management planning regions in Latvia. The Piejura region includes one city of national level and nine districts, which the total area is about 5,300 sq. km and the number of inhabitants 153,899. In accordance with national legislation, responsibility for waste management organization has been delegated to local municipalities.
In this study the solutions for elaboration of the Piejura region waste management strategy are based on those waste management processes which will produce the best environmental options. The main results of the research were obtained comparing various waste management scenarios in WAMPS: the existent situation in regional waste management, where more than 94% of domestic waste is landfilled; European Union framework demands according to Waste and Landfill directives; and the best technological solutions for the Piejura region based on local circumstances. The next phase of research will draw attention to the implementation and integration of the chosen technological solutions on the basis of economical solutions.

## KEYWORDS

Regional, Waste management development, Mathematical methods, Software.

# EMISSION OF VOC AND GHG BY BIOREMEDIATION OF SOIL CONTAMINATED WITH DIESEL

***Marcio G. Franco*[1]**
***Sergio Machado Corrêa*[1]**
***Marcia Marques*[1,2]**
***Daniel Vidal Perez*[3]**
*[1]Rio de Janeiro State University-UERJ, Brazil*
*[2]School of Natural Sciences, Linnaeus University, Sweden*
*[3]EMPRAPA - National Centre for Soil Research, Brazil*

## ABSTRACT

Bioremediation processes have been credited for reducing high levels of organic contaminants from soils. However, during bioremediation of diesel contaminated soils, for instance, diesel is converted to volatile organic compounds (VOC) and greenhouse gases (GHG), which means that such remediation technique contributes to the greenhouse effect. The ongoing construction of a large petrochemical industrial region in Rio de Janeiro Metropolitan Area (COMPERJ) and the transportation of large volumes of oil byproducts (mainly diesel), have raised deep concerns regarding accidents that may result in soil and air contamination. When the problem comes, remediation techniques shall be applied. The objective of this study was to characterize the emission of GHG and VOC during bioremediation of soils contaminated with diesel oil in pilot scale. Soil samples contaminated with 0.5, 2.0 and 4.0 w/w% diesel oil were kept during 3 months in glass rectors (2 L internal volume) kept under anaerobic/anoxic conditions. The soil moisture was controlled at 80% of field capacity. Bioremediation processes were investigated with nutrient's adjustment (biostimulation), no adjustment (natural attenuation) and sterilized soil (abiotic process). The gases emitted from different reactors were collected in activated carbon cartridges and the GHG were collected in Tedlar bags. The chemical analyzes were performed using a gas chromatograph (Agilent 7690) with multi-detection using FID for $CH_4$, ECD for $N_2O$ and TCD for $CO_2$. VOC were analyzed using a mass spectrometry detector (Varian 450GC MS220). The results indicated that gaseous samples contained high concentrations of $CO_2$ but low concentrations of $CH_4$ and $N_2O$. The differences in composition of the gas emitted from the reactors regarding $CO_2$ were statistically not significant. Preliminarily, regarding VOC emissions, such as alkanes and alkenes (both branched), cycloalkanes, and aromatic substituted (such as ethyl benzene), the compounds with higher emissions were cycloalkanes and branched alkanes.

## KEYWORDS

Air emissions, Greenhouse effect, Soil bioremediation, VOC, GHG.

# MODEL ESTIMATES OF HOLOCENE REGIONAL LAND-COVER INFERRED FROM POLLEN RECORDS FOR CLIMATE MODELLING

***Anna-Kari Trondman****
***Florence Mazier***
***Ralph Fyfe***
***Anne-Birgitte Nielsen***
***Marie-José Gaillard****
*[*]School of Pure and Applied Natural Sciences, Linnaeus University, Sweden*

## ABSTRACT

In order to refine climate models and to get a better understanding of the climate-vegetation feedbacks, the LANDCLIM project (sponsored by VR and NordForsk) has the objective to produce quantitative estimates of regional land-cover changes during the Holocene in NW Europe. The purpose is to evaluate the effects that human-induced landcover changes may have had on the regional climate through altered feedbacks. We use fossil pollen data and the REVEALS model to produce estimates of the percentage cover of individual taxa and plant functional types (PFTs). The past plant cover will be compared with the outputs of the dynamic vegetation model LPJ-GUESS, and applied to run the regional climate model RCA3. The first land-cover estimates are based on REVEALS runs using pollen from both lakes and bogs with chronologies based on ≥3 dates, 25 taxa (entomophilous taxa excluded) and, for each taxon, the mean of all pollen productivity estimates available. The maps are produced for 10 PFTs (for LPJ-GUESS) and 3 major land-cover types (for RCA3) at a 1ºx1º spatial resolution of for five time-windows with contrasting landcover. REVEALS estimates are now available for most of the countries in the study area and are compared with past land-cover obtained through different approaches such as historical data in conjunction with population/land-use models. A combination of estimates using complementary methods might be a sound way forward in the attempt to produce past land-cover data useful for climate modelling.

## KEYWORDS

Model estimates, Holocene, Regional land-cover changes, Fossil pollen data.

Investing in your future

Linnæus University
Sweden

EUROPEAN UNION
European Regional
Development Fund

IN PARTNERSHIP WITH THE
Knowledge Foundation

BROFÄSTET
HOTELL & KONFERENS KALMAR

VATTEN OCH Samhällsteknik

SUSTAINABLE
Sweden Southeast AB

VINNOVA

Kalmar Energi

RAGN-SELLS
En del av kretsloppet

Kährs®
QUALITY IN WOOD SINCE 1857

Flexus
BALASYSTEM

Länsstyrelsen
Kalmar län

IVA

e·on

SI.
Swedish Institute.

THE REGIONAL COUNCIL
IN KALMAR COUNTY

KSRR
KALMARSUNDSREGIONENS RENHÅLLARE

PURAC

Sida

STINT
Stiftelsen för internationalisering av
högre utbildning och forskning
The Swedish Foundation for International
Cooperation in Research and Higher Education

MIND MANCER
MJUK BEVAKNING