PROCEEDINGS

LINNAEUS ECO-TECH 2014

INTERNATIONAL CONFERENCE
ON
NATURAL SCIENCES AND TECHNOLOGIES
FOR

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

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

Linnaeus Eco-Tech

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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.

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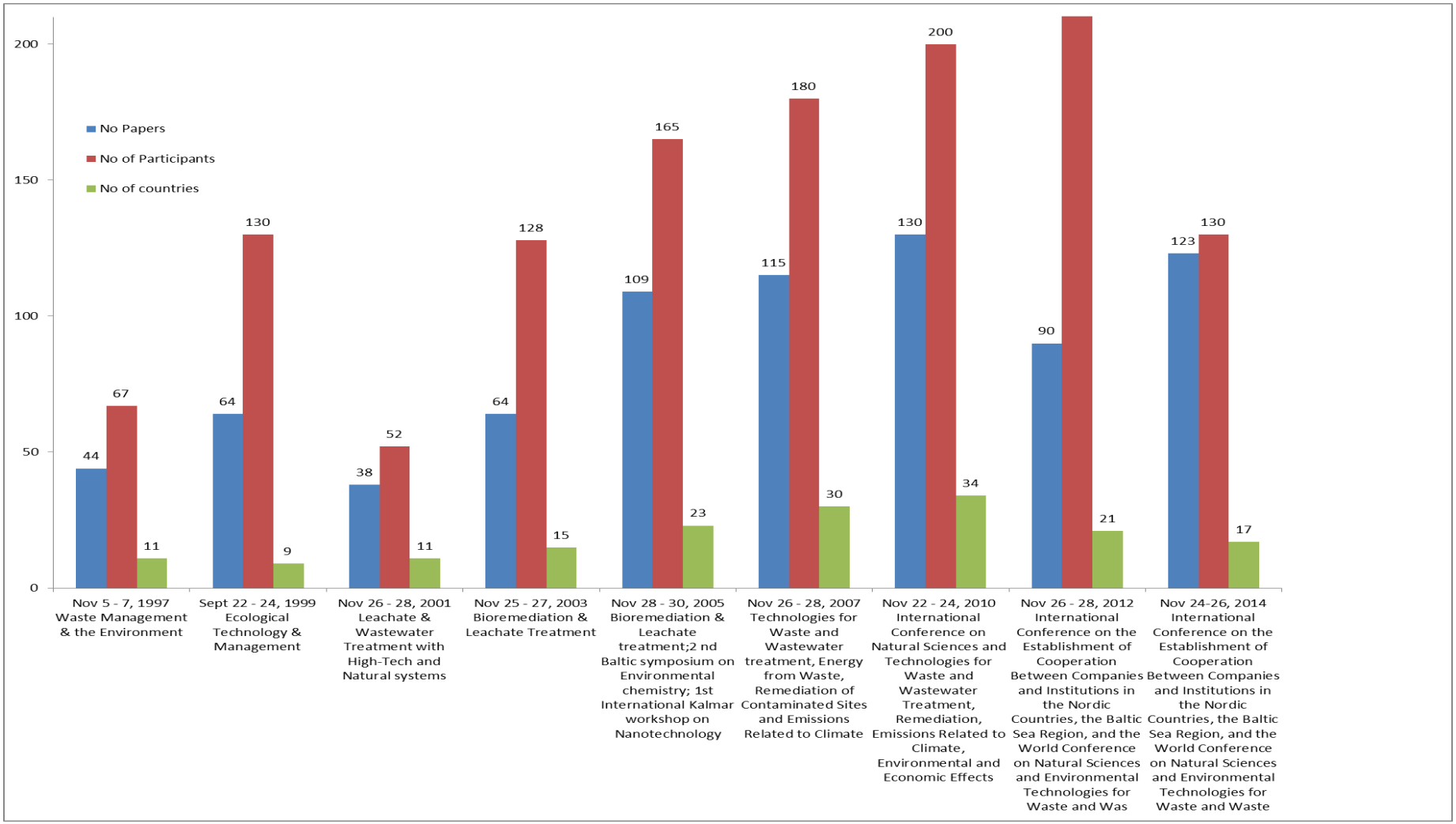

Figure 1. Kalmar ECO-TECH' 1997, 1999, 2001, 2003, 2005, 2007, 2010, 2012 and 2014. The themes are highlighted and number of papers, participants and countries

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	Dr Lennart Mårtensson University of Kristianstad, Sweden

	Technology for Waste Water in the Baltic Sea Region, Šiauliai, Lithuania	
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, 2006	The 6th International Youth Environmental Forum of Baltic Region Countries ECOBALTICA 2006, St. Petersburg, Russia.	Vaslii Rud, International Director, William Hogland; State 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 7th 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
2013	February 2013: International PhD course in Landfill Mining, in Estonia 18.09.13 Seminar and Closure ceremony of the Kudjape landfill, Estonia International seminar **„**Waste Dumpsite Recovery – Challenges for Latvia and Experiences of Europe Countries" Tuesday, 2013. 10th December, Riga, Latvia	Organisers: William Hogland, Linnaeus University; Mait Kriipsalu Estonian University of Life Sciences; *Gintaras Denafas, Kaunas University of Technlogy* Official persons from Swedish EPA, Swedish Institute; William Hogland Linnaeus University; Estonian Minister of Environment; Mait Kriipsalu Estonian Uni of Life Sciences; MoE, Estonia; Latvia Waste Mangement Association; , Kyiv Nat. University; Organizing: „Waste Management Association of Latvia" (LASA) in cooperation with Environment Protection Department, the Ministry of Regional Development and Environment Protection
2014	ERASMUS visits and International seminar **"Landfill mining in the context of global environmental mitigation"** Department of Environmental Technology, Kaunas University of Technology, Kaunas, Lithuania 06-11.04.2014 Landfill Mining project Vika Landfill seminar, Katrineholm (2013-04-25) Seminar on Landfill mining, Sätra Gård, Sweden 23 april 2014 International PhD course in Landfill mining I and II, Sätra gård, Sweden, summer 2014	Organisers: Gintaras Denafas, Kaunas University of Technlogy, William Hogland, Linnaeus University, SE; Mait Kriipsalu, Estonian University of Life Sciences others were Kyiv National T. Shevchenko Universit and Lappeenranta University of Technology Tekniska Verken, Linnaeus University, RGS 90, LundaHydro AB Ragnsells and Linnaeus University Ragnsells, Linnaues University and Estonian University of Life Sciences

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 30th 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 1st 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, 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, were acknowledged.
In 2012 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.
During the Linnaeus ECO-TECH 2014 the Triple Helix concept became even stronger and the concept "Beyond the Zero Waste" was introduced which encourages recovery of all materials lost during the entire life cycles of different products manufactured, and which are still available in different sinks (landfills, sediments of rivers, ocean, etc.). All waste, materials and chemical compounds lost as sludge, slag, harbor sediments and others can in principle, be returned to the anthropogenic loops and the toxics substances could be removed from the circuits and handle in an environmental friendly way. The long-term goal is to apply such innovative approach in an environmental and economic efficient way, making use of the accumulated knowledge, including reuse/recycling of materials bound in urban and rural structures. This time many thanks goes to the administrative secretary Jelena Lundström, the staff of the Envrionmnetal Science and Engineering Research Group: Fabio Kaczala, Joacim

Rosenlund, Yahya Jani, Parisa Hassanzadeh and also Ann-Christin Bayard from Sustainable Sweden South East making it possible to organise the workshop in Swedish “Remediation of Oskarshamn harbor – New knowledge and new possibilities.
Thank you to everyone who helped makes the event happen!

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David Newman	ISWA (President of International Solid Waste Association)	Austria
Vasiliy Rud	St. Petersburg State Polytechnical University	Russia
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Anders Granlund	SIDA (The Swedish International Development Cooperation Agency)	Sweden
Henrik Blomberg	Tillväxtverket (Swedish Agency for Economic and Regional Growth)	Sweden
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INVITED SPEAKERS AT OPENING CEREMONY

FROM THE FALL OF THE BERLIN WALL TO AN INTERNAL EU SEA

Håkan Brynielsson
The Regional Council in Kalmar County, Sweden

ABSTRACT

With the longest coast line in Sweden the development within Kalmar County is very much depending on the status of the Baltic Sea, but also on the relations and cooperation with other regions in the Baltic Sea Region. What actions have the regional council conducted since 1989 and what networks are we working in to secure a good environmental status of the Baltic Sea and to make the coast line of our region an attractive place to visit as tourists or even to settle down in? What kind of challenges are there ahead of us in our cooperation in the Baltic Sea Region in relation to questions like transport, business development and safety?

KEYWORDS

Regional development, Baltic Sea Region, Cooperation, Environment and sustainability

INTRODUCING INNOVATION AND IMAGINATION IN OUR RELATIONSHIP TO A SUSTAINABLE ENVIRONMENT

Désirée Liljevall
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Sweden

ABSTRACT

In Sweden, we often hear that we are good at taking care of our garbage. Large quantities of paper, plastic, glass, and metals are sorted and recycled. Less is spoken about the fact that we have totally failed with the overall goal of our waste – to reduce the amounts. Swedish households throw away an average of four to six kilos of perfectly edible food per week and approximately 56 kg per person and year. We waste numerous tons a year because we buy too much and simply do not find the time to eat the food before it gets too old. 30 percent of all fresh fruit and vegetables are thrown away from the produce section in the grocery store even before it reaches the shopping carts of the consumers. Putting food shortage in needy countries as opposed to food waste in prosperous countries is pure mockery to the millions of people who do not sufficient food for the day. 1,3 billion tons of the Earth's eatable masses end up as rubbish. Instead of providing for the millions of people who are hungry, the food ends up in the bin. Italy´s annual food waste could feed the entire undernourished population of Ethiopia. We should be ashamed of ourselves. Increasing the status of old food along with creativity can reduce food waste. Innovative thinking: selling soups or making marmalade out of crestfallen fruits and vegetables, are ideas that resourceful entrepreneurs come up with, all in keeping with the struggle towards a sustainable planet and a reduction in food waste. Furthermore, each one of us must think twice about our own habits when it comes to handling the goods in the fridge. Above all, we who live and work in today´s society must dare to smell and taste the food and rely on our senses the way that man has done throughout the ages.

KEYWORDS

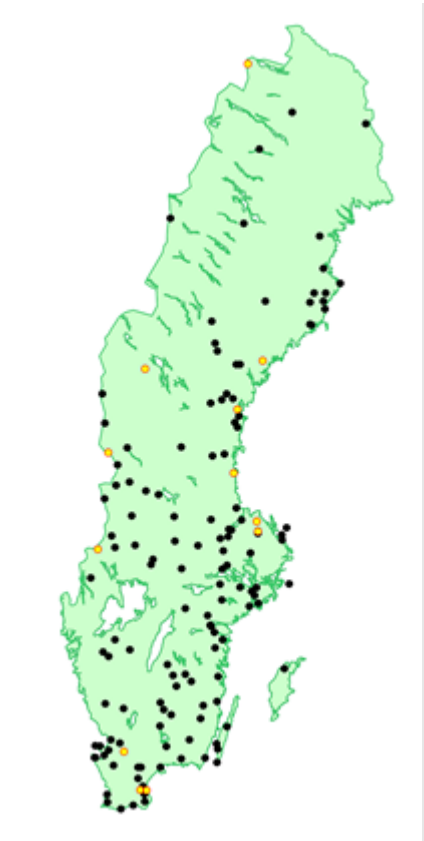
Garbage, Food waste, Urban mining, Creativity, Sustainability

CLIMATE CHANGE- WITH FOCUS ON PAST AND FUTURE CHANGES IN PRECIPITATION OVER SWEDEN-

Weine Josefsson
SMHI,
Sweden

ABSTRACT

Past Summers in Sweden we have seen a number of events with heavy precipitation flooding sewer systems, damaging roads and railways. Is this a sign indicating a change in the climate? What can be seen in the observations and what can we expect in the near future.



Swedish sites that have had at least 90 mm precipitation during one day in the period 1961-2014-August. Yellow dots two times.

QUO VADIS

Maja Heuer,
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Sweden

ABSTRACT

The Kingdom of Crystal in Småland is absolutely unique and one of Sweden's most exciting regions when it comes to cultural heritage and design. However, there is an ongoing transitional process with glassworks cutting back or closing down altogether. The knowledge of glass, its cultural heritage, craftsmanship, and the basis for renewal in art and design is at risk.
With the present situation of The Kingdom of Crystal in mind, new possibilities must be created in order to establish a sustainable, long-term renewal of a practice as well as regional development in an area where the glass industry has lost its role and is in need of redefinition. New innovative products in glass need to be developed and interesting markets and target groups within interior design, where glass is combined with other materials, lighting, the public sector and public commissions. Today, glass design is an expanded field not only limited to traditional products such as vases, bowls, and tableware.
That is why The Glass Factory museum and hot shop was initiated. The Glass Factory owns Sweden's most comprehensive collection of art glass, which consists of about 40,000 objects from various glassworks by more than fifty artists who have worked with glass, from the 18th century up until now. In addition, there is an extensive archive with hundreds of thousands of documents. A pivotal part of the museum is the hot shop which encourages the renewal of glass through national and international exchanges, an artistic production, and by being a creative meeting place for artists, designers and visitors in order to work in new innovative ways to increase regional growth.

KEYWORD

Glass industry, Artistic production, Risk, Sustainability

TRIPLE HELIX, EDUCATION AND COOPERATION

URBAN DEVELOPMENT AND LEADERSHIP FOR SUSTAINABLE CITIES

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ABSTRACT

As climate change increasingly impacts our communities, the need for emission reduction efforts is rising. This need is not, however, met by concrete actions. Achieving broad agreements between countries is seen as essential in order to meet a challenge that is global. At the national level, there is nevertheless an inertia and in some cases even a political unwillingness to enter into binding agreements. This has been illustrated in recent negotiations on climate change agreements. In an era of fast- urbanization, increased attention has turned to cities. Driven by processes of industrialization and urbanization, the world's cities account for a significant share of global emissions posing great challenges to sustainable development in many ways, But cities are also arenas where new ideas and technical solutions are developed and implemented. Many cities also learn from each other: There is a growing number of networks existing today, where cities cooperate in finding sustainable solutions as well as engaging in benchmarking processes. More than ever before, cities are at the very heart of sustainable urban development. The ways cities are constructed and administrated play a crucial role in tackling challenges facing the world of today. Governing a city is a quite demanding task. It implies striking a balance between many diverging interests, while at the same time pushing forward in the chosen direction. This is why urban leadership needs to pursue an integrated and holistic view of cities, acknowledging the fact that nobody has the full ownership of a city. Most fundamentally, urban leadership is about creating broad coalitions based upon a culture of consensus. The organizational structures of cities are furthermore highly complex. With the development of increasingly advanced technologies and systems, new ways are accessible for solutions in areas such as transport, energy, waste management, drainage and water supply. This brings about new opportunities for sustainable urban development, while it also places greater demands on the leadership administration. The complexity of cities adds another dimension to urban leadership: Cities need to be flexible, and able to adapt to an unpredictable and fast-changing future. The long-term vision and strategy therefore has to be balanced by flexibility. In short, the practical work of sustainable urban development contains several key components. Cities must have a vision to start with, an organization that can work with the adopted vision and practical tools for the vision to be implemented. The key lies in urban leadership.

KEYWORDS

Sustainable development, Nordic cities, Urban leadership, City administration, Coalitions

ECOTECHNICS/ECOTECHNOLOGY IN ÖSTERSUND – 30 YEARS OF ENTREPRENEURSHIP FOCUSED EDUCATION

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Sweden

ABSTRACT

1983 was the starting year for an interdisciplinary and sustainability oriented education at the former university college in Östersund, located in the Mid Sweden mountain region. In this paper – 30 years later - the different phases that the educational program has passed over the years is examined with an entrepreneurial focus. In 1983 the "slogan" for the education was: "Ecology, economy and technology in cooperation for sustainable development". One of the main ideas was to have a problem solving and entrepreneurial focus in the education. The goal was that the students should be prepared to start their own businesses after graduating, based on ideas they had developed during the education. The first years the program was two years in length, partly based on the idea to not "wear out" eager entrepreneurs with too many study years. Later a third year was added, to fulfill the bachelor's level. In the late 1990's the education had become part of Mid Sweden University, which during that period were struggling for full University status. This put pressure towards "academization" of the education program, which had its benefits but also its problems from the entrepreneurship angle. During the first decade after the millennia shift the education took a more international focus attracting students from many countries all over the world. A Master's level was also added to the program and the first graduate students received their Ph.D. during this period. The latest development is to split the Bachelor's program into three "sister" programs: the Ecoengineers with a more traditional engineer focus (but still interdisciplinary), the Ecoentrepreneurs with less chemistry and math, but more social entrepreneur and green procurement courses, and the Ecotechnology students standing in between as the most interdisciplinary students.

KEYWORDS

Sustainability education, Problem based learning.

APPROACH FOR SUSTAINABLE PROCESSES FOR THE BUILT ENVIRONMENT IN TRIPLE HELIX COOPERATION – THE CASE OF STORSJÖ STRAND IN ÖSTERSUND

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ABSTRACT

The built environment is an important component for a sustainable society. Choices made today will affect society during decades to come, both regarding performance of buildings and in affecting what is possible choices regarding mobility, energy, waste handling and human well being in general. There have been several projects in Sweden and around the world aiming at better sustainability performance of new built areas. A strong experience from earlier projects is that it is not that easy to actually achieve high ambitions set up at project initiation; the most common example in this direction that requirements on energy efficiency are not achieved when measuring in actual use of the final building.
One reason for this outcome is the complexity of building processes, the many actors involved, and that we in a free society do not want legislation or rules too intervening in the freedom of private entrepreneurship and creativity.
The project Storsjö Strand, a new township in Östersund in an earlier industrialized area, has aimed to work around identified earlier problems, using a strong interactivity and a triple helix process with the municipality, developers, and the university. The role of the university is to through an action research approach both be involved in the process to help guide it and to document and evaluate the process, with the research goal to contribute to and develop sustainable building processes for Sweden and elsewhere.
The Storsjö Strand project is presently an ongoing project. This paper describes the approach taken and how it is a development of earlier approaches for sustainable building processes and also evaluates early experiences of the triple helix process.

KEYWORDS

Sustainable building, Building processes, Energy efficiency.

ENVIRONMENTAL COLLABORATION IN PRACTICE – LESSONS LEARNED FROM KALMAR

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ABSTRACT

The Triple Helix platform project 2011-2014 further developed the wastewater treatment in the wood industry. Research was also carried out to study the actual practice of such collaboration between sectors. While the main project consisted of industry-university collaboration, initiatives to increase the unofficial regional networks of Triple Helix collaboration were also studied. Interactive research method was used to be able to work in this process and to gain access to the practical knowledge the participants have about this kind of work. Results from this show the importance of informal contacts and forums for discussion between sectors. Other important areas were the financing and time frames which are different and how such differences surface in the interaction between sectors. The changing role of university meant that researchers had the responsibility of creating knowledge with industry and other actors in society, reaching practical results and results of societal relevance. This increased emphasis on the practical relevance of knowledge had to be balanced with the traditional goals for research. Whether or not this is talked about as a Triple Helix there are several points of interest that can be related to wider changes in the way research and the third task is conducted and the context in which research is performed affects the day-to-day activities of the people working in such an environment.

KEYWORDS

Triple Helix, Environmental science, Interactive research, University-industry collaboration.

INTERNATIONAL NATURAL SCIENCES EDUCATION AND TRIPLE HELIX IN SAINT-PETERSBURG POLYTECHNICAL UNIVERSITY

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Russia,

ABSTRACT

In line with government policies aimed at attracting foreign contingent of students in universities in Russia, the problem of improving the quality of training of foreign citizens in the Russian higher education are particularly relevant.

In the St. Petersburg Polytechnic University for foreign students is responsible Institute of International Educational Programs (IIEP). We have developed a number of innovative solutions, including the main way of additional lessons, presentations and competitions. Students began work as a laboratory "Seventh Heaven", which will be carried out together with the teachers to develop scenarios for physics laboratory classes for subsequent sale in the form of training films.

Annually IIEP SPbSPU training on the training program in high school comes more than 300 foreign students from around the world. Now increased the number of foreign students who want to become professionals in the construction industry and the environment safety. We have developed a number of innovative solutions, including the main way for more lessons, presentations, contests, and this contributes to the mastery of the language of the subject as a practical means of obtaining scientific information in the volume provides an understanding of the texts of textbooks and lectures at the university at the further training in the general stream with Russian students [1]. Laboratory equipment was purchased under'll benefit a project under the administration of the Competition of the St. Petersburg Polytechnic University titled "Laboratory of my dreams" [2].

Constantly there is an improvement of laboratory instruments Physical Laboratory IIEP, which gets a new job, in particular - known corporation PHYWE. One of the trends is the expansion of a number of works in which the computer is used as a measuring stand, using technology Labwiev (Laboratory Virtual Instrumentation Engineering Workbench).

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UBATUBA'S SUSTAINABILITY CHALLENGE: FINDING OPPORTUNITIES FOR BUSINESS AND RESEARCH IN ENVIRONMENTAL MANAGEMENT, URBAN DEVELOPMENT AND FOREST CONSERVATION

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Brazil

ABSTRACT

The basic intention is to present Ubatuba, and the Green Coast region, as a space where the confluence of the largest preserved area of the Atlantic rainforest (recognized by UNESCO as both World Heritage Site and Biosphere Reserve) is threatened by poverty on one side and extremely fast economic development on the other. The idea is to present Ubatuba not so much for its achievements (there aren't that many) but for its potential as a hub for environmental science (including remediation and mitigation of oil impacts, as the nearing oil boom will require) and social/environmental responsible business ventures. We are not so much offering an opportunity for business investments for the profit opportunity, but for the exposure and the scale to make highly visible, replicable projects.

KEYWORDS

Ubatuba**,** Atlantic rainforest**,** Biosphere Reserve**,** World Heritage

POWER OF SOLID MUNICIPAL WASTE

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ABSTRACT

Land pollution belongs to the most serious environmental problems in Ukraine. The existing system of placing municipal solid waste (MSW) on landfills without proper pre-treatment based on ideas of the 1970s still dominates. Natural landscapes of Ukraine are largely destroyed due to legal and illegal landfills that exceed the space of all National parks and natural reserves. Currently Ukraine is going through massive social and political changes that allow modernization of the country on the basis of the fundamental trends of the sustainable development (SD). Waste management is a subject of particular attention. There is risk to give preference to outwardly attractive economic development, without regard to the unified, holistic models of the SD concept.

Landscape ecology is one of the sciences that explore complex issues of interaction between society, economy and environment. It has to be effective in producing appropriate knowledge for landscape-development processes and would be suitable for use in collaborative decision-making on a local level.

The purpose of this publication is to highlight opportunities for applied research in the area of MSW management which is the most problematic area in social and environmental measures. This is a subject for international environmental cooperation aimed at ensuring proper quality of Ukrainian landscapes as the country is seeking to be part of Western Europe. This paper presents local feasibility plan aimed at resolving problem of handling municipal waste flows and improving quality of urban landscapes. It is also aimed to show how significant the role of university has been in supporting the Triple Helix model, a driving force of MSW management on the local level.

KEYWORDS

Municipal solid waste, MSW management, Landfill, landscape, Enhance landfill mining, recycling, Sustainable development, Triple Helix cooperation, Baltic countries, University

AN OPEN TRIPLE HELIX FORUM – HOW THE FORUM MTF LEAD TO AN UNEXPECTED WIN-WIN SITUATION

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ABSTRACT

Informal meeting points are a growth ground for ideas and collaboration opportunities. One such initiative is called the "Miljöteknikforum" or Environmental Technology Forum. When using informal meeting places there are possibilities for the Triple Helix sectors to meet. One example of this is when representatives from industry and municipality sat in a meeting with a researcher from the university. During this meeting it was discovered that the issues that industry and municipality had were similar and the current focus of the research could help solve these problems. To know if the demands and goals of the different sectors are synchronised representatives from the different sectors have to meet in open forums.

KEYWORDS

Triple Helix, Environmental technology, Open networks

BALTIC SEA CHALLENGE – NETWORKING AND EXPERIENCE EXCHANGE ENHANCING THE IMPLEMENTATION OF CONCRETE WATER PROTECTION MEASURES

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ABSTRACT

Watercourses are affected by eutrophication, harmful substances, maritime traffic and leisure boating, dredging, littering and building of infrastructure. On the other hand, nature is an important factor for the well-being of coastal municipalities and industries. Monetary value of the ecosystem services produced by the Baltic Sea is about 5 billion Euros annually. These regulating services, natural resources and recreational services are responsible for e.g. recycling of nutrients, flood prevention, providing fish stocks and a framework for tourism. The protection of waters is governed by international and national laws, intergovernmental conventions and regional or local environmental permits. However, also the implementation of EU or HELCOM regulations is usually carried out on the local level. Municipalities, ports and water utilities examples of local actors which can set their own, more ambitious goals and take further steps for being exemplary – not only complying with regulations but accomplishing voluntarily measures for water protection. Cities of Helsinki and Turku in Finland see the state of the Baltic Sea as a basis for their competitiveness. They decided in 2007 to launch the Baltic Sea Challenge initiative for the protection of the sea: they published a joint Baltic Sea Action Plan with almost 40 activities that were additional to legal requirements, and challenged other organisations to join. In 2014 the network includes 200 organisations around the Baltic Sea. Together, events are organised, materials produced and best practices shared, in order to protect the waters. The network is free of charge and open to all. Helsinki and Turku updated their joint Baltic Sea Action Plan for 2014–2018, and new operating model with priorities for the network were set out. Baltic Sea Challenge continues to provide benefits and function as a strong communication channel for members, while retaining its distinctive nature as a free-form, easy and direct network.

KEYWORDS

Baltic Sea, water protection, cities, municipalities, voluntary, cooperation, networking, network mobilization

ZERO WASTE: THE JOURNEY OF AKZONOBEL

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Akzo Nobel Pulp and Performance Chemicals AB, Sweden

ABSTRACT

AkzoNobel's sustainability strategy, Planet Possible, captures the essence to deliver more value from fewer resources in a value chain prospective. As a part of this strategy, AkzoNobel has set the "Zero waste" goal and is actively working with waste minimization programs. Together with reducing waste at the source, one way of reducing waste is also to build industrial clusters, where waste streams from own manufacturing plants can be converted into material input for other plants, both internally and externally to AkzoNobel. AkzoNobel's working procedure, success stories, legal challenges and opportunities of thinking in terms of industrial clusters will be presented in order to reach a final zero waste production and a more efficient and wise use of natural resources.

KEYWORDS

Zero Waste, Reclassification to by-product, Industrial clusters, REACH legislation

WETLANDS AND PHYTOREMEDIATION

METAL AND METALLOID SEQUESTRATION IN A CONSTRUCTED WETLAND SYSTEM FOR TREATMENT OF LANDFILL LEACHATE DURING 2003-2012

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Sweden

ABSTRACT

The treatment of landfill leachate in constructed wetland systems is a common practice in Europe. However, very few studies were made to evaluate their performance over a long period of time. A free surface constructed wetland system consisting of sediment traps followed by 10 ponds connected with overflows was built at Atleverket near Örebro, Sweden in 2001. It receives pre-treated leachate from the municipal landfill. As part of the wetland monitoring programme a large data set on the surface concentrations of 15 metals and 2 metalloids has been collected from different sampling sites within the wetland during the operation period. In this study, the data from inlet and outlet of the wetland were compiled and analysed. The aim of this paper is therefore to estimate the removal efficiency of metals and metalloids using data on concentrations and flow and investigate the effect of wetland age on removal pattern. The elements with the highest removal efficiency were Al, As, Ba, Ca, Cr, Cu, Fe, Mn, Pb, V and Zn ranging from 95% for Pb to 65 % for Ca. The elements with the lowest reduction were B, Co K, Mg, Ni and S ranging from Co 56 % to 40 % for S. It was found that the removal efficiency was not related to inlet concentrations of the elements as the elements with high and low inlet concentrations were found in both groups. Analysis of reduction pattern also revealed that the group with higher removal efficiency showed fairly constant outlet concentrations during the study period, while the elements with lower removal efficiency demonstrated variable outlet concentrations. No statistical difference in removal due to age of the wetland was found. The study results showed that the wetland system has high removal efficiency of metals and metalloids and the removal pattern is not affected by age of the wetland. The influence on reduction due to leachate characteristics, wetland design and retention time will be discussed.

KEYWORDS

Landfill leachate, Treatment wetlands, Wetland design, Metals and metalloids

TREATING URBAN STORMWATER IN CONSTRUCTED WETLANDS IN KALMAR, SE SWEDEN, FOR IMPROVED WATER QUALITY AND BIODIVERSITY

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ABSTRACT

Stormwaters' heavy loads of nutrients, metals and oil etc, via urban ditches / streams, are increasingly treated in engineered shallow wetlands/ponds. Such approaches are still only remedying a minor part of affected storm waters, urban streams, and freshwater and marine recipients. In the western part of Kalmar, a medium sized Swedish town at the Baltic Sea, > 10 such wetlands / ponds are established for reduction of such heavily polluted waters. Aiming at determining the effectiveness in reduction of nutrients and metals, and the facilitation of the aquatic biodiversity (primarily in the wetlands), monitoring programs were initiated. Regular in/outflow water sampling, water flow and biology, were followed for 1-2-3 years (varied with parameter) after construction in two of these wetlands. Skälby Dämme, constructed 14 years ago, showed 40-50 % nutrient reduction figures, less for TSS and metals, while Hagbygärde Dämme, constructed two years ago, attained only much lower figures. Reasons might be that Hagbygärde is less surrounded by forested land, also that only one year elapsed before evaluation commenced, while two years in Skälby. More recent monitoring in Skälby Dämme will also be compared with. Moreover, this kind of wetlands/ponds can favor the biodiversity of benthic invertebrates, (aquatic) plants and birds.

KEYWORDS

Stormwater, Wetland, Nutrient reduction, Metals, Biodiversity, Benthos, Plants

PHYTOREMEDIATION OF PETROLEUM HYDROCARBONS CONTAMINATED SOILS WITH ALFALFA (MEDICAGO SATIVA)

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Fabio Kaczala [2]
Yahya Jani [2]
William Hogland [2]
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[2] *Department of Technology, Linnaeus University, Sweden*

ABSTRACT

The contamination of soil by petroleum hydrocarbons is of major concern worldwide nowadays. Some petroleum compounds are extremely persistent in the environment and affect negatively the health of living. Thus, the remediation of contaminated soil deserves more attention. Different physical and chemical remediation methods can be applied but they are costly. Phytoremediation is an alternative method that use plant and associated soil microbes to reduce concentration and toxic effects of contaminant in the environment. In this work the remediation of petroleum hydrocarbon contaminated soil from a former car scrap yards was investigate using a phytoremediation with Medicago sativa. After five months, the results showed that alfalfa survival capacity and dry biomass were significantly lower in contaminated soil (CS) in comparison to non-contaminated soil (NCS). Only 5% of plants survived in CS and petroleum hydrocarbon C10-C50 content in soil after phytoremediation were not statistically lower in comparison to the unplanted treatment. Using alfalfa alone is not a good strategy to reduce hydrocarbons in aged contaminated soil. Further studies are in progress to improve this phytoremediation process.

KEYWORDS

PAHs, Metals, Phytoremediation, Compost, Contaminated soil

WASTEWATER TREATMENT IN WOOD INDUSTRY

WASTEWATER TREATMENT–WOOD INDUSTRY: A TRIPLE HELIX APPROACH TO A FULL SCALE PROCESS AND 6 PhDs 2007-2014

Bruce Uhler
Åke Erlandsson
AB Gustaf Kährs,
Sweden

ABSTRACT

The Project - The Environmental Science & Engineering Group (ESEG) for several years conducted research into industrial water treatment, both process wastewaters and storm water in the wood industry.

The discharge of industrial wastewaters into either municipal sewerage system or directly into recipient water bodies has raised serious concerns during decades, leading to intensive research and development of on-site treatment technologies for industrial wastewater. However, whereas investigations have been focusing on industrial sectors that have water as an important input to their manufacturing processes, "dry-process industries" such as wood-floor and wood furniture industries that have no water requirement in their production processes have been neglected. One of the most neglected storm water types is storm water runoff from industrial areas, which often discharged directly and untreated into the nearby recipient water body. Even if significant research on urban runoff was carried out since the late 1970' and beginning of the 1980's investigation on industrial storm water is scarce. In these areas the group are today conducting research in close cooperation with EU and industries.

KEYWORDS

Wastewater, Wood industry, Treatment

**Keynote speaker*

TREATMENT OF WASTEWATER GENERATED BY WOOD-BASED DRY INDUSTRIES: ADVANCED OXIDATION PROCESS AND ELECTROCOAGULATION

Henrik Hansson, *PhD*
Marcia Marques*
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ABSTRACT

For decades, the development of wastewater treatment technologies tailored for the wood sector has focused on those industries that have water as an integral part of the industrial production, such as paper and pulp. However, there is a sector that has been neglected, which is formed by industries in which water is not part of their production line, such as, wood floor industries. These industries produces relatively low volumes of highly polluted wastewaters due to cleaning/washing procedure. These cleaning wastewaters are often sent to the municipal wastewater treatment plant. Once there, recalcitrant pollutants are diluted and discharged into recipient water bodies or trapped in the municipal wastewater sludge. Another type of contaminated water these "dry industries" often generate in high volumes, and which is usually discharged with no previous treatment, is storm-water containing contaminants that have leached from large wood storage areas. The aim of this work was to increase knowledge and to present on-site wastewater treatment options for wood-based dry industries, with a focus on combined treatment methods and solutions applicable to both the cleaning wastewater and storm-water. Electrocoagulation was studied both as a standalone treatment and combined with sorption using activated carbon. The combined treatment achieved a COD reduction of approximately 70%. Some advanced oxidation processes were also studied: a COD reduction of approximately 70% was achieved by photo-Fenton, but the most successful AOP was ozone combined with UV light, were a COD reduction around 90% was achieved, with additional improvement in the biodegradability of the treated effluent. Ozone also proved to be effective in degrading organic compounds (approximately 70% COD reduction) and enhanced the biodegradability of the storm-water runoff from wood storage areas. The results have shown that the application of ozone can be considered an option for treatment of cleaning wastewaters and possibly for storm-water biodegradation enhancement.

KEYWORDS

Advanced oxidation processes, Electrocoagulation, Fenton, Industrial storm-water, Ozone, Respirometry assays, Wastewater, Wood floor industry

**Keynote speaker*

TREATMENT METHODS FOR TREATMENT OF WASTEWATER CONTAMINATED WITH OAK WOOD LEACHATE

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ABSTRACT

At log yards are water in contact with wood causing a leachate. This leachate are different depending on the type of wood handled at a specific industrial site. During the period 2010-2014 has researched at Linnaeus university been conducted with the aim to treat wastewater contaminated with oak wood leachate. Wastewater contaminated with oak wood leachate are found at wood industries that is handling pediculate oak. The contaminated water can be found as storm water on storage sites, irrigation water from timber irrigation process or process water from veneer production. Wood leachate has been found to be a source of organic matter (COD) causing high colour and toxic effect in the waste water. Present studies had a main focus has been on treatment studies with constructed wetlands. One study did follow 12 pilot scale wetland treatment system during 2 years. However more advanced treatment methods has also been tested in pilot scale at the university as ozone or low cost filter solutions with a mix of peat and ash.

KEYWORDS

Wetland, Storm water, Wastewater, Filter, Ash

OZONE-BASED ADVANCED OXIDATION PROCESS AS PRE-TREATMENT OF WASTEWATER FROM THE WOOD-BASED INDUSTRY

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ABSTRACT

Three ozone-based advanced oxidation treatments (O_3 only, O_3 with initial pH adjustment and O_3 /UV with initial pH adjustment) were compared for the treatment of recalcitrant wastewater generated during washing of surfaces and equipment employed in filling and gluing processes (urea-formaldehyde and phenol-formaldehyde resins) in a wood-floor industry in Sweden. The wastewater treated (initial COD 3400-4000 mg/L) was obtained at the outlet of a sedimentation tank, which receive an average inflow with COD of 45,000 mg/L. The experiments were performed in a semi-batch microbubble column reactor connected to a UV reactor, where 2.5 L samples of wastewater were submitted to the maximum dose of 2 g of O_3 per gram of initial COD. For the full-factorial design, the independent variables were O_3 concentration (gO_3/Nm^3); recirculation flow (L/min); and initial pH (pHi). The treatment performance evaluation was based on COD and TOC reduction (%), and the effluent obtained was used in respirometric assays with activated sludge to indicate variation in biodegradability/inhibitory effects. The results showed that pure ozonation at low pH promoted a reduction of 65% and 31% of COD and TOC respectively, but made the effluent less biodegradable. The highest COD and TOC reduction rates were achieved when O_3 /UV treatment with pHi = 9.3 were applied (93% e 56% reductions for COD and TOC respectively). The results with the respirometry tests suggest that application of O_3 only at higher pH values promoted biodegradability enhancement of the effluent, making it treatable by microbiota obtained with activated sludge from a municipal wastewater treatment plant.

KEYWORDS

Industrial wastewater treatment, advanced oxidation processes, ozone, UV, respirometry

SOIL REMEDIATION AND MINING

BEYOND THE ZERO WASTE CONCEPT

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ABSTRACT

During the last 40 years the existing solid waste management models have been developed and implemented including advanced systems for recycling, recovery and reuse. However, even though such waste management models have not been always economically feasible, recycling systems have been implemented due to the wide support from the citizens and their interest in source separation of solid waste. There has been a common sense among citizens and waste management companies that such models are sustainable in relation to natural resources depletion. Nowadays, "the zero waste concept" has been widely used not only in Sweden but in many regions of world discussing different ways of modern waste management in order to reduce the amounts of waste for final disposal as much as possible. Among the existing challenges, development of technologies for metal recovery, nutrients, and other valuable constituents that have escaped the anthropogenic circuits since the industrial revolution are some of them. During the next 30 years more focus must be addressed towards recovery of lost resources in ore mining waste, old landfills, in harbor and sea sediments, slag, ashes, sludge but also materials that are bound to urban constructions such as residential, commercial and industrial infrastructures, water distribution networks, sewage systems and underground electric/electronic networks such as telephone etc. An overview regarding the recovery of mentioned materials and chemical compounds called "Beyond the zero waste concept" will be presented in this paper in order to raise concerns and awareness about the importance of establishing a new model of waste management schemes..

KEYWORDS

Sediment mining, landfill mining, environment, metals, nutrients, toxic substances, chemical bindings, recovery, extraction, economy.
**Keynote speaker*

BIOREMEDIATION OF CLAYEY SOIL CONTAMINATED WITH CRUDE OIL: COMPARISON OF DYNAMIC AND STATIC B BIOPILES IN LAB-SCALE

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ABSTRACT

Bioremediation of aged and newly clayey soil contaminated with crude oil was investigated using two different strategies (biostimulation-BIOS and bioaugmentation-BIOA) and two different technological options: dynamic biopile (M) and static biopile with forced aeration (B). The inoculum used for bioaugmentation was from the aged contaminated soil and then, enhanced. The treatment was performed in triplicates and one control. Contaminated soil sampling was done after 0, 24, 59 and 121 days and Total heterotrophic microorganism (PHT), fungi (PF), oil-degrading microorganism (PDO) as well as the extracted total petroleum hydrocarbons (TPH) and the 16 polycyclic aromatic hydrocarbons (PAH) prioritized by U.S. EPA were analyzed. A reduction of the microbial population density of PHT, PF and PDO from 0 to 121 days was observed and the population densities of PHT and PDO were much higher in the bioaugmentation treatment in both biopile technologies at day 0. However, after 121 days, such PHT superiority was observed only in the static biopile with forced aeration (BIOA-B). The static biopile with forced aeration performed better in the removal of TPH when associated with bioaugmentation (BIOA-B), being equivalent to the dynamic biopile-B for the other treatments (CONT and BIOS). For PAH, the superiority of the biopile-B was less conspicuous but observed in both bioremediation strategies (biostimulation BIOS-B and bioaugmentation BIOA-B). The results suggested that regarding TPH, the strategy of bioaugmentation was superior to biostimulation and that the static biopile with forced aeration reached better contaminant reductions. However, the increasing amount of PAH observed after inoculation with PDO made difficult the comparison between biostimulation and bioaugmentation. Clayey soil contaminated with crude oil poses big challenges to the bioremediation, both due to the texture of the soil favoring adsorption of organic contaminants and to the complex contaminant composition.

KEYWORDS

Clayey contaminated soil, bioremediation, Bioaugmentation, Biostimulation, Dynamic Biopile, Static biopile with forced aeration.

**Keynote speaker*

AEROBIC BIOREMEDIATION: NEW SOLUTIONS AND APPROACHES FOR A CONSOLIDATED TECHNOLOGY

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ABSTRACT

Aerobic bioremediation is a consolidated technology widely used for the removal of many organic contaminants, in particular for those of petroleum origin (TPH, DRO, GRO, BTEX, ...). This technology optimizes the ability of autoctonous bacterial strains to oxidize contaminants (electron donors) using oxygen as an electron acceptor.
The biological process can be limited by many factors such as dissolved Oxygen availability. When dissolved Oxygen is not available, bacteria will use other sources of oxygen (electron acceptor) such as nitrates (nitrification), sulfates and other oxidized species. These other sources of oxygen are thermodynamically less convenient and result in reduced rates of contaminant removal.
From a process point of view is therefore necessary to ensure a good availability of oxygen to stimulate the most effective aerobic degradation reactions. Most of the products that release oxygen are based on CaO2 or MgO2 and should be injected into groundwater in the form of diluted suspension (slurry), dense and difficult to inject.
As an alternative to peroxides Oxygel is a product in gel form of new concept that can be injected as it is at a very high concentration of available oxygen with respect of conventional diluted slurries. The easy and low-volume injections can greatly reduce the total cost (product and injection) and duration of field operations. The duration of Oxygel in the subsoil is equivalent to CaO2 and MgO2 based products.
Weidemeier et al. (1999) showed that over 70% of fuels natural attenuation are due sulfates reduction by sulfate-reducing autoctonous bacteria. Further studies have shown significant success in remediation hydrocarbons exploiting the capabilities of sulfate-reducing bacteria (Reinhard et al., 1997; Anderson and Lovely, 2000; Somsamak et al., 2001; Sublette et al., 2006). For this reason, in collaboration with Carus, Redoxtech (USA) has developed OBC+ an innovative product to stimulate sulfate-reducing bacteria by supporting their activities with nutrients and buffering the pH. As a side effect precipitation of dissolved metals in the form of insoluble and stable metal sulfides has been observed. The use of OBC+ results in unexpected high contaminants degradation rates even in presence of residual free phase (LNAPL).
We will present the different available technologies to improve aerobic bioremediation reactions (Oxygen release, sulfate reducing bacteria stimulation) along with cost comparisons and several case studies.

KEYWORDS

Aerobic Bioremediation, Petroleum Hydrocarbons; Fuels, Oxygen Release,

INORGANIC SPECIES IN GROUNDWATER-HEALTH AND REMEDIATION: A GLOBAL OVERVIEW

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ABSTRACT

The most problematic species are anions, as adsorption of anions is weaker than adsorption of cautions. Adsorption of anions decrease with pH while the opposite is true for captions like most heavy metals. Anionic health affecting species are arsenate, fluoride, chromate and nitrate. Common adsorbents are organic matter and ferric hydroxides, the former adsorbing captions and the latter anions. Arsenic is an old poison that has made a come-back and found to be a health risk in groundwater. Coastal, reducing aquifers in Bangladesh, West Bengal in India, in the Mekong and Red River deltas in Vietnam carry arsenic causing melanises which might develop into cancer. Bangladesh is worst affected with 35-70 M people exposed, depending on the permissible limit, WHO:s at 10 mg/l or the national at 50 g/l. While arsenic is easily removed, filters do not function socially in developing countries – women expected to handle them are too burdened with other tasks. In Bangladesh it has been found that safe aquifers can be identified by sediment colours. Reddish oxidizing sediments carry low arsenic water.Manganese is another redox sensitive element, recently found to have adverse effect on chronically exposed children. The intellectual capacity is lowered even at levels below the WHO:s and Swedish permissible limits. Manganese is an essential element; its uptake is well controlled from food but not from water. Fluoride protects teeth from caries at levels around 1 mg/l but has a narrow therapeutic spectrum. Dental fluorosis occurs at 2 mg/l in warmer climates like in India. At 5 mg/l the skeleton is affected and at 10 mg/l crippling is seen. Fluoride filters do not function well in developing countries. A low capacity requires frequent regeneration. In India water harvesting is found to dilute the fluoride sufficiently to come down to lower levels. Chromium is in the form of chromate and as such mobile. Excessive chromate in groundwater is found in India at metal plating and leather tanning, industries at level of several mg/l. Uranium is not a health risk due to irradiation but may cause kidney problems. It is rather common in granitic terrains. The uranium species at neutral pH are anionic or have no charge while uranium is quite mobile.

KEYWORDS

Groundwater, Health, Mobility, Arsenic, Manganese, Fluoride

COMPARATIVE STUDY: TECHNIQUES FOR TPH AND PAH EXTRACTION FROM CLAYEY AND SANDY SOILS FOR CHROMATOGRAPHY ANALYSIS

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ABSTRACT

The objective of this study was to compare three extraction procedures: soxhlet (SOX), microwaves (MARS) and accelerate extraction with solvent (ASE) regarding the extraction efficiency of different fractions of total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) from sandy and clayey soil with aged contamination analyzed by gas chromatography. Besides the extraction efficiency, water, solvent and time consumption were also considered. Regarding clayey soil, for the extraction of different fractions of total petroleum hydrocarbons (TPH), ASE resulted in better recovery of n-alkanes and hydrocarbons resolved fraction (HRF). SOX and MARS performed better for the heaviest fraction (non-resolved complex mixture-NRCM). Regarding sandy soil, ASE performed better during extraction of all TPH fractions. In the case of polycyclic aromatic hydrocarbons (PAH), extraction with ASE showed the best result in both clayey and sandy soils. When other variables were taken into account (water, solvent and time consumption), MARS is the most economical method, particularly when TPH is the group of interest and n-alkanes is relatively less important in the analysis. Therefore, in aged contaminations, soil texture and the petroleum fraction of interest in the first place and availability of resources such as water, solvent and time in the second place must be considered before deciding what is the most appropriate extraction method.

KEYWORDS

Aged contaminated soils, Extraction methods, Gas chromatography, TPH, PAH.

ORGANIC BY-PRODUCTS FOR SUSTAINABLE SOIL REMEDIATION -THE EFFECT OF 3 DIFFERENT AMENDMENTS ON THE DEGRADATION OF DIESEL FUEL IN A TROPICAL ULTISOL

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ABSTRACT

In many tropical developing countries, economic incentives are small for soil remediation to take place. Such locations demand special strategies that are energy-efficient, locally adapted and economic. In situ technologies are appealing where energy and material costs are more limiting than the time factor. One potentially sustainable and economic way to enhance the self-organizing capacity of soil ecosystems is by applications of locally available organic by-products to stimulate the polluted ecosystem´s inherent capacity to heal by utilising the embodied energy of the organic pollutant itself, as an energy source for the necessary biochemical transformations. Tropical climate is favourable for biodegradation but many tropical soils are rich in clay which can inhibit the bioavailability of the pollutant and reduce biodegradation kinetics. A pilot scale experiment was performed in order to assess the capability of three amendments based on by-products; whey, pyroligneous acid and compost tea, to enhance degradation of diesel in ultisol. Biweekly applications of 6 mL whey kg^{-1} soil significantly increased the degradation rate but no positive effect on degradation was found of any of the other amendments.

KEYWORDS

Bioremediation, Self-design, Whey, Pyroligneous acid, Compost teas, Tropical developing countries

ADVANCED INTEGRATED IN-SITU TECHNOLOGIES OUTPERFORM TRADITIONAL REMEDIAL TECHNIQUES

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ABSTRACT

RGS 90 has been commissioned by the Swedish Military to remediate a large fuel storage facility servicing the military. RGS 90 is currently using both injection of oxygen released compound (ORC Advanced) and chemical oxidation (RegenOx) to degrade the petroleum products in soil and groundwater. The facility housed a variety of petroleum products for over 40 years and several documented release incidents resulted in the contamination of a 50,000 m^2 area. The largest known event occurred in 1958, where an explosion caused the release of 14,000 m^3 of various petroleum products. During the clean-up, only 8,000 m^3 of the product was recovered while an estimated 6,000 m^3 reached the surrounding environment. The site has been investigated since 2003. The client initially proposed a remedial strategy consisting of biosparging and in-situ chemical oxidation using hydrogen peroxide; however, RGS 90 found these methods to be unsuitable for this site due to the geology of the area, which subsists of impermeable and heterogeneous dense, rocky moraine. There are also safety risks and environmental hazards associated with the use of hydrogen peroxide. RGS 90 suggested an alternative method which was accepted by the Swedish Military and a pilot test was carried out in 2012. The pilot test included a series of volume injection tests and direct push injection of ORC-Advanced within an area with lower levels of contamination (<10 mg TPH/l). RegenOx was injected across another area over three campaigns with higher TPH levels (>10 mg TPH/l). Sampling at the two pilot test areas showed mass reductions of 95 – 100% of TPH after 4-5 months. The results from the pilot tests confirmed that the use of ORC-Advanced and RegenOx would successfully remediate the extensive TPH contamination at the site. The data gathered from this pilot test allowed RGS 90 to refine and optimize the proposed full-scale treatment of the wider plume. The full scale remediation process started in December 2013 in area C and D. ORC-Advanced was injected in 257 points, C-C 5 m. The initial results are looking very good. Sampling 6 month after injection shows that the target values have been achieved in almost all sampling points. During summer and fall 2014 RGS 90 are planning for the full scale remediation process of the remaining areas, (B1-B3). The plan is to inject RegenOx and ORC-Advanced into the ground and groundwater. In some areas free phase product has been noticed during the initial groundwater sampling, carried out to get a better delineation of the plume. Within these areas multiphase extraction might be used to remove the free phase.

KEYWORDS

Redmediation, In situ, Biological degradation, Chemical oxidation, Petroleum

COMPOST ASSISTED PHYTOREMEDIATION IN TREATMENT OF PAHs AND METAL CONTAMINATED SOIL

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ABSTRACT

The contamination of soil by polycyclic aromatic hydrocarbons (PAHs) and metal are of major concern worldwide nowadays. These compounds are extremely persistent in the environment and some are carcinogenic, mutagenic and teratogenic. Thus, the remediation of contaminated soil by PAHs and metal deserves due attention. Different physical and chemical remediation methods can be applied but they are costly, alternative micro flora and soil properties. Phytoremediation is an alternative that use plant and associated soil microbes to reduce concentration and toxic effects of contaminant in the environment. In this work the remediation of PAHs and metal contaminated soil was investigate using a double remediation technique: compost assisted by phytoremediation with *Medicago sativa*. The performance of this double remediation technique was investigated in terms of (i) pollutants concentration reduces after five months (ii) toxicity reduction by using different test organisms. Previews results show that *M. sativa* had a less biomass production in contaminated soil. But compost assisted by phytoremediation is efficient to reduce the concentration of some PAHs and metal in soil. Thus, the toxic effects on seed germination (*Lepidium Sadivum*; *Zea mays*) and earthworm survival are lower after the remediation ($p<0-05$).

KEYWORDS

PAHs, metals, Phytoremediation, Compost, Contaminated soil.

REMEDIATION AND TREATMENT OF DIOXIN CONTAMINATION: A FORMER SAWMILL SITE WITH SOIL AND SEDIMENTS CONTAMINATED WITH DIOXINE AND PENTACHLOROPHENOL

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ABSTRACT

Between 1928 and 1976, a sawmill was located at the shore of Brosjön in the small village of Ydrefors in Ydre municipality in eastern Sweden. During the last ten years of the sawmill's operating years, a product namned Servarex was used to prevent fungus attacks of the timber. Servarex caused a contamination of dioxine in the soil, as well as pentachlorophenol (PCP). In the main study, the sampling revealed concentrations of dioxine (610,000 ng/kg) that was the highest detected levels in Sweden. During the autumn of 2013, RGS 90 performed remediation of dioxine contaminated soil and sediment through excavation. The dioxine contaminated soil with levels above the hazardous waste limit (15,000 ng/kg) are not allowed to be deposed in Sweden. The soil was therefore successfully treated with chemical oxidation at RGS 90:s facility in Norrköping, Sweden.

KEYWORDS

Soil remediation, Dioxine treatment, Sawmill, Excavation

COMPARING SUBSTRADE PERFORMANCE AND LONGEVITY: NON-EMULSIFIED VEGETABLE OIL BLEND (CAP18®) FOR ENHANCED ANAEROBIC BIOREMEDIATION

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ABSTRACT

Enhanced anaerobic reductive dechlorination with emulsified and non-emulsified vegetable oils has been implemented globally. For effective reductive dechlorination of chlorinated volatile organic contaminants (cVOC) to occur, sufficient hydrogen must be generated to meet the stoichiometric demand of target compounds and non-target species (*i.e.* other electron acceptors). At many sites, abundant electron acceptors can limit the availability of hydrogen to support contaminant biodegradation. Therefore, substrates that release higher hydrogen yields over extended periods of time are generally more favorable. When choosing substrates for enhanced anaerobic bioremediation (EAB), two important factors to consider include 1) the rate at which the substrate is consumed and 2) substrate longevity following application. CAP18® Anaerobic Bioremediation Product is a non-emulsified vegetable oil blend consisting of triacylglycerols which are made up of fatty acids and glycerol. Once injected into the subsurface, the triacylglycerols slowly hydrolyze releasing volatile fatty acids (VFAs) and glycerol. The VFAs are large hydrogen-rich molecules that are digested by microorganisms via beta oxidation (or other processes). The down-gradient VFA plume produced after injection provides a long-term enhanced anaerobic bioremediation (EAB) reactive zone that supports active dechlorination of CVOCs. To quantify the transport and release of VFAs, a variety of experiments were performed to evaluate distribution and release of organic carbon from several biological substrates. Batch microcosm experiments were used to quantify the dechlorination kinetics in the presence of various biological substrates, and 1-D/2-D experiments were conducted to demonstrate initial substrate distribution and long-term VFA development. The VFA development was quantified during the course of the experiment using 1) TOC and 2) a GC-MS method to measure individual fatty acids (e.g. acetic, propionic). The results of these experiments will be presented with a CAP18® case study in the context of field application and performance.

KEYWORDS

Bioremediation, Anaerobic Bioremediation, Anaerobic Dechlorination, Reductive Dechlorination, Halorespiration, Chlorinated Solvents, Carbon Substrates, CAP18

LANDFILL MINING

DRIVING FORCES AND INHIBITORS OF SECONDARY STOCK EXTRACTION

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ABSTRACT

Even though it's well known to mankind that our common resources are limited and that recycling is a key for a sustainable future; in reality we see few examples of true recycling where virgin raw material is substituted by waste. There are endless number of examples where waste is utilized to some extent without solving the core issue: reducing the need of extracting virgin raw materials. This article analyses some of the driving forces and inhibitors that explains why it's so difficult establish secondary stock extraction although technology is available. The authors discuss and suggest possible ways for reducing the some of the main barriers.

KEYWORDS

Resources, Recycling, Economy, Sustainability, Circular Economy

DANISH EXPERIENCES ON LANDFILL MINING

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ABSTRACT

The concept of Landfill Mining (LFM) was developed back in 1953, and since then a number of projects and pilot studies have been carried out in Europe, USA, and Asia but in most cases the studies are unfortunately insufficiently described in the literature.
In Denmark the experiences from LFM are very poor - only two investigations have been conducted recently. The investigations were undertaken with different aims:

- Excavation of waste for recycling and combustable waste suited for incineration with energy recovery (Project Waste Minimization at Gerringe Landfill)
- Recovery of potential resources from landfilled shredder waste (Simple size fractionation of shredder waste from two mono landfills, http://www2.mst.dk/Udgiv/publikationer/2012/09/978-87-92903-44-0.pdf)

This paper provides an overview of the environmental and financial aspects of the LFM projects and discusses the future perspectives in Denmark.

KEYWORDS

Landfill Mining, Waste for Energy, Economics

LANDFILL MINING IN ESTONIA: DIALOGUE WITH THE AUTHORITY

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ABSTRACT

A full-scale Landfill Mining (LFM) project at Kudjape Landfill was made in 2012–2013 in Estonia. As a first in its kind, it was a new experience for the manager, technical team, and also the permitting body. In this article it is described how the LFM project was initiated, which requirements were necessary for permitting and monitoring, and which aftercare requirements were set when the project was over.
Landfill Mining is not described as a waste treatment method in EU legislation. Therefore, permitting will take place as an individual dialogue between the manager and authority. Requirements are set on basis of permitting similar environmental projects; however, this does not necessarily fit in purpose with sophisticated and multidisciplinary nature of LFM. Apparently, a dialogue with authority includes elements of bi-lateral education, and the participation of academic team is beneficial for LFM projects.
In this project, Estonian University of Life Sciences was contracted to monitor landfill water and gas, characterise excavated materials and do paperwork. Our comments, conclusions, and proposals will be presented in the article.

KEYWORDS

Environmental impact assessment, Permits, Aftercare routines, Environmental board, Sampling, safety

FEASIBILITIES AND PERSPECTIVES FOR LANDFILL MINING IN LITHUANIA

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ABSTRACT

Despite that mechanical-biological treatment and incineration as municipal waste treatment methods are already under starting positions, the landfilling leaves still a main MSW disposal method in Lithuania. Currently 11 modern regional landfills are exploited, and all in Lithuania acted district and township landfills and dumps have been closed and rehabilitated. The expected total amount of formerly landfilled recyclable fractions is about 645 Mt.
For EU funds closed and rehabilitated local landfills cannot be in principle "touched". However the used and eventually almost already fulfilled regional MSW landfills have the additional inducement for restoration by landfill mining. Also the mining of special landfills for construction and demolition waste becomes already the practical character.

KEYWORDS

Mechanical-biological treatment, Landfills, MSW.

LANDFILL MINING – POTENTIAL SOURCE FOR MAINTENANCE-FREE CONSTRUCTION MATERIALS?

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ABSTRACT

As the use of plastic products is very widespread, reuse of the plastic waste represents a huge challenge. Plastic packaging (e.g. thin plastic bags, foil, foodwrappings) and other plastic waste (pallets, garden furniture, buckets, sport and hobby equipment, car bumpers, canisters, pipes, bobbins, computer and TV cases, plastic refrigerator details, etc.) form the most problematic and continuously growing type of waste, that according to common solutions can be mainly landfilled, or incinerated. Initial sorting of waste and subsequent recycling of single-type plastics into uniform mass, granules or new products are the generally preferred solutions for recycling plastic. Recycling is normally performed based on one specific type of plastic, e.g. LDPE, HDPE, PS, PP or PET, in the course of which the sorted plastic waste is washed, shredded, dried and granulated. The biggest problem with mixed plastics is posed by the fact that polymers of different types are immiscible because of their different molecular weights and long polymer chains. Heating the polymers is not sufficient for decomposing polymer molecules; therefore, the polymers to be recovered must typically have identical compositions to achieve effective mixing. When plastics of different types are simultaneously melted together, they usually do not mix – like oil and water – and will form layers. Low-grade mixed dirty plastic is typically rejected from recycling. Rexest Grupp Ltd, however, has developed a technology for recycling mixed plastic waste.
In this study it has been discovered that mixed plastic waste that was landfilled for over a decade did not differentiate from the fresh mixed plastic, neither had the landfilled plastic lost its polymeric properties. Landfilled plastic needs only to be separated from other materials (eg textile, paper) and soil. After mechanical separation, recycling technologies that are able to use of mixed plastic waste, were as also able to handle mixed landfill plastic. Experiments demonstrate that construction materials and products like decking boards, noise barriers, garden furniture etc. could therefore be produced also from landfilled plastic waste, turning this waste into the maintenance free products that are also recyclable after decades of use. Taking into account vast number of landfills that contain plastic waste it raises question whether turning these materials into recyclable construction materials could form a new challenge and possibility to support the environment, and lower the need for the usage of new resources.

KEYWORDS

Mixed plastic recycling; landfilled plastic waste; incineration, waste plastic-to-product.

A STUDY ON METHANE DEGRADATION LAYER EXTRACTED FROM LANDFILL MINING

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ABSTRACT

Due to the harmful effect on the environment, landfill gas has to be collected and processed. One possible solution would be covering the landfill with a bioactive layer, where methane gas is oxidized.
The aim of this research is to study the possibilities of extracting material for the methane degradation layer from the landfill itself by means of Landfill Mining (LFM). Chemical and biological properties as well as hydro-physical properties like hydraulic conductivity and saturated volumetric water content of the fine fraction were measured to verify whether the material meets the requirements.
As the result of the study it appeared that the fine fraction sieved out during Landfill Mining was suitable as a methane degradation layer when mixed with amendments. The best ratio of components was found 60 % fine fraction from LFM, 20 % soil, and 20 % matured sludge compost.
The installation of the methane degradation layer has been finished. The research continues to closely observe the result of methane degradation in full scale. While applying the knowledge obtained in this study to any other landfill it has to be kept in mind that the properties of the covering layer and the ratio of components directly depend on the properties of the fine fraction, amendments, and the parameters of the landfill.

KEYWORDS

Bioactive layer; Landfill mining; Landfill gas; HYPROP, Hydraulic conductivity, Saturated volumetric water content; Oxytop.

THE ECONOMICS OF LANDFILL MINING SHREDER RESIDUE – FOCUS ON THE AFTERCARE

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ABSTRACT

The main part of shredder residues produced in Denmark is landfilled today. It is well-known that shredder waste contains resources that can be recycled or incinerated with energy recovery and is a better solution than landfilling the material. The Danish Government launched its Resource Strategy in the summer 2014 with the objective that shredder residues ought to be landfill mined towards 2024. Consequently, pre-landfilled shredder waste should be excavated and up-cycled.
In Denmark, shredder residue is classified as hazardous waste. Up until the beginning of 2012, landfilling was the only way to manage and disposal waste. In 2012, a temporary permission for incineration of a fraction of shredder residue was given.
Regarding landfilling, the waste tax on hazardous waste was partly introduced 1 January 2012 with €21.33 pr. ton. In addition, the waste tax is scheduled to full implementation 1 January 2015 with €63.33 pr. ton. It is expected that the full waste tax will have a vast impact on the quantity of shredder residue, which is to be forward-looking landfilled. By the year of 2015, the objective is that the resources in shredder residue will be better exploited and the quantity for landfilling will be significantly reduced without containing recyclable resources.
It´s estimated that more than 1.9 million tons of shredder residue are situated at mono landfills at 4 landfill sites containing resources in the form of materials – especially metal – and energy, i.e. resources that can be reclaimed by LFM. As a basis for the specific considerations regarding LFM, the memorandum will identify the significant cost factors as well as estimate the amount of these factors. The premise is that the landfill site owns landfilled waste. Hence, the economic conditions are viewed from the landfill site's part.
The purpose is show what main factors that influences on the economics of landfill mining, where I address some of the differences, barriers, and externalities concerning landfill mining of waste and economics of mining shredder waste from a Danish landfill, with the main focus on the aftercare costs and the effect of this on a project.

KEYWORDS

Landfill Mining, Aftercare, Closure costs

THE POTENTIONAL OF PLANTS TO CLEANUP METALS FROM AN OLD LANDFILL SITE

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ABSTRACT

Old landfill sites contain different hazardous materials like heavy metals which have the ability to affects the entire environment. These places are sometimes covered by plants to increase the stability of the soil and to reduce the effects of erosion. 15 soil samples (3 samples from each place) and 5-7 timothy-grass (*Phleum pretense*) plants from 5 different places were taken from an old landfill place in an active landfill site in Högbytorp /Sweden owned by Ragn-sells Group Company. XRF scanning was used to analyze the metal content of soil samples and of plants. High concentrations of metals were detected in the soil samples like Fe with an average of about 25000 ppm, Mn about 250 ppm and 2800 ppm of Ti. The plants results showed an average concentration of Fe in the shoots about 730 ppm, Mn about 60 ppm and Ti about 1760 ppm. On the other hand, the roots results showed an average concentration of about 10 000 ppm of Fe, about 160 ppm of Mn and 2200 ppm of Ti. These results gave the indication that the Timothy-grass has the ability to extract metals from contaminated soils and can help to cleanup these soils**.**

KEYWORDS

Phytoremediation, Heavy metals, Old landfill sites, Soil pollution, Timothy-grass

EXPERIENCES OF THREE LANDFILL MINING PROJECTS IN THE BALTIC SEA REGION – WITH FOCUS ON MACHINERY FOR MATERIAL RECOVERY

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ABSTRACT

There exists huge number of old landfills and dumps located close to the rivers and lakes in the Baltic Sea Region as well as the Baltic Sea itself. The main risks from landfills are water pollution from leachate and global greenhouse effect from methane emissions as well as effects on human health. 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, save cost for final coverage of the landfill and aftercare. The research project "Closing the Life Cycle of Landfills - Landfill Mining in the Baltic Sea Region for future" sponsored by the Swedish Institute includes studies of excavations of landfills in Baltic Sea Region. It is well known, that landfills contribute to a major extent in the dumping of hazardous substances and the reclamation of such landfills is essential for the sustainable development of the environment. Through the approach used solutions for the remediation/prevention of water and soil pollution and for land reclamation is shown. The resource recovery is one of the beneficial areas of generating revenue for the success of excavation projects. In present paper three landfill mining excavations are presented and in particular with focus on the machinery used. The full-scale excavation is presented from the Estonian Kudjape Landfill, Högbytorp landfill and Vika landfill in Sweden.

KEYWORDS

sediment mining, landfill mining, environment, metals, nutrients, toxic substances, recovery, extraction, economy

LEACHING CHARACTERISTICS OF THE FINE FRACTION FROM AN EXCAVATED LANDFILL: PHYSICO-CHEMICAL CHARACTERIZATION

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ABSTRACT

This investigation was focused on the physico-chemical characterization of the leachate generated by the fine fraction (<10 mm) of excavated waste from full-scale landfill mining project. The samples were taken in the Kudjape Landfill, Saarema Island, Estonia in four different test pits (TP_1, TP_2, TP_3, TP_4) that were divided in four different layers (L_1, L_2, L_3, L_4). Total chemical oxygen demand (CODt), dissolved chemical oxygen demand (CODd), total organic carbon (TOC), dissolved organic carbon (DOC) and metals (Zn, Cu, Pb and Cd) were analyzed. The results have shown that most of the COD fraction released into the water (approximately 70%) was in particulate/colloidal state. The TOC released ranged between 3,530-mg/kg dry matter and 2,326 mg/kg dry matter for test pits. Dissolved organic matter (DOC) had concentrations ranging between 365-874 mg/kg and 317-940 mg/kg for different test pits and sampling layers respectively. Very low average leaching rates (%) of metals were observed with leaching ranging between 0.2% and 1.5% which might be explained by the lower solubility of these metals in alkaline pHs. Pb had a significantly higher average leaching rate (1.0%) in comparison to Zn (0.70%) and Cu (0.35%). This study also showed the potential use of COD_t as a surrogate indicator of organic carbon in both suspended and dissolved forms (TOC and DOC) and also Zn on the basis of high correlation coefficients observed. To conclude, the proposal and implementation of adequate management strategies that minimize environmental impacts and take advantages of the beneficial use of fine-grained fractions in landfill mining rely on detailed physico-chemical characterization of both the fine fractions itself and the leachate generated during storage and use.

KEYWORDS

Landfill mining; Fine fraction; Leachate; heavy metals; TOC; DOC

SPECIATION OF METALS IN THE FINE FRACION OF SOLID WASTE FROM AN EXCAVATED LANDFILL

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ABSTRACT

In this current study, speciation of metals in the fine fraction (<10 mm) of excavated solid waste from an Estonian landfill was performed in order to evaluate metal contents and their potential mobility and bioavailability. The fine fraction speciation was carried out following the BCR sequential extraction method for Pb, Cu and Cd and the exchangeable (F1), reducible (F2), oxidizable (F3) and residual (F4) fractions were determined. The results have shown that Pb was highly associated with the reducible (F2) and oxidizable (F3) fractions suggesting the potential mobility of such metal mainly when in contact with oxygen, despite the low association with the exchangeable fraction (F1). The metal Cu has shown also potential for mobility and bioavailabilty when in contact with oxygen since high associations with the oxidizable fraction (F3). On the other hand, Cd was mostly found associated with the residual fraction (F4) were observed raising low concerns regarding mobility and toxic effects in case of excavation. To conclude, studies addressed to understand not only the total concentration of metals in solid phase, but also the speciation and which form metals are bound, are very important in order to bring information on how to manage fine fraction from excavated waste both in terms of environmental impacts and also recovery/extraction.

KEYWORDS

Landfill mining; Fine fraction; heavy metals; metals speciation, mobility, bioavailability, toxicity

ENERGY ASPECTS

CHANGES IN THE ENERGY SECTOR

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ABSTRACT

This is about the challenges that we are meeting in the energy sector in a near future. Sun and Wind are taking a larger place in the energy system which is a nice change but it also gives us new problems to solve. The small scale production turns customers into producers and suddenly the roles as we have known it has turned to something else. What happens when there is no sun or wind? And is renewable cheaper than other electricity production?
For the moment the questions outnumbers the answers.

KEYWORDS
Energy sector, Energy system, Electricity, Natural power

**Keynote speaker*

IMPROVED POWER GENERATION FROM BIOCATHODE SEDIMENT MICROBIAL FUEL CELL

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ABSTRACT

Sediment microbial fuel cell is a noble technology to produce bioelectricity, but to become a reliable energy source; it is faced with an increased number of challenges. In this study, three series of experiments are conducted to improve this system performance. At first DO level of catholyteis increased with native algae of Caspian Sea. Power output is then improved about 2-fold and maximum power density of 46.148 $mW/m^2$is produced in the presences of algae. Secondly, the best depth to embed anode is then determined. Anode is embedded in 3, 6, 9 and 12cm below the sediment/water interface. The best depth to bury the anode is finally determined in 3 cm below the sediment/water interface, Maximum power and current density of 42.156mW/m^2 and 282.92mA/m^2, are respectively obtained in this depth.In addition, influence of agitated flow on power generation from SMFC is investigated. A mixer with three rates of 160, 280 and 400 rpmis used to make an agitated flow. The optimal speed rotating was found in 160rpm to produce a maximum power density.

KEYWORDS

Clean energy, sediment microbial fuel cell, power density, biocathode, turbulence flow

PROVISIONAL NOTICE/PROJECT OF ENERGY SYSTEMS IMPLICATIONS FOR IMPLEMENTING BIO CARBON CAPTURE AND STORAGE IN SWEDEN

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ABSTRACT

Carbon capture and storage (CCS) has lately been discussed for plants using bio fuels since it is one of few possibilities to actively decrease the concentration of carbon dioxide in the atmosphere. Since Sweden has several bio fueled facilities for heat as well as for combined heat and power generation, Sweden might be a country that should be considered to lead such a development. However, energy systems are complex, and environmental performance indicators do not always respond in the intended way when changes are introduced. In this study we investigate delimitations for introducing bio-CCS into the Swedish energy system, and a give some examples for a case study of a potential carbon capture and storage (CCS) installation at the bio fueled combined heat and power (CHP) plant in Lugnvik, Östersund was studied with screening life cycle assessment (LCA) methodology.

KEYWORDS

Biofuel, CCS, LCA, Energy system

HYDROGEN SULFIDE ELIMINATION FROM NATURAL GAS BY NATIVE ISOLATED BACTERIA FROM HOT-SPRING

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ABSTRACT

Recently due to strict environmental regulations, concentration of hazardous organic sulfur compounds from gas stream should be reduced. A new efficient method for removal of hydrogen sulfide from natural gas is required. Conventional methods for desulfurization are very costly and required solvent, high operation temperature, and pressure. In contrary, biological processes have great potential to eliminate hydrogen sulfide under mild conditions. Extensive research has been conducted on sulphur oxidizing bacteria for the removal of hydrogen sulfide. However, with present achievements is still not enough to satisfy the industrial requirements. To improve the biodesulfurization efficiency additional research required to isolate a particular strain organism. In this article the ability of newly isolated bacteria was discussed. For this purpose the mixed culture was isolated from native hot spring in the hill side of Damavand Mountain (in North of Iran). The isolated culture was inoculated on nutrient plate agar under anaerobic condition. After incubation for duration 72 h two distinct colonies white and yellow color were observed. Each species was separately grown in nutrient broth and then the optimal conditions were obtained. The desired conditions for white colony such as temperature, pH and agitation rate were 36˚C, 6.5 and 180 rpm, respectively. All the above conditions for yellow colony were identical except for pH slightly reduced to 6. On the basis of optimal biodesulfurization conditions, maximum cell dry weight for the each isolated specie was achieved; approximately were 1.35 and 1.12 $g.l^{-1}$ for white and yellow colony respectively. The removal of hydrogen sulfide from natural gas stream as the aim of present work was obtained. The percentage removals were 67 and 35% for white and yellow colony, respectively.

KEYWORDS

Biodesulfurization, Hydrogen Sulfide, Optimum Condition, Sulphur Reducing Bacteria

A TWO FAMILY HOUSE BUILT TO PASSIVE HOUSE STANDARD IN THE NORTH OF SWEDEN – ENVIRONMENTAL SYSTEM PERFORMANCE

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ABSTRACT

A life cycle assessment (LCA) of a low energy / passive house in northern Sweden, including building materials and energy use is reported. The case study building is semi detached house for two families situated in Östersund (lat. 63°N), Sweden. Each apartment having a floor space of 160 m^2 divided on two floors. The building was constructed during 2010 with a design meeting the requirements for Swedish passive houses as defined by the Forum for energy efficiency buildings (FEBY) and the Swedish center for zero energy houses (SCNH).
When it comes to more sustainable buildings, energy use in the build environment has been in focus for some time. The life cycle assessment in this study reveals that the building materials can contribute significantly to environmental burdens of a residential building in northern Sweden. Energy efficiency, efficient use of good building materials and issues of appropriate design need to be discussed in the same context to move toward a more sustainable built environment.
For energy efficient buildings in a energy system with renewably based energy carriers, building materials might give rise to a significant or even dominating part of the life cycle impact of a building. This give rise to considerations regarding choices of building materials as well as design of buildings to minimize such impact; while not forgetting social aspects impacted by building design.

KEYWORDS

Passive house, LCA, Energy assessment, Building material

BIOELECTRICITY GENERATION IN ANNULUS STRUCTURE OF SINGLE CHAMBER MEMBRANE-LESS MICROBIAL FUEL CELL USING WASTEWATER FROM CHOCOLATE INDUSTRY

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ABSTRACT

Microbial Fuel Cell (MFC) is an efficient system for generating low power where wastewater is substrate for the biocatalyst. In this work, Annular Single Chamber Microbial Fuel Cell (ASCMFC) with spiral anode was fabricated and tested. Carbon cloth and stainless steel 400 meshes were selected as cathode and anode electrodes, respectively. In order to enhance the conductivity of anode, the graphite coating was applied. A 40% platinum as catalyst was used on carbon based cathode in MFC. The carbon cloth was coated with 5% Nafion solution. In fact Nafion acts as Proton Exchange Membrane (PEM) in the fabricated MFC. For the first time, wastewater of Chocolate industry with COD 1400 mg/L was used as substrate in anode compartment. Also a mixture of anaerobic sludge from wastewater treatment plant (Qaem-Shahr, Iran) was introduced into MFC. Maximum voltage obtained in the ASCMFC system was 792 mV in an open-circuit mode. Also, Fabricated MFC operating at 30 ◦C, the maximum achieved power density using an external resistance of 500Ω was about 4.8 W/m3. The upshots from single chamber MFC were compared to dual chamber MFC. The findings demonstrate that, due to the generated high power density and voltage by the cell, the ASCMFC has a great potential for COD removal and wastewater treatment.

KEYWORDS

ASCMFC, Power Density, Bio-electricity, Chocolate wastewater

MODELING AND COST ESTIMATION OF ENERGY PRODUCTION FROM SLUDGE

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ABSTRACT

Wastewater treatment sludge has several polluting effects on atmosphere, soil and groundwater, and its pathogenic nature could be detrimental to human health. Today efforts have shifted from disposal methods to new ways of extracting energy from sludge. The challenge facing sludge managers is to find cost-effective and innovative solutions whilst responding to environmental effects. However, the energy from sludge could be considered carbon neutral because it comes from renewable and green sources and could replace traditional natural gas. Some reports stated that the use of sludge to produce biogas could decrease the amount of greenhouse gases that are released, by about 2000 tons per year. Consequently, the process of energy production from sludge is truly beneficial. In fact, for 15,000 tons/yr of solid waste, around 2.40 million kWh/yr could be produced by anaerobic digestion process. However, all things being equal, the yield of bio-oil is optimized when the pyrolysis temperature is around 500 C. Under these conditions bio-oil yield of 60-70 wt% can be achieved, with 15-25 wt% yield of bio-char. The remaining 10-15 wt% is syngas. Gasification is another process which converts a carbon-containing feedstock into a syngas which has less than half the energy density of natural gas. Syngas can be burned directly or used as a starting point to manufacture fertilizers, pure hydrogen, methane or liquid transportation fuels. The Gasification Technologies Council expects world gasification capacity to grow by more than 70 percent by 2015. The main purpose of this article is to determine the cost of diverse processes of energy producing from sludge and model these processes to compare them in term of energy requirements. Energy production from sludge is a critical part of sludge management. Some of the main processes which could result in massive energy production will be considered here.

KEYWORDS

Sludge management, Biofuel production, Cost effective process; Modeling, Wastewater treatment

EVALUATION OF MATERIALS AND PRACTICES FOR STATIC SMALL-SCALE COMPOSTING WITH MINIMUM IMPACT, LOW COST AND ENERGY UTILIZATION

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ABSTRACT

This article describes studies of new materials and practices for static composting, passive aeration and energy use, to obtain economic and environmental advantages in the in situ treatment of solid organic waste (SOW), focusing on small-scale generators. Two types of composting four forms of inoculation were investigated for a period of 60 days. The compost reached maximum temperatures of 64 °C and 76°C and thermophilic conditions were maintained for more than 20 days. The mean percentage of CH_4 generation within the composters ranging between 0.0 and 0.2%, statistically insignificant with respect to emissions. The average percentages of O_2 inside the compost ranged between 15.4 and 20.03%, attesting to the efficiency of the method of passive aeration via thermal convection. Small generation of leachate was observed due to the contribution of water for wetting the SOW, which showed an average COD value of 116.5 mg / l after 60 days. All treatments were effective to compost the SOW with minimal side effects, including minimized formation of CH_4, and treatment G2A (inoculation with compost maturing every SOW contribution) performed best. The energy use of compost was tested via circulation of 300l of water in coils immersed in 2m³ of SOW. From an average ambient temperature of 21°C, the water reached 51°C after 24 h of movement between the coil and an accumulator boiler with heat insulation, and remained at around this temperature for eight days.

KEYWORDS

Static composting, Solid organic waste, Compost, Leachate

MINERAL DISSOLUTIONS, METAL RECOVERY AND GLASS MINING

THE STEEL INDUSTRY PRODUCES MORE THAN JUST STEEL

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ABSTRACT

The Swedish steel industry produces about 5 Mton steel annually. As a consequence of the steel production the amount of residue is produced, about 2 Mton annually. The residues can then be divided into bi-product or waste for landfill. The steel industry is constantly driving towards as little landfill as possible. Therefor a lot of energy is put into the development of making more bi-product from residues; "productifying". The strategy in our business can be presented as a process in four steps. Step one is internal recycling of material in your own plant. Some materials are easy to circulate, others more difficult. For processing the latter materials you have to take account these considerations:

- Metal content
- Chemical form
- The recycling often requires a new process, not seldom energy demanding
- A new process can produce another waste that could be more environmentally potent compared to the material we started with
- Risk for emissions
- Investment costs

Step two: External recycling; residues containing metals can be processed at another company with others processes. Step three: a residue can be processed in a way that it can be sold and used as a product. Many bi-products in the steel business have good physical properties that are making them popular for different construction applications. Step four: landfill. Landfill in Sweden are constructed so that the materials are stored individually in order to make them possible to be recycled if a suitable process will be available in future. What is the approximately amount of alloy metals in existing landfills located at the steel mills? An indicative study has been made showing that, although the tonnage in the landfills can be considered as significant, the total amount of alloy metals are less than one year consumption in Swedish steel industry if they could be extracted.

USING RESIDUES FROM OTHER INDUSTRIES FOR STABILISATION OF SULPHIL-BEARING MINE WASTE – SOLVING TWO WASTE PROBLEMS AT SAME

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ABSTRACT

The global production of mine waste is at least 15 000 - 20 000 million ton/year and the 27 countries of the European Union generate more than 670 million ton/year. In Sweden the current annual production of mine waste is more than 100 million ton, and within 10-15 years this will probably increase to 200 million ton, most of it sulphide-bearing. The major potential long-term environmental effect of mining is the formation of acid rock drainage (ARD) in sulphide-bearing mine waste, which can last for hundreds or thousands of years in a certain deposit. The common ways to deal with ARD are i) limiting water and oxygen infiltration, and ii) liming the effluents in sedimentation ponds, generating huge amounts of potentially toxic sludge. ARD is a challenge for the mining industry to manage. Once it has begun to be formed in a waste deposit it is generally difficult and costly to control or suppress. It is more cost and material efficient to prevent or minimize sulphide oxidation than treating the drainage. Using alternative materials such as industrial waste to mitigate the negative effects of ARD would solve two waste problems simultaneously. However, there is an urgent need of detailed research of the function of the alternative materials before they can be used at an industrial scale, especially with regard to long-term efficiency. Three examples will be given. Green liquor dregs (GLD), an alkaline rest product from the paper industry may be used to mitigate the negative effects of ARD. Mixing GLD and tailings to construct sealing layers is one option - adding GLD to waste rock to coat the reactive mineral surfaces and create a barrier at the mineral scale is another. Fiber sludge, another rest product from paper mills, have the potential to function as covers on reactive mine waste. Sewage sludge is used for establishment of vegetation on mine waste deposits but it may also be used for construction of sealing layers, as it is or mixed with other materials.

KEYWORDS

Toxic sludge, Green liquor dregs, Acid rock drainage, Fiber sludge, Waste deposits

BIOLOGICAL SYSTEMS FOR METAL RECOVERY, RECYCLING AND REMEDIATION

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ABSTRACT

Biotechnologies suggested for the recovery, recycling, and remediation of metals includes biological sulfide production to precipitate target metals and bioelectrochemical systems such as microbial fuel cells that generate the electricity for metal recovery in a similar manner to electrowinning. Sulfide generation for precipitation of metals is carried out by sulfate reducing bacteria that couple the oxidation of an energy sources to sulfate reduction as the terminal electron acceptor. The generated sulfide then recovers solubilized metals by precipitation as a metal sulfide. If the reaction is carried out at acidic pH then pure metals can be selectively recovered from solutions containing a mix of one or more metals. Microbial fuel cells function by exploiting the metabolism of microorganisms to donate electrons from a substrate to a bioanode and when they are used for metal recovery, the metal is recovered at the cathode. Most research in microbial fuel cells has been carried out at neutral pH and oxidizing an organic carbon and energy source. However, exploitation of acidophilic microorganisms that optimally grow at low pH to metabolize inorganic energy sources found in mining wastewaters is also a promising technology for bioremediation of metals. Both techniques have been demonstrated in the laboratory and are the subject of research efforts in scale-up and industrial implementation.

KEYWORDS

Biotechnology; metals; sulfate reduction; sulfide; bioelectrochemistry; microbial fuel cell

SPECIFICATION THE METAL CONTENT OF WASTE GLASS FROM AN OLD GLASS LANDFILL

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ABSTRACT

Glass has been manufactured in Småland region (the "Kingdom of Crystal Glass") since the 18th century and during all these years a huge amount of heavy metals accumulated in this region. There is more than 25 glassworks in Småland which contain an estimated of 310 tons of arsenic, 19 tons of cadmium and 1600 tons of lead. Recently, the Sweden's county administrative boards have mapped 20,000 locations that are contaminated with hazardous materials for human and environment. 10 of the 22 acute risks and dangerous locations are glassworks in Småland. The first stage to handle these wastes is to specify the metal content of the waste glass and the contaminated soils. Semi-quantified X-ray fluorescence analysis (XRF) was used to analyze 14 samples of waste glass from an old glassworks landfill in the south of Sweden. The results showed that different amount of metals were detected and with a high concentration like Pb (about 3500 ppm), As (about 300 ppm), Fe (about 17800 ppm), Mn (about 800 ppm) and others.

KEYWORDS

Waste glass, characterization of waste, XRF analysis an old landfills

EFFECTS OF DITCHING OF SULPHUR-RICH AGRICULTURAL SOILS ON ACIDIFICATION AND METAL DISPERSION

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ABSTRACT

Acidic soils under farmland in Sweden and Finland, referred to as acid sulphate soils, deliver large quantities of acidity to drains after snow melt in spring and heavy rains in summer and autumn. This is a well-known phenomenon, generally thought to be the main reason for frequent fish kills in many streams and estuaries. Whereas there is no question that the acidity release is of environmental concern and deteriorate the surface-water quality, several recent studies have indicated that potentially toxic metals, accompanying the acidity, may be an even larger environmental threat. A nationwide hydrogeochemical investigation, based on more than 1000 headwater streams distributed throughout the country, showed that while there are several sources of the acidity, including acid sulphate soils, metals such as Ni, Mn, Al, Tl and Cd are strongly enriched only in streams draining areas where acid sulphate soils are widely spread. In line with these findings, other studies have shown that small drains running through acid sulphate soils have strongly elevated concentrations of a number of metals including Al (up to 300 mg/L), Mn (up to 16 mg/L) and Ni (up to 1 mg/L), and that runoff from acid sulphate soils in Finland carries much larger quantities of several metals than is discharged in effluents from the entire Finnish industry. As there is now consensus among farmers with land on acid sulphate soil, responsible environmental authorities and researchers regarding the sources and effects of metals discharged from the acid sulphate soils, technical solutions are being tested and developed to combat the serious environmental problem of metal leaching from soils.

KEYWORDS

Acid sulphate soil, metals, hydro geochemistry

PUBLIC PERCEPTION OF RISKS ASSOCIATED WITH CONTAMINATED GLASS WORKS SITES IN SOUTH-EASTERN SWEDEN

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ABSTRACT

Glass has been produced for centuries in Kalmar and Kronoberg Counties in south-eastern Sweden. This industry has lead to severe contamination particularly due to the historical use of lead, cadmium and arsenic. People may be exposed to heavy metals for example via direct soil contact or consumption of locally produced food. The public risk perception was investigated in this study. Do the public perceive a high risk for their own health, for future generations or for the environment, and are they worried? Is there a difference if you live close to the glass factory? Is there a desire for more information about possible risks? With the aim to answer these questions, a questionnaire was sent to 599 individuals in Kalmar and Kronoberg counties. In order to reach people living very close to these industries, half of the questionnaire was sent to four communities with glass factories and half was sent to randomly selected individuals in the two counties. Two groups were compared; one with respondents living closer than 1 km and one living more than 1 km away from a glass factory. The results showed that the respondents were more concerned about risks for the environment than their health. People living close to the glass industry perceived a higher risk for the environment, for their health, for future generations and were more worried compared to people living more than 1 km away from factories. There was no difference in trust in authorities or companies that perform risk assessments, but those living close to the factories were somewhat keener on having more information about possible risks. About half of the respondents in this group wanted more information about risks indicating that there may be a need for an improved risk communication and exchange of information between authorities, researcher and the public.

KEYWORDS

Risk perception, Worry, Risk communication, Heavy metal contamination, Glass industry

NEW EXTRACTION PROCESS FOR RECOVERY OF METALS IN GLASS DEPOSITS

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ABSTRACT

A new process, named salt extraction process, has been developed to enable recovery of metal values from secondary sources e.g. scrap and waste materials such as slag and flue dust. It is also feasible in extracting metals from certain ores that normally are difficult to enrich and process by traditional metallurgy – two examples are nickel and cobalt. The salt extraction process has also been applied in the recovery of metals from silicates including lead from glass wastes.
The process is based on extraction of the metals from the raw materials by processing in a molten salt bath consisting of NaCl, LiCl, and KCl corresponding to the ternary eutectic composition and with $AlCl_3$ dissolved in the salt melt as the chlorinating agent. Normal processing temperature is in the range 973 K (700 °C) to 1173 K (900 °C). The dissolved aluminium chloride reacts with the metals in the fine comminuted raw material and the metal ions thus formed are deposited electrolytically on a solid cathode. Chlorine gas is formed on the anode, which consists of liquid aluminium. Chlorine and aluminium react forming aluminium chloride *in situ*, which gets dissolved in the salt melt. The salt extraction process has been used successfully in the extraction of Cr and Fe from electric arc furnace (EAF) silicate slag. Experiments have also been carried out in which lead has been recovered with high yield from spent cathode ray tubes. The process has also been applied successfully in the extraction of the rare-earth metals neodymium and dysprosium from permanent magnet scrap. The method is a highly promising process route for the recovery of strategic metals. It also has the added important advantages of being environment-friendly, with only small amount recyclable, potentially useful rest products like alumina and silica as well as limited energy consumption.

KEYWORDS

Salt melt, Extraction, Electrolysis, Recovery, Glass, heavy metals, lead, Alumi

DESIGNING A PHYTOREMEDIATION PARK AT BODA GLASBRUK- LANDSCAPE ARCHITECTURE AND TREATMENT OF CONTAMINATED SOIL WITH PLANTS

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ABSTRACT

Many old industrial sites are currently unused waiting for new uses as the land around them is often heavily contaminated. The most polluted brownfields in Sweden are the areas around the old glassworks in the Kingdom of Crystal in Småland. This is because the toxic residues from the manufacturing of glass were deposited into landfills that were placed in the surrounding environment.
In modern times it has proven difficult to deal with polluted areas because of the high treatment costs. An alternative remediation method is the use of phytoremediation e.g. cleaning up polluted areas using plants. The method has many advantages over more traditional cleaning methods.
This method is less expensive and more environmentally friendly. The method can give aesthetic value and be utilized to create recreational and educative sites.
The pilot project ”The Phytoremediation Park at Boda Glasbruk” is an example of how an unused and contaminated site could be activated meanwhile the ground is purified.
The paper shows how a polluted area can be designed and how technology, architecture and phytoremediation can be combined to get a cleaner environment.

KEYWORDS

Design, Landscape architecture, Park, Phytoremediation, Glassworks, Boda Glasbruk, Cleaning, Contamination, Pollution

GLASS IN THE CIRCULAR ECONOMY

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ABSTRACT

In 1994, producer responsibility was implemented in Sweden. Each producer selling a package has to make sure the package is collected and recycled. The task to collect and recycle packaging glass in Sweden is handled by SGÅ.
This year 2014 SGÅ will collect 195 000 tons of packaging glass. The collection ratio of packaging glass in Sweden is 100 % and the recycling ratio is 93 %.
Glass is a unique material and can be recycled indefinite times. SGÅ has 3 main customers buying processed glass cullet: glass works, glass wool isolation and foam glass. Together with the company Förpacknings & Tidningsinsamlingen (FTI) SGÅ run an own designed-collection system across whole Sweden. Over 6 000 drop-off points are established. For glass there always one bin for colored glass and one for uncolored glass. Once the bins are full a local transport company will empty the bin and deliver the glass directly to Hammar or to a local stock where it will be loaded on a truck for delivery to Hammar. When the glass is processed and contaminations removed the glass cullet is sold.
The collection of packaging glass has increased over the years. For the last 10 years the collection of glass packaging has increased by 2.5 % on average every year.
Main product coming out from the processing plant in Hammar is glass. However, organics, metal, ceramics, stone and porcelain are also sorted out from the plant (approximately 7 % of total tonnage).

KEYWORDS

Packaging glass, deposits, recycling, design-collection system

METAL SPECIATION IN SOIL AT A CONTAMINATED GLASSWORKS SITE IN SOUTHEASTERN SWEDEN

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ABSTRACT

Risk assessments of metal contaminated sites are often based on total metal concentrations of the soil material, although it is well known that the potential for leaching is determined by the fractionation between labile metal forms and forms that are not to be assessed as geochemically active. In the present study, a 4-step sequantial leaching procedure was applied to solid material from five subareas of a glass waste site in southeastern Sweden (including, for example, landfill areas and natural till material). The aim was to assess whether the major fraction of the total Cd and Pb content should be considered labile (easily mobilizable) or relatively stably sorbed, which is a question that is motivated by the fact that previous site-specific investigations have shown strongly elevated metal concentrations in soil, but very little impact on local groundwater. Although the total metal concentrations as well as the amount of visable glass particles differed between the subareas, the fractions extracted in the different steps of the sequential leach were similar for all areas. Only a minor part of the total content of both Cd and Pb was released in the final strong acid residual leach (9-19 %), which indicates that there has been a significant release of metal ions from the glass waste material in the past, followed by a transition to secondary phases. Of the two metals, Cd was assessed to be the most labile one. The first extraction, targeting the exchangeable and carbonate bound fraction, released 43-59 % of the total Cd content. So, although the relatively small effect seen on groundwater quality indicates an effective retention of these metal cations by the soil solid matrix, the relatively high fraction of potentially mobile forms highlights the need of further assessments of the stability in major retention mechanisms.

KEYWORDS

Metals, cadmium, lead, contaminated sites, speciation, risk

WASTE MANAGEMENT ON GLOBAL SCALE

FROM 99% LANDFILLING-TO 99% RECYCLING

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ABSTRACT

From the late 1800 hundreds up till the 1960´ies waste management was very much in Sweden a matter of collecting and transporting waste in such a correct way that the negative impact on human health and the spreading of dangerous diseases was minimized. All waste was more or less landfilled, in most cases just put on an open dump. The increasing awareness of the environment and the risks of handling the waste in an incorrect way grow stronger and stronger during the 1960´ies, resulting among others in a strong and efficient legislation. As one of the first countries in the world Sweden in 1968 got an Environmental Protection Act, decided by the Parliament and implemented by the industry and the municipalities in Sweden. In 1972 a responsibility by the law was put on all Swedish municipalities concerning collection, transportation, treatment and landfilling of household waste/municipal waste. Due to this legislation an efficient infrastructure for waste management successfully was introduced all over Sweden. Old dumps were closed down and modern landfills were being constructed with collection of leachate and methane gas. Step by step more advanced waste treatment, like waste-to-energy, source separation, recycling and biological treatment has been developed and introduced with the aim to minimize landfilling and to maximize the recycling of materials and energy, saving limited natural resources.
The legislation has been even stronger and efficient, today very much with its origin in EU directives and policies, implemented in the national legislation. The early discussion from the 1970´ies about the "polluters pay principle" has during the 1990´ies and 2000´ies been achieved in "producers' responsibility" on packaging, waste paper, electronic waste, old vehicles, tires etc.
From the middle of the 1970´ies till today Sweden has gone from 99% landfilling of municipal waste to 99% recycling of materials and energy, in that way saving human health, the environment, limited natural resources and the climate.
These excellent results have been achieved due to a number of driving forces where Legislation is the strongest one followed by Economical Incentives, Education, Engagement and Communication.

KEYWORDS

Waste management, Waste- to- Energy, Landfill, Recycling

**Keynote speaker*

DANISH POLICY ON WASTE MANAGEMENT – DENMARK WITHOUT WASTE

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ABSTRACT

In November 2013 the minister for the environment, introduced a new Danish strategy for waste for the next decade, stating: "We incinerate an enormous amount of waste in Denmark; waste which the Government could get much more out of by more recycling and better recycling."
Waste is a consequence of economic activity: the more vigorous the economy, the more waste is produced. However, waste can contain materials and resources that it makes sense to recycle. Denmark has come a long way in terms of environmentally responsible waste management and waste incineration. However, it is also one of the countries in Europe producing the most waste per inhabitant
Over the past 20 years, by far the majority of Danish waste has been recycled. Between 1994 and 2011:

- the recycling rate went up from 55% to 61%;
- the incineration rate went up from 21% to 29%; and
- the percentage of landfilled waste dropped considerably from 22% to 6%..

Resource efficiency is also high on the agenda outside Denmark. All EU member states have agreed on the Seventh Environmental Action Programme – for which the slogan is "Living well, within the limits of our planet" – and on a roadmap for a resource-efficient European Union. Globally, the world's heads of state and government continue to debate the green economy and resource efficiency. Denmark is playing an active part in these negotiations.
The Danish government has therefore decided to move towards perceiving waste as a resource that can be reused and recycled, rather than merely something to throw away. This paper describes the major political changes and ideas for Denmark.

KEYWORDS

Waste policy, Resource efficiency, Zero waste, Waste strategy

ECOTOXICOLOGICAL ASSESSMENT OF DRILL CUTTINGS OF OIL DEPOSITS BY BIOTESTING METHODS

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ABSTRACT

Complex multi-component wastes include sewage sludges of treatment plants, industrial and domestic wastes, as well as drill cuttings. In the oil-producing regions, they are the main large-capacity waste. Chemical composition of drill cuttings is conditioned by mineralogical composition of drilled solids and properties of chemicals used in drilling. Since the composition of the latter is not always known (in some cases it can be protected by patent), it is almost impossible to establish the danger or safety of drill cuttings to the environment, based only on the use of chemical analysis methods. Therefore, the only way allowing to assess the cumulative toxicity of drilling waste is biotesting which is based on the determination of reaction of the living organisms to content of the pollutant in the tested sample. While assessing the toxicity of drill cuttings by biological methods, scientists often test the aqueous extract to which the soluble forms of pollutants tend to migrate (eluate biotesting method), and various hydrobionts are used as the tested organisms. However, for adequate assessment of multicomponent solid mediums apart from the eluate methods, it is necessary to use substrate biotesting that provides direct contact of test organism with the tested sample, and thus allows to establish the level of cumulative impact rendered by the contaminants present in the solid substrates, on the living organisms. Therefore we, especially for the purpose of drill cuttings evaluation, have developed substrate methods in which higher plants and natural complex of microorganisms contained in the sludge itself are used as the tested organisms. The goal of our researches was ecotoxicological assessment of drill cuttings in the oil fields of the Western Siberia, applying methods of substrate and eluate biotesting. For this purpose, test organisms at various levels of organization were used: microorganisms, aquatic organisms, higher plants, and mammals. It has been established that the studied drill cuttings are hypotoxic or practically nontoxic. According to current statutory regulations of the Russian Federation, they can be classified within IV and V hazard classes. The results of the conducted researches indicate the advisability of applying, for the purpose of environmental assessment of drill cuttings, of both eluate and substrate biotesting methods.

KEYWORDS

Drill cuttings, Ecotoxicological assessment, Biotesting methods

TREATMENT OF MSW IN BIOCELLREACTOR AT HYLLSTOFTA WASTE TREATMENT PLANT

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ABSTRACT

Biodegradable MSW, industrial waste and sludge was treated biocellreactor (BCR). The waste was crushed and put in piles and covered with plastic foil. Horizontal gas drainage pipes and water pipes were placed in the waste. The waste was digested for about 5 years and then dug out, composted and sieved into 2 fractions, burnable and fine fraction. The burnable fraction was incinerated and the fine fraction is used as construction material in covering of an old landfill.
After about 5 years the waste was digested and there was no odour when the reactor was dug out. The total weight lost was about 40 % due to gas production and drainage of water. After sieving the material in a 40 mm drum sieve the course fraction, about 45 % of initial weight, was sent to incineration. The fine fraction, about 15 % of the initial weight showed high content of copper (>400 mg/kg) and zinc (>1000 mg/kg) and has a content of about 60 % of inorganic material.
The treatment in BCR was about 15 euro/ton and 18 euro/ton cheaper than incineration or landfilling.

KEYWORDS

MSW, Biocellreactor, Gas yield, Treatment costs, Legislation

MSW MANAGEMENT IN SÃO PAULO CITY AND THE NATIONAL POLICY OF SOLID WASTE

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ABSTRACT

The objective of this paper is to present a brief overview of the current situation of solid waste in Brazil, as well as the importance of the National Solid Waste Policy as the main regulatory milestone of the country, clarifying the role of society, government and the private sector, determining the closing of dumps, encouraging municipal consortia and establishing a hierarchy for solid waste management through waste reduction at source, reuse, recycling, energy recovery and disposal. Also it aims to understand how São Paulo, the most important city of Brazil, is currently facing the problem and what are the scenarios and proposals indicated in the Integrated Management Solid Waste Plan of the city to get the sustainable solid waste management of São Paulo in operation.

KEYWORDS

Municipal Solid Waste Management, Public Policies, Urban sustainability, Recyclable collection

ELIMINATION OF GREENHOUSE GAS EMISSION DUE TO IMPROVEMENT OF BIODEGRADABLE WASTE MANAGEMENT SYSTEM

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ABSTRACT

European Union (EU) Landfill Directive 1999/31/EC requires a progressive reduction of the disposal of municipal biodegradable waste (biodegradable waste – is waste capable to undergo aerobic or anaerobic decomposition, such as food waste, park and garden waste, paper etc.), in order to reduce the emissions of greenhouse gasses (GHG) from landfills. The main problem of waste management system in Latvia is heavy dependence from disposal on landfills. The insufficient separate waste collection in the country and promote landfilling as a major treatment option, leaded to landfilling of 84% from the total collected municipal waste in 2012 with a high share of disposed biodegradable waste. The tests of composition of disposed waste and further mathematical evaluation shows that more than 8% of the total emitted GHG are provided by disposed biodegradable waste in Latvia. The aim of this research is to revise the current situation of the management of biodegradable waste in Latvia, to propose the future activities for the practical improvements dealing with biodegradable waste. The Waste Management Planning System (WAMPS) software has been used as the environmental impact analysis tool for modelling waste management scenarios. The WAMPS software calculates emissions, energy and turnover of waste streams for processes within the waste management system, e.g., waste collection and transportation, composting, anaerobic digestion, and final disposal – landfilling or incineration. The results are presented in four environmental impact categories: acidification, global warming, eutrophication and photo-oxidant formation, which are characterised by a certain emission. It covers an integrated waste management system starting with the activities where products become waste and have been put into the waste bin at waste generation source to the last point, where the waste becomes either useful material (recycled material, biogas or compost) or becomes part of emissions in the environment after its final disposal at a landfill or incineration plant.

KEYWORDS

Biodegradable waste, mathematic modelling, waste management

MUNICIPAL PERTNERSHIP WITHIN WASTE MANAGEMENT BETWEEN VÄXJÖ MUNICIPALITY AND THE AN GIANG PROVINCE IN VIETNAM

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Sweden

ABSTRACT

According to the UN, between now and 2025, the world population will increase by 20% to reach 8 billion inhabitants (from 6.5 today). Moreover, by 2050, the total population will be around 9.5 billion, unless specific control measures are broadly adopted. It is important to note that 97% of this growth will happen in Asia and Africa, which includes some of the poorest countries that have the least capability to absorb it. After 2025 it is expected that Asia will hold more than two thirds of the world's population.
As the 3rd highest-ranking country with the highest population density in Southeast Asia, Vietnam continues to achieve high growth rates despite the effects of the global economic crisis, with an average GDP growth rate of 7% in the period 2006-2010. National development strategies promote a continued expansion of the industrial and service sectors, and the country has indeed seen ongoing rapid developments in production, within services in urban areas and within industrial zones. However, the resulting increase in the generated volumes of solid waste of all types (municipal, industrial and medical) strains the country's coping capacity and environmental carrying capacity. In a country where illegal waste dumping and ineffective management remains widespread, there is considerable room for improving waste management to address environmental pollution, health hazards and quality of life.
In order to address this issue you need to focus on how waste is organized and managed at local level; which will be the main focus of our partnership.

KEYWORDS

Waste management, Hazardoust waste, Community collaboration

FIRE STATISTICS AND EXPERIENCE FROM FIRES IN BIOFUELS AND WASTE

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ABSTRACT

The gradual shift from fossil fuels to different types of biofuels and waste fuels has resulted in much more extensive handling and storage of these products. This project provides a detail study of the situation today regarding fire safety in relation to handling and storage of biofuels and waste due to these changes. Fire statistics has been compiled using the MSB (Swedish Civil Contingencies Agency) data base which is covering all alarms to the Swedish fire and rescue services focussing on fires in industry applications which involved biofuels or waste, mainly during the period 2005-2012.
The total number of such fires varied from 464 to 676 per year. A detailed study of the reported data from the fires during 2012 (488 fires) showed that only 154 fires were considered "relevant" while the rest were considered "not relevant" or "uncertain". Of the 154 relevant fires, 38 occurred in buildings while 116 were outdoor fires. Spontaneous ignition was the most common reported cause for the fires.
In order to collect information on typical handling and storage of biofuels and waste, a questionnaire was distributed to about 280 industries/ storage facilities. The questionnaire included questions about type of material, total quantities handled per year, type of storage, etc., but also questions about the number of incidents at the facilities. In total, 81 respondents answered the questionnaire. The most common material fractions among the respondents were industrial waste, wood chips from forest residues and recycled wood. Most of the respondents had never experienced a fire situation, while some reported a fire frequency of 3-8 fires /year. The most common types of fires were in outdoor storage.

KEYWORDS

Biofuel, Waste, Storage, Fire, Statistics

TOWARDS A BROADER SYSTEMS APPROACH TO RESOURCE MANAGEMENT – LOCAL TO GLOBAL AND SHORT-TERM TO LONG-TERM SOLUTIONS

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ABSTRACT

The overall aim of this paper is to holistically address current challenges to WM with the help of a much broader systems view. In order to accomplish this aim, current WM issues are discussed in a global perspective to explore the gaps in current practices on a systemic level. Different examples are used to illustrate the various 'deep root' causes responsible for the current situations by highlighting various aspects related to WM, such as product design, consumer awareness and limited systemic view. The study leads to conclusions that the current efforts, rather isolated, in different systems for WM, waste reduction and resource management are indeed not sufficient in a long term sustainability perspective. The proposed broader systems approach considers production, consumption and WM systems aligned to provide long term sustainable solutions to waste issues.

KEYWORDS:

Waste management, Broader systems approach, Root causes

ACHIEVMENT OF END-OF-WASTE STATUS FOR WASTE-DERIVED AGGREGATES-FOCUS ON LEACHING LIMIT VALUES

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ABSTRACT

Waste-derived aggregates are being considered as possible candidates for development of End-of-Waste (EoW) criteria at European Union (EU) level in accordance with Article 6 (1) of the EU Waste Framework Directive (2008/98/EC) as a means of increasing the recovery of resources from waste. If a waste-derived aggregate achieves EoW status, it will become a (construction) product and hence be regulated by the Construction Products Regulation (CPR) which means that in most EU Member States there will be no applicable environmental protection regulation. It is therefore important that the criteria a waste-derived aggregate must fulfil to achieve and maintain EoW status ensure sufficient protection of the environment and human health. It is shown that EoW criteria that do not include restrictions on the conditions of the use of waste-derived aggregates for specific construction purposes will result in leaching limit values that are so stringent that very few, if any, waste-derived aggregates can meet them. It is therefore proposed to impose restrictions and conditions on the use as part of possible future EoW criteria for waste-derived aggregates, and a step-wise methodology for development of more realistic leaching limit values for EoWis outlined. The methodology incorporates the mitigating effects of various measures that reduce the potential environmental impact of construction applications with waste-derived aggregates. Recommendations are also made of the practical testing and documentation procedures for aggregates with EoW status within the framework of the CPR.

KEYWORDS

End-of-Waste , Waste-derived aggregates, Risk-based leaching criteria, Construction Products, Regulation, Water protection

**Keynote speaker*

EVALUATION OF COLLECTION SYSTEMS FOR RECYCLING OF PLASTICS PACKAGING

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ABSTRACT

Plastic packaging in Sweden are collected by different collection systems that can provide different amounts and quality of plastic packaging. In order to compare collection systems such as curbside collection and drop-off points, the quality of source sorted plastic has to be determined. The project was limited to studies in five Swedish municipalities. Main methods for implementation of the project were sampling, waste composition studies, interviews, literature studies, evaluation of the data and calculations. Waste composition studies were made on the samples from curbside collection and drop-off points in selected municipalities during the years 2010-2012. The result from waste composition studies of 75 m3 of material (2800 kg) collected as plastic packaging in five different municipalities, shows that there was 72 weight percent correct sorted plastic packaging and 16 weight percent was plastic that are not packaging. The remaining 12 weight percent were other totally wrongly sorted material, other packaging and magazines and other miscellaneous products.
Plastic packaging collected with curbside collection system have a better quality for recycling (10% non-plastic) than the plastic packaging collected from drop-off points (15% non-plastic). The best quality of plastic packaging was in plastic collected from single-family houses with curbside collection (6.5% non-plastic). Single-family households with curbside collection delivers the best quality of sorted plastic packaging even when there was no dedicated information work about source sorting of plastic packaging. There was no significant difference between the quality of the plastic collected from multi-family houses with curbside collection and drop-off points.
If the goal is to get as much plastic as possible, the best system is curbside collection in combination with dedicated communication about source sorting and recycling. Municipalities with fully expanded curbside collection raised almost twice as much plastic per inhabitant (9.0 kg) compared with the national average of 4.9 kg (2012).

KEYWORDS

Plastic Packaging, Waste composition studies, Curbside collection, Drop-off, Error ratio, Recycling, Source separation, Waste management

CHARACTERIZATION OF SELF-HEATING IN STORED WASTE

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ABSTRACT

A common cause of fires in large bulk storages is spontaneous combustion. This project aimed at creating a general test procedure and an evaluation methodology to obtain relevant risk parameters for different types of waste with respect to self-heating characteristics and the risk of spontaneous combustion. SLF (Shredder Light Fraction) from shredding of automobiles has been used as a pilot waste. The methodology is aiming at being used by e.g. the waste management sector in order to examine the propensity to self-heating of a specific waste fraction. Based on such characterization, storage could be better planned to avoid fires.
The work of the project showed that with a combination of a relatively large scale test method (1 m^3), and isothermal calorimetry one can study both how a material behaves regarding self-heating in bulk form and how the various constituent components affect self-heating. This means that these methods can give an indication on the cause of a specific fire, on which components of a given waste contribute to the self-heating, on how a particular mixture behaves in relationships to another, etc.
In summary the developed methodology involves: 1) Representative sampling and characterization of the waste including grinding of subsamples for analysis by laboratory methods, 2) Analysis of heat generation from self-heating by isothermal calorimetry, 3) Determination of thermal properties of the waste bulk material by using a small-scale test method (TPS) for the heat capacity and for the effective thermal conductivity, 4) Large scale self-heating tests with the waste in its original fraction to provide information on critical temperatures for varying storage conditions.

KEYWORDS

Self-heating, Heterogeneous waste, Storage, Characterization methodology

TOWARD A BROADER SYSTEMS APPROACH TO RESOURCE MANAGEMENT – AN UTOPIAN VISION TO GUIDE REALISTS

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ABSTRACT

This paper proposes an ideal/utopian *normative* vision on sustainable resource management with its twofold aim to highlight; the need to explicate and address the underlying evaluative and normative assumptions in industrial ecology (IE) research (theoretical challenges), and the challenges to implement such broader system level solutions (practical challenges). The main theoretical challenges highlighted in the paper are the lack of linkages between natural science, social science and normative analysis. The main practical challenges remain the issues regarding mutual trust and, governance and regulation in a global context. The normative vision aims to propose actions to develop (current) realistic approaches to resource management.

KEYWORDS

Sustainable resource management, Global challenges, Social embeddedness, Industrial ecology, Utopian/idea vision, Normative approach

FROM WASTE MANAGEMENT TO PHYSICAL RESOURCE MANAGEMENT – THE ECO-CYCLE MODEL 2.0 FOR THE ROYAL SEAPORT IN STOCKHOLM

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ABSTRACT

The Eco-Cycle Model 2.0 for the Royal Seaport in Stockholm is an attempt to grasp ecological sustainability challenges at an over-arching social level. It was developed in a pre-study 2012-2014 for the City of Stockholm and with the purpose to investigate options for developing an eco-cycle model that grasps more dimensions than the Hammarby Model. The latter is a globally recognized model illustrating interlinks between waste, water and energy flows in the Hammarby sjöstad city district in Stockholm.

The primary objective of the eco-cycle model is to explain important connections and synergies between resource flows. In this way the model contributes to a deeper understanding of the complex interlinks between different functions in modern society and corresponding resource and waste flows. Secondary objectives that can be fulfilled with the model are: to be a tool for monitoring and follow-up of environmental objectives, to serve as a (dynamic) tool for monitoring and analysis of resource flows. An important aspect of the work was to move away from the current two sided thinking, discussing inflow of resources to society and outflow of waste (emissions) from society. Instead, the study emphasizes a unified approach to physical resource management thinking.

By aid of the model, it is possible to take an overarching unified approach to inflow of resources and outflow of wastes and emissions for a city district or a whole city. In this way, we make true the old saying that “waste is a resource”.

WASTEWATER AND STORMWATER MANAGEMENT

REDUCTION OF PHOSPHORUS AND NITROGEN IN PRIVATE SEWERAGE SYSTEM

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ABSTRACT

The efficiency of sludge well is fundamentally dependent on the volume of the well, the free water surface and availability of oxygen. This is very important for creating a viable fauna of microorganisms that break down organic material and will purify wastewater. An effectively operating sewerage system combined with a smart sludge removal technique will help microorganisms to do their job. A new sewerage system for private use, named 4K, has been developed in order to reduce eutrophication of lakes, streams and oceans and make it easier for private persons to purify their waste water. The sewerage system 4K requires no electricity or chemicals. The sludge well is divided into four chambers and the waste water flow into the first chamber to the fourth chamber without pumping. The reduction of phosphorus and nitrogen has been studied during 3 years and is more than 90% of incoming sewerage water.

KEYWORDS

Sewerage water, Sludge well, Private sewerage system, Phosphorus, Nitrogen, Eutrophication, Microorganism

WASTEWATER CHARACTERISTICS IN PARTIALLY SEALED CESSPIT – CASE STUDY FROM BEIT DAJAN, PALESTINE

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ABSTRACT

Raw domestic wastewater from an individual home was characterised and the water quality was followed after disposal to a partially sealed cesspit over the whole filling period of 4 months. The results revealed that raw wastewater was of medium strength according to the US EPA classification, and was more concentrated than Palestinian municipal sewage. Septage is the water accumulating in the pit, but above the accumulated bottom sludge. The septage was more concentrated than the raw sewage. The specific household water consumption, wastewater generated, septage collected by vacuum truck and septage water infiltration were respectively (59 L/c.d; 100%), (52 L/c.d; 87%), (11 L/c.d; 19%) and (40 L/c.d; 68%). The specific removal of pollutants in the cesspits were: BOD_5 (78 g/c/d), COD (62 g/c/d), N total (52 g/c/d), PO_4-P (66 g/c/d) and TSS (69 g/c/d). The specific pollution loads of emptied septage were BOD_5 (5.6 g/c/d), COD (19.3 g/c/d), N total (4.8 g/c/d), PO_4-P (0.17 g/c/d) and TSS (25.5 g/c/d). The concentrations of heavy metals (Cu, Pb, Mn, Fe and Zn) in septage water were not in compliance with heavy metals concentration limits of the Palestinian regulations for wadi disposal and effluent reuse in agriculture. As a consequence, septage disposal in wadis and agricultural fields is not safe. However, according to municipal regulations, the heavy metals concentrations allow septage to be disposed in the Al-Bireh wastewater treatment plant septage receiving unit, to be further treated in the aerobic system. Regarding nitrogen that is removed in the cesspit, the vast majority will most likely exfiltrate out of the cesspit into the surrounding soil, and might potentially reach the groundwater. Therefore, cesspits should be replaced by proper wastewater treatment systems.

KEYWORDS
Onsite treatment, Sewage, Cesspits, Heavy metals, Nitrogenous compounds, Groundwater pollution

INVESTIGATION OF HARD BIODEGRADABLE PHARMACEUTICALS POLLUTANTS TREATMENT OF HOSPITAL WASTEWATERS

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ABSTRACT

According to the results of the research performed in the different modern research laboratories the remnants of drugs and their derivatives are found in surface waters in France, USA, UK, Germany, Denmark and Sweden. These substances also can be found in sewage sludge, river and ocean sediments and in the municipal landfills filtrates. Some species have been found even in drinking water and ice, ground and ocean waters.
Many studies confirmed the data of the annual drug releasing into the environment, which counts several hundred of kilograms.
Thus, the investigations of negative impact of pharmaceutical substances and their derivatives on aquatic organisms have been performed during more than 20 years and showed an extremely negative presence of any drugs in the waters. Now, they are still considering as emerging organic contaminants in the different type of waters.
The main sources of water pollution by pharmaceuticals and their derivatives are wastewater from hospitals, clinics, pharmaceutical industries and domestic sewage as well. However, the main percentage of pharmaceuticals dumped into wastewaters is coming from the hospitals. This is typical for large cities, where is situated a great number of hospitals and health care institutions. In the opinion of one study hospital wastewaters have been found in a 15 times higher potential ecotoxicity than the general urban have.
The negative effect of pharmaceuticals influence into environment can be decrease due to application of different kinds of additional wastewater treatment as Advanced Oxidation Processes (AOPs). The main approaches of hospitals wastewater treatment in Ukraine and Sweden by implementation of AOPs method were considered in this study. The main data of this research will be presented.

KEYWORDS

Hospitals, Swage waters, Pharmaceuticals, Waters, Treatment, Advanced Oxidation Processes

REMOVAL OF ORTHOPHOSPHATES IN WATER BY MODIFIED CARBONATE MATERIAL OF BIOLOGICAL ORIGIN

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ABSTRACT

The excessive release of phosphorus (P) and nitrogen (N) and the organic load, by domestic or industrial effluents is directly associated with the eutrophication of water bodies. The method most commonly used for phosphorus removal from wastewater is chemical precipitation although is relatively expensive and demands proper sludge disposal. Therefore, research on low cost materials with high removal efficiency is needed. The introduction of exotic species in aquatic environments (biological invasions) is considered a serious environmental problem affecting the integrity of natural communities, food webs and nutrient cycles. Some species have high concentrations of carbonates in their exoskeleton composition, which may be used in water treatment, particularly for phosphorus removal. This study aims to investigate the removal capacity of orthophosphates, using as material, the exoskeleton of exotic species in powder form, comparing the raw material (RCS), with physically modified (CSA) and chemically modified (CSC) material. To study the orthophosphates removal efficiency by RCS compared to CSA and CSC, a factorial design with rotatable central composite design (RCCD) was applied. In order to optimize the variables levels for phosphorus removal, the influence of the following independent variables was investigated: adsorbent/adsorbate ratio, pH and temperature; with the kinetic control associate at each configuration obtained by RCCD. The orthophosphate's quantification was performed using the APHA 4500-P E method, as described by the American Water Works Association (AWWA). Based on the preliminary results, the orthophosphate removal capacity by RCS varied from 0.50 to 4.01 mg L^{-1}; the removal by CSA varied from 0.95 to 6.16 mg L^{-1}; and the removal by CSC varied from 1.54 to 7.74 mg L^{-1}. The exoskeleton powder can become a sustainable alternative as material, from the environmental, economic and technical viewpoints in several applications, such as treatment of urban and industrial wastewaters and phosphorus removal/retention to prevent eutrophication of water bodies, population control of exotic species from commercial exploitation. Additionally, the final product (phosphorus-adsorbed exoskeleton powder) can be used as fertilizer and as soil pH adjustment.

KEYWORDS

Wastewater treatment, Adsorption, Phosphorus removal, Factorial design

MICROBIOLOGICAL FOAMING PROBLEMS IN THE ACTIVATED SLUDGE AND THEIR CONTROLS IN KALMAR WASTEWATER TREATMENT PLANT

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ABSTRACT

Foaming problems in activated sludge processes of wastewater treatment plants are worldwide problems. It occurs on a regular basis in both municipal and industrial activated sludge processes. Foaming is often caused by excessive growth of filamentous bacteria such as branched filamentous Mycolata (formerly named nocardiaforms) and Microthrix parvicella. They are very hydrophobic and can result stable foam containing large quantities of filaments and other biomasses. This can result high TSS in the effluent from the clarifier. When the biomass containing large amount of filamentous bacteria enters the anaerobic digester, it can also cause stable foam in the digester and lead to many operation problems. There are different ways to control microbiological foaming. One way we tested in Kalmar Wastewater Treatment Plant in the spring 2014 is to control the growth of Microthrix parvicella with polyaluminium chloride (PAC). After 8 weeks simultaneous precipitation of PAC treatment in the activated sludge process and control of fat and septicity in the influent, the foaming problem disappeared. Microscopic examinations were conducted on a weekly basis to follow the trend during the treatment. Experiences will be shared during the presentation.

KEYWORDS

Wastewater treatment, Activated sludge, Microbiological foaming control, Filamentous bacteria

A SYSTEMS ECOLOGY VIEW ON SUSTAINABLE WASTEWATER TREATMENT

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ABSTRACT

The environmental, economic, and social dimensions of sustainability were connected in a systems ecology model with focus on wastewater treatment. Life Cycle Assessment and similar approaches are the most common systems analysis models in the wastewater treatment context. These models are beneficial, but are not the only possible approach to systems analysis. The model in this paper showed that the social and economic dimensions were inseparable intertwined, and both of them dependent on the environmental dimension for ecosystem services in the form of natural resources and regenerating capacity. The holistic view, as applied by a systems ecology approach, put focus on how sustainable wastewater treatment are limited to deliver something that can be assimilated by the environmental systems, and in the best applications, produce something that is again useful to the society.

KEYWORDS

Sewage, Sustainable Development

FOCUS ON KINETICS OF REMOVAL ANTIBIOTICS WASTEWATER BY NANO-ZERO VALENT IRON IN OXIDATION AND PHOTOXIDATION PROCESS

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ABSTRACT

Pharmaceutical wastewater can be difficult to treat with conventional physical/chemical and biological treatment systems. The presence of antibiotics in sewage selects for resistance markers that are able to spread through the microbial community and as a result, antibiotic resistant bacteria can potentially disseminate their resistance genes widely among members of the endogenous microbial community. The sludge products of urban and rural wastewater treatment plants are increasingly used to fertilize agricultural crops, dispersing unknown amounts of resistance genes and antibiotics that withstand standard sewage treatment. OTC is one of the nonbiodegradable antibiotics that makes antibiotic-resistant, so it can make be high risk for environment. NZVI can be a good choice for removal of OTC in aqueous solution. Response surface methodology (RSM) was used to optimize the amounts of NZVI and OTC to be used at pH 3 and under 200 W, UV-A irradiation. The responses were removal percent of absorption at 290 and 348 nm, TOC and COD of OTC. In the optimum condition, Linear model was performed 155 ppm of OTC were removed by 1000 ppm NZVI after 6.5 hours and the removal efficiency of absorption at 290 and 348 nm, TOC and COD were 87, 95, 85 and 89 percent, respectively. In the similar process, there is no organic compound after 14 hours. The parameters ORP, DO and pH were investigated for 6:30 hours to study the type of NZVI reaction in process. In the beginning of reaction, oxidation was the dominant reaction after 3 hours, photo catalytic reaction was remarkable. The mechanism of OTC degradation is proposed by HPLC/ESI-MS and four by products were found. Also the rate constants (first order kinetic chain reaction model) were 0.0099, 0.0021, 0.0010, 0.0049 and 0.0074 min^{-1}, respectively. Also by using Artificial Neural Network – ANN the chemical products and gain 6 neurons for P_1 and P_5 as the best result. 4 neurons for P_2, P_3 and P_4 was the best.

KEYWORDS

Response Surface Methodology, Photocatalyic Reaction, UV- Irradiation, HPLC, ORP

Fe-MODIFIED BIOMATERIALS FOR METALLOID REMOVAL

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ABSTRACT

Nowadays, growing attention is being paid to environmental pollution with metalloids (As, Sb, Te). Due to the wide distribution and toxicity, arsenic is the most studied metalloid. At the same time, considerably less attention has been given to antimony and tellurium. However, it is important to study the occurrence of antimony and tellurium in the environment, associated environmental pollution and possible solutions for environmental remediation.
Arsenic and antimony is present in natural water systems as a result of natural and anthropogenic activities. In order to solve the problem of metalloid pollution, different treatment systems, for instance precipitation, adsorptive, ion exchange and membrane processes have been used. Adsorption is considered to be one of the best methods because of its simplicity and potential of regeneration as well as, it is economical and easy to set up.
There are a lot of different sorbents for metal and metalloid removal so far. Some of the sorbents are effective for removal of one form of metalloid, but are not useful for other as well as sorption efficiency and costs are very variable, thus opportunities for finding new sorbents and new areas of sorbent application is open.
New sorbents based on natural materials have a similar efficiency to synthetic sorbents. Sorbents based on natural materials are cheap, environmentally friendly and recyclable. A prospective matrix for such sorbent development is peat – an abundant resource in Northern Europe and elsewhere.
We have developed new sorbents based on biomaterial impregnation with iron oxohydroxides. Raw peat material, iron modified-peat, iron modified-biomass (shingles, straw, sands) were used for removal of metalloids. Sorbent characterization was done using SEM, FT-IR, element content and specific surface area data analysis. Langmuir, Freindlich and Dubinin-Radushkevich sorption models were examined to characterize sorption process. Obtained data fitted to Langmuir sorption model. Biosorbent impregnation with iron compounds significantly enhance sorbent sorption capacity and make them useful for removal of metalloids. We have found that sorption capacity depends on used biomass sorbent although reaction conditions were similar. The highest sorption capacity was observed for iron modified-peat sorbents; iron modified-shingles and iron modified-straw show similar results.

KEYWORDS

Metalloids, Arsenic, Antimony, Tellurium, Sorption, Fe-modified Biomaterials, Sorption Models

DETERMINATION OF ACUTE TOXICITY OF DIFFERENT TYPES OF WASTEWATER

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ABSTRACT

Toxicity tests for determination of acute toxicity of wastewaters is an interesting approach for e.g. evaluating treatment methods. Toxicity tests help assessing the potential damage of wastewater to organisms in the environment. Different test-organisms have dissimilar response to various wastewaters and the evaluation can often be difficult. Results of toxicity tests can be expressed in different units and commonly used values are EC_{50} or EC_{20} (the concentration that cause a response in 50% or 20% of the population after a predetermined exposure time). Additionally, the results can be expressed as NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration). Also the exposure time will vary between tests and must be included in the assessment. In this presentation different kinds of wastewaters have been examined with respect to acute toxic effects on two different aquatic organisms, the crustacean *Artemia salina* and *Vibro fischeri,* the latter using the Microtox® apparatus. In one study, two different Advanced Oxidation Processes (AOPs), photo-Fenton oxidation and ozonation, have been investigated as post-treatment after the anaerobic degradation of raw textile wastewater. Here the performance of the AOPs has been compared based on their ability to reduce organic content, as COD, and acute toxicity. In another study, wastewaters from different wood species (pine, spruce, beech, larix and oak) were examined. Solutions including the anti-inflammatory pharmaceutical Diclofenac, Ibuprofen and acetylsalicylic acid (ASA), and the same compounds extracted from sediment and sludge from sewage treatment plants were tested in another study. Furthermore, studies were the crustacean *A. salina* was used, as a tool for evaluating different treatment procedures for leachate waters from landfills, will be presented. For most of the tested waters, results show that the bacteria *V. fischeri* was more sensitive than the crustacean *A. salina*, and in some cases no toxicity was detected with the shrimp toxicity-test.

KEYWORDS

Acute toxicity tests, *Artemia salina*, Textile wastewater, Wood-leachate, Landfill, Pharmaceuticals

SIMPLE THE BEST–WELL-PROVEN TECHNOLOGY FOR NEW KALMAR SOUND WWTP

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ABSTRACT

Kalmar Water initiated the first studies for extension of Kalmar WWTP in 2010. The basic idea is to keep the existing sludge handling plant intact, and to build new wastewater treatment tanks in order to ensure higher reduction of foremost nitrogen and phosphorus.
In a multi-criteria-analysis, four different techniques/processes for the biological treatment step have been evaluated. MBR-technique, which currently has become very popular in Sweden, has been studied thoroughly before analyzing it with the multi-criteria-analysis.
For Kalmar Water, the well-proven solution with AS+settling tank in combination with chemical treatment/sandfiltration was evaluated higher than MBR-technique, foremost due to the following reasons (without internal order):

- Little vulnerability
- Little consumption of chemicals
- Little cost for staff

Currently, Kalmar Water is working on a rough cost estimation for the chosen solution.

KEYWORDS

Wastewater treatment, Multi-criteria analysis, Evaluation of techniques, Kalmar Water

STORM WATER MANAGEMENT AT ARLANDA AIRPORT

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ABSTRACT

Vatten och Samhällsteknik has since 1985 been deeply engaged in developing purification systems for polluted waters by the use of constructed wetlands. This abstract will focus on storm water from airports and the case Arlanda Airport. The specific pollution at airports in Sweden and other northern countries is the result of winter operation. At most northern airports formiat is used to clear the runways from ice. Snow will mainly be removed in mechanic ways and also warm sand can be part of a winter operation. In some special occasions and at some airports also urea (concentrated ammonia) might be used. For de-icing the aircrafts different sorts of glycol normally is used. Both formiat and glycol are organic substances, very effective to melt the ice, but they will be broken down rather quickly and during this process demand oxygen. The result in a recipient will be that existing oxygen in the water will end and living fauna rapidly die.

KEYWORDS

Airport, Storm water, Formiat, Oxygen

APPLICATION RO TECHNIQUES WITH "OPEN CHANNEL" MEMBRANES TO TREAT WASTEWATER FOR RECYCLING AND REUSE: MODERN METHODS OF ENVIRONMENTAL PROTECTION AND WATER RESOURCES MANAGEMENT

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ABSTRACT

The solution to contemporary ecological problems such as wastewater reuse requires rational water resources management, and in turn, rational water resources management requires the development of new, more efficient techniques.
The modern concept of rational water resources management requires the development of new efficient techniques that provide wastewater treatment and reuse. For many local industries, the problem of wastewater treatment and discharge into surface reservoirs can't be solved through the use of conventional biological treatment techniques. Current discharge standards require very strict removal of a number of impurities such as ammonia, nitrates, phosphate, etc. To reach this level of removal, expensive reagents and sorbents are used.
As RO membranes simultaneously reject all dissolved impurities such as BOD, TDS, ammonia, phosphates etc., they become very attractive for the direct treatment of wastewater without biological stage. To treat wastewater, specially designed membrane "open channel" modules are used that do not possess "dead areas" that cause fouling or require pretreatment. A solution to the concentrate disposal problem is presented that consists of reducing of initial wastewater volume by 100 times. Concentrate is withdrawn from membrane unit as sludge humidity.
Local utilities and privately-held industrial sites are encouraged to reuse wastewater and reduce freshwater intake, thereby prompting rational water management and reducing environmental pollution.

KEYWORDS
Reverse osmosis, Stormwater treatment, Open-channel module, Wastewater reuse, Ecology

COASTAL AREA MINING

HARBOR MINING AND MINING FROM CONTAMINATED SOILS-WHAT OPTIONS DO WE HAVE?

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ABSTRACT

Sweden has about 80 000 potentially contaminated areas. Several of these are situated in coastal areas, e.g. harbour sediments, and metals contaminate about 50 %. The metals contained represent possible large values, provided they can be extracted with reasonable efforts. The only commercially available technique for metal recovery around the Baltic Sea today is the pyro-metallurgical process, e.g. the smelter Boliden Rönnskär outside Skellefteå. Several constraints limit the possibilities to recover metals from contaminated sediments and soils, mainly to low concentration of commercially interesting metals and to high amounts of slag forming elements. To be able to recover metals from contaminated sediments and soils these normally have to be treated to concentrate the metals in a matrix suitable for recovery in smelters or, alternatively, recovered using other techniques like the hydro-metallurgical process. To enable large-scale recovery of metals from contaminated soils and sediments, as well as from metal-rich ashes, which today are landfilled, new techniques must be developed. Ongoing research points out possible alternatives.

KEYWORDS

Metal recovery, Harbour sediments, Contaminated soil

**Keynote speaker*

ALGOLAND–INDUSTRY AND ECOLOGY TOGETHER

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ABSTRACT

In close collaboration with the industry microalgae are tested as biofilters to clean air and water with spin-off production of high-value products for the market. Microalgae biomass can be used as a renewable and sustainable energy source, as feedstock for animal feed supplement and as raw material for the industry. ALGOLAND develops innovative solutions to use waste as a resource and in the process decrease eutrophication effects, and to mitigate climate change for industry in reducing their overall carbon footprint.
In collaboration with Cementa Heidelberg AB and SMA Mineral, CO_2 capture from industrial flue gas is currently being tested in pilot plant scale in Degerhamn, Öland, with promising initial results. Microalgae are also used for biofiltration of landfill leachate water, high in ammonium, in collaboration with Kalmarsundsregionens renhållare (KSRR) and Kalmar Energi. Microalgae have the potential to play a vital part in implementing a circular economy in the South Baltic Region, as they grow rapidly in seawater, are carbon neutral, and do not compete with food-production. The research project is co-funded by the European Development Fund.

KEYWORDS

Microalgae, Biofilters, Seawater, Air, Cooperation

TOWARDS RECOMMENDATIONS FOR DESIGN OF TREATMENT WETLANDS FOR EFFLUENTS FROM WASTEWATER TREATMENT PLANTS IN THE BALTIC REGION – GDAŃSK CASE STUDY

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ABSTRACT

There are many challenges that need to be addressed if the far reaching objectives on high environmental status as required in the EU Water Framework Directive and the Marine Strategy Framework Directive will be met in the Baltic Sea Region within the next decade. For wastewater treatment plants (WWTP) this implies, in spite of the many improvements made during the last decade, development and introduction of new technology to further reduce eutrophying compounds, hazardous chemicals and pharmaceuticals. Constructed wetlands when properly designed and operated have been shown to be robust systems with low energy requirements that may not only reduce many types of pollutants but may also provide many additional ecosystem services beyond requirements generally imposed by authorities. For example, they may support and enhance biodiversity and be used to convert brownfield areas in urban landscapes to recreational areas. Reduced cost is possible if treated water is reused in industry or for irrigation. In a project, supported by the Swedish Institute, a group of scientists, a water company and water using industry has together with local authorities through workshops, field studies and literature studies worked on finding a general first recommendation on design and operation. In this paper we will present the scientific rational and legal constraints for the general design and operation of a wetland system for treatment of effluents from WWTPs using Gdańsk as an example. The proposal includes a first part, which mainly will be focusing on pollutant and pathogen removal using particle traps and a HSSF wetland on land owned by the WWTP and a second part consisting of a FWS wetland which, in addition to further polishing the water, will enhance biodiversity and provide recreational areas on derelict land owned by the city.

KEYWORDS

Waste water, Treatment wetlands, Sustainable cities, Ecosystem services

SEDIMENT AND SLUDGE DEWATERING AND TREATMENT: REAL EXAMPLES AND CASE STUDIES

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ABSTRACT

Remediation of contaminated sediments is becoming more and more common in Sweden, and often the remediated sediments are accompanied by large amount of water when remediation is done by suction dredging or excavation dredging. RGS 90 have developed techniques to dewater the remediated sediments to minimize the cost of treatment as well as the environmental impact (*e.g.* less transports are needed if the sediments are being dewatered on site). In the stream Viskan outside Borås in western Sweden, RGS 90 performed a suction dredging where the sediments were dewatered and stabilized. Also, in a pond near Kristinehamn in mid-Sweden, RGS 90 performed an excavation dredging where the sediments were dewatered on a tilting plane.

KEYWORDS

Remediation, Sediment, Dredging, Dewatering

BALTIC SEA CHALLENGE – NETWORKING AND EXPERIENCE EXCHANGE ENHANCING THE IMPLEMENTATION OF CONCRETE WATER PROTECTION MEASURES

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ABSTRACT

Watercourses are affected by eutrophication, harmful substances, maritime traffic and leisure boating, dredging, littering and building of infrastructure. On the other hand, nature is an important factor for the well-being of coastal municipalities and industries. Monetary value of the ecosystem services produced by the Baltic Sea is about 5 billion Euros annually. These regulating services, natural resources and recreational services are responsible for e.g. recycling of nutrients, flood prevention, providing fish stocks and a framework for tourism. The protection of waters is governed by international and national laws, intergovernmental conventions and regional or local environmental permits. However, also the implementation of EU or HELCOM regulations is usually carried out on the local level. Municipalities, ports and water utilities examples of local actors which can set their own, more ambitious goals and take further steps for being exemplary – not only complying with regulations but accomplishing voluntarily measures for water protection. Cities of Helsinki and Turku in Finland see the state of the Baltic Sea as a basis for their competitiveness. They decided in 2007 to launch the Baltic Sea Challenge initiative for the protection of the sea: they published a joint Baltic Sea Action Plan with almost 40 activities that were additional to legal requirements, and challenged other organisations to join. In 2014 the network includes 200 organisations around the Baltic Sea. Together, events are organised, materials produced and best practices shared, in order to protect the waters. The network is free of charge and open to all. Helsinki and Turku updated their joint Baltic Sea Action Plan for 2014–2018, and new operating model with priorities for the network were set out. Baltic Sea Challenge continues to provide benefits and function as a strong communication channel for members, while retaining its distinctive nature as a free-form, easy and direct network.

KEYWORDS

Baltic Sea, Water protection, Cities, Municipalities, Voluntary, Cooperation, Networking, Network mobilization

SMALL-SCALE SIMPLE PLANKTON COMMUNITIES AS A TOOL FOR SHORT-TERM ASSESSMENT OF POTENTIAL ENVIRONMENTAL RISKS FROM CHEMICAL PRODUCTS IN AQUATIC ECOSYSTEMS

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ABSTRACT

Of the large number of chemical products that are introduced to the technosphere annually, several of them pose serious environmental threats. Risk chemicals are identified and detected mainly by single-species toxicity testing in the laboratory or they have been brought to light as a result of observing biological effects in situ. The overall knowledge base regarding environmental and ecotoxicological harmful effects of chemicals are in some cases quite extensive and detailed. Not because of ingenious standardized test methods for toxicological risks, but rather because of academic research in the area since the 1950s.
This study, based on a pilot study and previous research, discloses a very simple and inexpensive system for testing the effects of chemical pollution on ecological communities. The study suggests the use of plankton communities (microcosms) as small-scale models for testing the effects of chemical mixtures, products or single compounds on ecosystem structure and biodiversity.
In this study test-media (plankton communities) were taken from a natural pond ecosystem. Pond-water with a homogeneous mixture of plankton was transferred to glass jars (20 ml) that then were exposed to tree different commercial chemical products used as models (containing deltamethrin, glyphosate and paracetamol respectively). Ten selected species of plankton were quantified to evaluate changes in diversity and abundance after treatment.
All chemical products had some kind of effect on the model plankton communities in this experiment. As expected, the deltamethrin product had the most evident and pronounced effect by the well-known targeting of arthropods like Crustacean zooplankton. Glyphosate however, unexpectedly affected “zooplankton” and did phytoplankton more abundant.
The results from this pilot study suggests that important ecosystem level effects such as changes in community composition not can be predicted from risk assessment strategies based upon reductionistic science traditions only.

KEYWORDS

Chemical products, Plankton, Ecosystem, Treatment

FISHING FOR STICKLEBACK: MUTUAL BENEFITS FOR COASTAL ECOSYSTEMS AND FOR THE DEVELOPMENT OF AQUACULTURE INDUSTRY IN THE BALTIC SEA REGION?

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Sweden

ABSTRACT

Three spine stickleback is a small fish species that has increased dramatically in the Baltic Sea during the last decades. It is also a species that today has no commercial value. The increasing amount of stickleback have been associated with adverse effects on the Baltic coastal ecosystems. By feeding on larval stages of perch and pike, sticklebacks have cause declines in local piscivore populations. By feeding on benthic invertebrates, stickleback also reduce the grazing by invertebrates on filamentous algae which then have caused increased algal blooms in the coastal areas of the Baltic Sea. A commercial fishing after stickleback as a primary ingredient in fish feed is therefore expected to have positive effects on the recruitment of coastal piscivorous fish like perch and pike and to reduce eutrophication symptoms in coastal area of the Baltic Sea. The use of sticklebacks in fish feed manufacturing likely enhance future expansion of aquaculture industry in the Baltic Sea basins. This because the net nutrient load to the Baltic Sea will be zero if the fish feed used is based on primary ingredients from the Baltic Sea.

KEYWORDS

Benthic invertebrates, Eutrophication symptoms, Feed, Primary ingredients

SOLID WASTE MANAGEMENT

THE REGIONAL SYSTEM OF MUNICIPAL WASTE MANAGMENT IN LATVIA AND NEW CHALENGES IN ENVIRONMENTAL ENGINEERING FOR THE PERIOD BY THE YEAR 2020

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ABSTRACT

The report describes the system of municipal waste management in Latvia, it highlights the necessity of creating the waste management regions (WMR), their history and importance.
Four examples of technically different regions are discussed to reach the goal of environmental protection and waste management (Pierīga, Ventspils, Zemgales "Brakši", Ziemeļvidzeme).
The report contains analysis of pros and cons of the given examples as well as the challenges in environmental engineering by the year 2020 - the use of municipal waste energy and potential raw material - will be discussed. Particular attention will be paid to the use of organic fraction in the context of European Union (EU) policy to limit the household expenditure for recycling in the amount of 0.7% of the average household total expenditures.

KEYWORDS

Municipal waste, Organic fraction, European Union**,** Recycling

PREPRATION OF NANOEMULSION CLOVE OIL IN WATER AS A GREEN NANO PESTICIDE

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ABSTRACT

Nowadays, environmental problems caused by excessive use of pesticides have brought scientists and public special attention. Annual rate of pesticide used on crops is estimated to be2.5 million tons. The worldwide damage caused by pesticides is projected to be $100 billion per year. The reasons are two folds: (1) the high toxicity and non-biodegradable of pesticides and (2) the lack of scientific formulations, i.e. only few percentage of pesticides has been effectively used, many of them either been washed away into soil, revers causing pollution of soil, water resources and aquatic life or remained on the fruit crop surfaces affecting public health. Hence, it is necessary to search for the new highly selective and biodegradable pesticides to solve the problem of long term toxicity to mammal or one must study the green (environmental friendly) formulations of pesticides. In addition, one has to develop techniques that can be employed to reduce pesticide use while maintaining crop yields. Present research was conducted to use nanoemulsion of clove oil in water as a green nanopesticide. Clove oil has biological activities, such as antibacterial, antifungal, insecticidal and antioxidant properties. In this work, nanoemulsion of Clove oil in water was formulated using non-ionic surfactants such as Tween80/Span80 by ultrasonic emulsification method. In order to replace the use of organic solvent and increase the dispersity of active ingredient, suitable emulsifiers were used. Droplet size measurement method is used to determine the stability of nanoemulsions. Stable nanoemulsion Clove oil with droplet diameter 34 nm was formulated in duration of 7.5 min.

KEYWORDS

Nanoemulsion, clove oil, Green nano pesticide, Non-ionic surfactants, Tween80/Span80

INSTITUTIONAL APPROACHES TO THE DEVELOPMENT OF SOLID WASTE TREATMENT AND IT'S STAFFING IN THE RUSSIAN FEDERATION

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ABSTRACT

Research , the results of which will be discussed in the present report were obtained in the framework of the Commission under the President of the Russian Federation for Modernization and Technological Development of Russia's Economy.
Key issues affecting the management of the flow of all types of waste in Russia are:

- A huge number of unsorted household waste and unprocessed
- Extremely high yield landfill business and its criminal
- Lack of waste treatment business
- Possibility of selling the energy received from the recycling can not be considered as an incentive for the development of business
- Building regulations do not provide for the installation of systems for separate collection of household waste

Public services and private investors are not able to effectively solve the problem of eliminating the effects of pollution of waste production and consumption with the formation of an efficient, cost-effective and environmentally sound waste management industry.

It is necessary to pay more attention to not direct support projects on waste recycling, and introduce restrictive measures for the development of businesses not harmless to the garbage.
We need to develop a "roadmap" of joint actions of government and business to create a national market for emissions trading of greenhouse gas emissions on the basis of voluntary commitments by companies to reduce them.
As a result of the work done has been formulated for a number of assignments signed by the President of the Russian Federation .

KEYWORDS

Municipal solid management, Public-private partnership, Institutionalism,
Project management

SIDERURGICAL RESIDUES MANAGEMENT IN RIO DE JANEIRO STATE AND POSSIBILITIES OF INTEGRATION WITH URBAN RESIDUES

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ABSTRACT

The new Brazilian Solid Waste Policy is being implemented. The expectation is of changes in management of all kinds of residues, including urban and industrial wastes. The valorization of residues gains importance with this new policy. Brazilian steel plants must assess possibilities of co-processing industrial and urban residues. Plastics can be processed in blast furnaces, as is performed in some developed countries. Industrial siderurgical plant has high production of sludge. Moreover, leachate from this sludge has low contamination risk. Therefore, landfill co-disposal with urban wastes can be performed safely. There are many ways to save energy and adopt proper disposal of such residues. Waste steel slag can be used in constructions and vitrification of hazardous wastes. Tires can be recycled in blast furnaces contributing to energy recovery. It can also be a solution for reverse logistics which is being implemented in Brazilian law.
Nowadays, the management of siderurgical residues is very difficult and of high economical cost. This is due to low internal recycling and to the large amount of residues generated and high costs of transport and disposal in landfills. These residues are complex and, in general, non-inert or hazardous. Blast furnaces and Steelmaking are great generators of non-inert sludge, but of low contamination risk. However, sludge produced in effluent treatment of the carbochemical plant and finishing lines is more dangerous and leads to greater environmental and health risks. So forth, proper disposal is more difficult.
The present paper gives information about siderurgical residue management in Rio de Janeiro and describes possibilities of integration with urban residues. There are new possibilities to integrate residue destruction and energy recovery to reduce costs of steel production and use energy recovered of urban waste. The possible integration of processes such as: tire and plastic recycling, pyrolysis, incineration with energy recovery can lead to reduction of coal consumption. These issues are of great interest for all siderurgical complexes in Brazil.

KEYWORDS

Solid waste, Siderurgical residues, Landfill, Recycling

UPSTREAM SILVER SOURCE MAPPING

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ABSTRACT

As the use of consumer products is increasing, a similar increase of hazardous substances can be seen in sewage sludge in Swedish wastewater treatment plants (WWTPs). Silver (Ag) is a heavy metal with a high accumulation rate in soils when applying sewage sludge as fertilizer on arable land. Silver is therefore prioritized in REVAQ, a certificate system for Swedish WWTPs. The levels of Ag in the incoming water to the WWTP are today too high and must be reduced. This study aims to identify major diffuse emission sources of Ag and map out the inflow to, the stock (accumulated amount in the techno sphere) and the outflow from Stockholm during 2012.
For 2012, 61 kg silver was measured in the sludge in Henriksdal wastewater treatment plant in Stockholm. Sources explaining 56 % of the measured amount of silver have been identified in this study, corresponding to 46 mg Ag per person and year. The sources with the largest contribution of silver are estimated to be textiles (19 %), urine and faeces (from for example amalgam fillings and food) (15 %) as well as cleaning products (7 %). The inflow of Ag to Stockholm during 2012 was estimated to 3 200 kg and the stock to 105 tons, where electric goods and appliances as well as silverware and jewellery together explain 94 % of the inflow and 98 % of the stock.

KEYWORDS

Silver, Sewage sludge, Substance flow analysis, Wastewater

USE OF QUALITATIVE RESEARCH METHODOLOGY IN ASSESSING THE HEALTH OF RESIDENTS IN THE VICINITY OF MORRO DO CE`U LANDFILL

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ABSTRACT

The care to municipal solid waste is necessary for the quality of the environment and the lives of people living around the sites and waste disposal, and a relevant topic of the National Solid Waste Policy, signed in August 2010, but still far from an effective implementation. Proper management of these wastes must be done in order to avoid inadequate gas and leachate emissions, extend the life of landfills and seek to reduce chemical degradation caused by waste in the environment. On the other hand, little is known about the effects of these landfills on the health of humans. This paper aims to propose the use of qualitative research methodology to understand the perception of individuals, residents and health professionals who live and / or work in the areas surrounding the landfill. The Morro do Céu landfill, located in the city of 500 000 inhabitants in the state of Rio de Janeiro is where the waste began to be launched in the early 80s, without any prior preparation of the land had been carried out, becoming therefore, in a large garbage dump. In the mid-90s some academic researchers were developed extolling the high risk potential that this region entailed the environment and possibly the health of the population of their surroundings. From the year 2004, the landfill began to have monitored their effluents, garbage began to be covered as well as important works of the leachate drainage were performed. The landfill was closed in mid-2012, but still continues to display horizontal and vertical deformations, beyond the generation of gas and leachate that is due to biochemical degradation of organic material. We use the methodology of qualitative research through open at depth interviews with residents and health professionals to assess their perception about the health conditions of the population seeking to understand the association between health and the evolution of the landfill, his transformation from landfill to control from improvements and environmental monitoring of the landfill area. It is hoped that this research meet the demands of residents and understand the relationship of this population to the landfill, since a large portion of the population, despite the possibly affected by the harmful health effects of landfills depends on the income generated from the sale of recyclable materials collected on site. Finally, we stress the importance of knowledge of this subject by the authorities, and must therefore be considered within the sanitation programs aimed at improving public health.

KEYWORDS
Municipal solid waste, Leachate, Chemical and biochemical degradation, Recycling

IN SITU NITROGEN MANAGEMENT IN LANDFILL BIOREACTORS USING COMBINED SHARON AND ANAMMOX PROCESSES

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ABSTRACT

Landfill bioreactors (LFBR) are gaining significant attention as sustainable alternative for conventional landfilling. Nitrogen management is an important issue in landfill bioreactors. The present study is to establish the combined SHARON (single reactor system for high activity ammonia removal over nitrite) and ANAMMOX (anaerobic ammonium oxidation) processes in landfill bioreactors for *in situ* nitrogen management. Laboratory scale landfill bioreactors (43 L volume capacity) as SHARON-ANAMMOX LFBR were loaded with mined municipal solid waste operated for 147 days at a nitrogen loading rate of 1.2 kg $N/m^3/d$. The results showed a nitrogen removal efficiency of 83% with maximum partial nitritation efficiency of 57% and specific ANAMMOX activity of 0.7 mg Amm-N/mg MLVSS/d was achieved in the LFBR. Nitrogen transformations, biomass development and, hydrazine and hydroxylamine formation authenticated the aerobic ammonium oxidising bacteria (AOB) and anaerobic ammonium oxidising bacteria (AnAOB/ANAMMOX) activities responsible for combined SHARON-ANAMMOX processes in LFBR. 99% of the biogas in LFBR as N_2 the end product confirmed the combined SHARON-ANAMMOX processes. The study successfully demonstrated the combined SHARON-ANAMMOX processes for *in situ* nitrogen management in landfill bioreactors with shorter start-up time and stable operation.

KEYWORDS

Municipal solid waste, landfill bioreactors, *in situ* nitrogen management, combined SHARON and ANAMMOX processes, aerobic and anaerobic ammonium oxidising bacteria

OPTIMISATION OF THE RESOURCE ECONOMY OF METALS, MINERALS AND ENERGY IN AN INTERPLANETARY PERSPECTIVE

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ABSTRACT

Valuable metals and minerals are becoming ever scarcer on Earth. The global population is steadily increasing. Thus, new sources of natural resources in space are now needed as an alternative to digging deeper into Earth. Therefore, a cost structure is proposed for generally improving the resource economy of metal and mineral commodities and energy resources based on the optimisation of residuals as regards resource exploitation on primarily an interplanetary scale. The introduced methodology involves business administration and economics theory and employs the previously introduced equality principle and the Efficient Use of Resources for Optimal Production Economy (EUROPE) model. The suggested theory is applicable in the solar system and the space-platform context. A case study shows how to in practice apply the findings on the USA exploiting natural and energy resources on asteroids and the red planet Mars. It is concluded that the presented methodology is useful for increasing the cost-effectiveness of mainly the occurring residuals when exploiting natural and energy resources and commodities outside of our own planet in space. Also, the equity of the distribution of such facilities is improved on all scales. The developed methods are suitable information support tools for decision-making in the management of natural resources, with emphasis on the economy of residuals on the interplanetary level as well as generally being applicable on ore mining. A proposed key figure enables management to immediately obtain an overall comprehension of the economic, technological and environmental performance of their interplanetary endeavours that hence continuously can be reviewed, monitored and evaluated.

KEYWORDS

Space economy; natural resources; business economics; economics; residuals; nations; solar system; space-platforms; the equality principle; the EUROPE model.

THE IMPACT OF WASTE MANAGEMENT ON CLIMATE CHANGE

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ABSTRACT
Waste treatment techniques have a growing impact on the flux of carbon dioxide and other greenhouse gasses from the urban system to the atmosphere. Municipal solid waste and different types of waste derived fuels contain between 20-40 % organic matter with fossil origin, based on dry matter and carbon content. This includes plastics, synthetic textiles, synthetic rubber, a.s.o. Recycling of this fossil material into long-lived new products is of great importance. If this cannot be done, landfilling of these fossil fractions is strongly preferred instead of incineration. During landfilling fossil carbon is brought back to long-term storage, and will not contribute to methane gas emissions. Landfilling can in this respect also be a way of storing the material for future use as raw material, when better chemical technology is available. If incinerated, waste with fossil origin can be a major source of atmospheric emissions of fossil CO2. Also, during reduction of NOx from the stack-gases from waste incineration, N2O is often a by-product that is emitted to the atmosphere. N2O is approximately 35 times as potent as an agent for climate change compared to CO2. Returning to forestry or agriculture of compost or organic residues from biogas production increase the soil organic matter content, and provides an increased storage of organic carbon in the soil. Environmentally controlled landfills, and different types of landfill bioreactor cells for residual wastes, also provide one of the few available carbon accumulating processes in the human society, and can be compared to the natural peat and sediment accumulating processes in natural ecosystems. Thus, provided that a reliable and efficient biogas collection system is installed, strictly controlled landfilling of municipal sold waste could be a technique to counteract global warming. New techniques from e.g. the US, UK Australia and Sweden show promising results for such improved efficiency in landfill gas collection. According to recent estimates a landfill or a landfill bioreactor cell is positive from a climatic point of view if more than 60-65 % the produced biogas can be collected, and be prevented from reaching the atmosphere. In modern, strictly controlled reactor landfills around 80-95 % of the produced biogas can be collected and used as fuel in cars or for heat- and electricity production. In a landfill reactor-cell, treating approximately 100 000 tons of waste per year, and where the fermentation residues are left in the landfill, a long-lived organic fraction corresponding to about 45 000 metric tons of carbon dioxide is long-term accumulated each year. This compensates for the annual carbon dioxide emissions from about 15 000 cars, provided that each one runs 15 000 km per year with fossil fuel. To this should be added the benefits of replacing fossil fuels with the collected biogas. Long-lived organic matter in a landfill further helps to immobilize e.g. heavy metals and decrease leaching. Also other processes during landfill management will increase the capture and binding of CO_2. One such process is increased biomass production and accumulation of soil organic matter after irrigation of leachates to forest plantations within the restricted landfill area. This increases the effect of landfills as carbon sinks.

ENVIRONMENTAL MODELLING AND MEASUREMENT

TREATMENT OF MUNICIPAL WASTEWATER IN FULL SCALE TRADITIONAL SANDFILTER AND BIOMODULE GROUND FILTER – ACCOUNTING FOR TOTAL INFLOW AND OUTWLOW GIVES THE WHOLE PICTURE

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ABSTRACT
One traditional sandfilter and one biomodule ground filter were constructed in the fall of 2012 at Biolinja 12, Turku, Finland. The filters were placed together on a field bordered by open ditches from all sides to collect excess rain and melt waters. Untreated municipal wastewater from Varissuo suburb was pumped from a sewer separately via three septic tanks into the filters. Initially the daily flow was 1200L/d to both filters to reflect the average organic load of a household of five persons (load: ca 237 g/d BOD; 73 g/d total N; and 10.4 g/d total P). Samples were withdrawn from the inlet water, from the water entering the filters after the third septic tank, and from the outflowing water. The retention time of the filters, when measured separately, was 10 – 12 hours. After an initial adaption time the reductions in BOD and COD were constantly between 92 and 98%, showing that the biological degradation process in the filters functioned optimally and clearly comply with the national and EU standards. The reduction in total nitrogen and total phosphorus, however, reached required levels only during the first months of testing, apparently when buildup of microbial biomass was still ongoing. After this initial period the reduction of total nitrogen varied between 5 - 15% and total phosphorus 5-10%. Nitrification was efficient in both filters, but based on the poor nitrogen reductions, denitrification was inefficient or absent. During the winter period the temperature in the filters dropped to near freezing, but the flow of water was unaffected by freezing. During snowmelt and heavy rain occasional flooding may lead to dilution rather than purification of the waste water. In conclusion, the sand or biomodule filters worked well for reduction of the organic load in municipal waste water, but failed to reduce nitrogen and phosphorus levels.

KEYWORDS
Municipal waste water, soil filtration, BOD, nitrogen, phosphorus
**Keynote speaker*

ENHANCEMENT OF AMPEROMETRIC RESPONSE OF GLUCOSE BIOSENSOR BY ELECTRODEPOSITION OF SILVER NANOPARTICLES ONTO CHITOSAN-MODIFIED ELECTRODE

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ABSTRACT

A highly sensitive biosensor based on silver nanoparticles (AgNPs) was fabricated for glucose detection in aqueous phase. Firstly, a platinum (Pt) electrode was modified with the mixture of glucose oxidase and chitosan. AgNPs were electrodeposited into the modified electrode by single pulse potentiostatic method at –0.4 V. The electrochemical performance of the modified electrode was evaluated by cyclic voltammetry and amperometry. The fabricated biosensor had a high sensitivity of 58.6 μA mM^{-1} cm^{-2} and detection limit of 4.4 μM glucose at a signal to noise ratio of 3. In addition, the biosensor showed a short response time less than 5 s and a wide linear range of 0.05-11.5 mM. The apparent Michaelis–Menten constant (K_M) was found to be 9.14 mM. In addition, thermal stability and anti-interference ability of the biosensor were investigated. The results demonstrated that AgNPs enhanced the analytical performance of the biosensor.

KEYWORDS

Biosensor, silver nanoparticles, chitosan,glucose oxidase, electrodeposition

**Keynote speaker*

RATIONALLY DESIGNED NANO-STRUCTURED MATERIALS ENGINEERED FOR THE MONITORING OF PERSISTENT ORGANICS

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ABSTRACT

Molecular imprinting science and technology[1] offers significant opportunities for the development of robust recognition materials for use in sensor development. In this presentation, a background to the technique shall be provided followed by examples of recent efforts to use computational strategies to assist in the development of molecularly imprinted polymers (MIP) for persistent organic monitoring.[2,3]

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2. Nicholls, I.A.; Karlsson, B.C.G.; Olsson, G.D.; Rosengren, A.M. *Industrial & Engineering Chemistry Research* (2013) *52*, 13900-13909.

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A WETTER CLIMATE IN THE NORDIC COUNTRIES: EFFECTS ON WATER QUALITY

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ABSTRACT

Growing evidence tells that we are facing a climate change. Predictions are varying depending on which region we look at. In Northern Europe a warmer climate and higher precipitation is a likely scenario. This might increase groundwater levels during the cooler seasons and result in more reducing conditions in groundwater, raising concentrations of redox sensitive elements like iron, manganese and arsenic. Iron is the most common groundwater problem in Sweden and Finland. While iron is rather easily removed from groundwater the removal of manganese requires more oxidizing treatment. Manganese was previously considered a technical problem but recently it has been shown to be a health risk. Manganese is an essential element, its uptake from food is well controlled in humans, but in drinking water it may cause intellectual impairment in children chronically exposed. Private wells with excessive manganese levels are common in the Nordic countries. Arsenic is another element mobilized in reducing aquifers, observed globally.

Increasing rainfall is likely cause higher DOC in runoff. The adsorption of DOC is efficient in drained areas but less so in discharge area with lateral flow at a raised groundwater level. Increasing DOC requires more efforts in treating surface water for water supply. A secondary effect is that the transport of mercury to lakes increases. In the Nordic countries, mercury is by atmospheric deposition accumulated in the organic surface soils. Mercury is transported as organic complexes and this transport increases with the DOC content. Mercury is methylated in bottom sediments and transferred in food chains to fish. Half of the lakes in Sweden have fish with mercury levels higher than recommended for human consumption. This will be a growing problem.

A positive effect of increasing DOC might be lesser toxicity of heavy metals in lakes and surface water. Acid rain caused acidification of many streams and lakes in the second half of the 20th century. At a low pH DOC was less soluble and the toxicity of metals notably aluminium was a problem. When acid rain has been controlled, DOC tends to increase and acts as a ligand to aluminium whose bioavailability is decreased. This applies also to many streams and lakes in mining districts in Sweden and Finland.

KEYWORDS

Climate change, metals, DOC, mercury

POSTERS SESSION

LANDFILL PLASTIC TO LIQUID OIL

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ABSTRACT

A full-scale Landfill Mining (LFM) project was made in 2012–2013 in Estonia at Kudjape Landfill. As a result of mining, mixed plastic waste was separated from excavated material. After sieving and shredding the received plastic fraction was washed and dried for further research.
The waste plastic may be incinerated for energy and heat recovery or used as solid recovered fuel in cement industry. However, more favoured could be reprocessing this material to liquid fuel. A series of experiments were made to study pyrolysis of landfill plastic after being buried for up to ten years. Mixed plastic was treated thermally by semi-coking process as used by thermal treatment of oil shale in Estonia. The preliminary studies have shown, that oil, gas and solid carbon-rich residue may be received. All of these products show value as energy source.
In this project, interdisciplinary research was done by Estonian University of Life Sciences (responsible for mining, sorting, pre-treatment and washing of landfill plastic), and Tallinn University of Technology (responsible for semi-coking of plastic waste and analyses of end-products). Results, conclusions, and proposals are presented in the article.

KEYWORDS

Mixed landfill plastic, Pyrolysis, Semi-coking, oil, Gas, Carbon-rich residue, Energy

DEVELOPMENT OF INTERNATIONAL ENVIRONMENTAL EDUCATION IN INSTITUTE OF INTERNATIONAL EDUCATION PROGRAMMES (SAINT-PETERSBURG POLYTECHNICAL UNIVERSITY, RUSSIA)

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ABSTRACT

Institute of International Educational Programs at the St. Petersburg Polytechnic University, established over 45 years ago and is one of the leading educational establishments that carry out international educational programs in the Northwest region of the Russian Federation. Globalization, which takes over the world puts internalization universities as one of the most important directions of its development. In general, the Polytechnic University characterize the internationalization of the university as the development of new interdisciplinary courses, the use of technology in the educational process, to be effective in the educational systems of other countries, as well as the use of new methods and techniques of evaluation of educational achievements students. The effectiveness of training professionals in the field of ecology, including related and performance evaluation - a basic principle of learning, founded by the Bologna process aimed at updating and assessment practices in the educational achievements of Russian and foreign universities. Increasing the attractiveness of education, leads to the need to develop and implementation of programs of internationalization in higher education, as competitiveness depends on the participation of teachers and students in academic mobility programs that promotes the study of positive foreign experience. In Russia, we have a situation where on the one hand, there is the need to integrate into the global educational community, and the other - are not sufficiently defined the strategy of internationalization of universities, due to the modernization of higher education. To expand the possibilities of strengthening the competitiveness of students who will be in the natural sciences professionals conducted to develop new directions, including remote computer lecture and laboratory applications. This also held a number of additional classes, summer schools, as well as international scientific activities and conferences (such as International Youth environmental Forum for Baltic region countries named "ECOBALTICA" with widest participation of Linnaeus University) with a wide participation of leading professionals (for example Professor William Hogland from Linnaeus University).

KEYWORDS

International education, Natural sciences, Environmental sciences, Summer school

THE DEVELOPMENT OF THIN-FILM PHOTOVOLTAIC APPLICATIONS BASED STRUCTURES ON CuInSe2 WITHIN THE TRIPLE HELIX MODEL

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ABSTRACT

It is expected that the thin-film modules will dominate new markets. Therefore continue the work with new materials and structures, in order to develop new technologies and improvement of solar cells. This work we conclude that there is a possibility of using the new material and photosensitive structures based on it as thin film solar energy photoconverters. It is the basic direction in the new environmental economics.
Currently in Russia, Ukraine, and Kyrgyzstan exist and develop programs of development of alternative energy, including solar power, a number of joint projects with foreign firms, which are practically engaged in supplying silicon feedstock and replication of foreign equipment and technology.
In the European Union since 1997, the annual cost of creating photovoltaic technologies estimated sum of 100 million U.S. dollars; Germany had the largest contribution - about $ 40 million. To coordinate research in the field of solar energy, a special commission with headquarters in Brussels.
Since 1997, technological development has been carried out for amorphous Si, CdTe thin film polycristal and $CuInSe_2$ (CIS) solar cells in the thin film solar cell family. These works are carried out on the interaction between business, science and education within the Triple Helix model.
Thin film solar cells based on $CuInSe_2$ and the related materials heretofore have been studied only for the aims of creating efficiencies. Complex physical and technological studies of the thin film solar cells on the basis chalcogenide chalcopyrite materials have made it possible to create devices with high radiation hardness and efficiencies as high as 18%.
At the same time, basic studies aimed to speed up film deposition were conducted from the aspect of material and substrate technologies for further cost reductions.
For CIS solar cells research and development efforts continue to establish both element technologies necessary for the improvement in product quality and efficiency and large-area film fabrication technologies as essential part of the solar cell production process.

KEYWORDS

Environmental economics, Solar energy, Thin film solar cells, Triple Helix model

STUDENT PROJECTS IN NATURAL SCIENCES, ENVIRONMENTAL TRENDS THEIR SUPPORT FROM BUSINESS AND STATE GOVERNMENT

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ABSTRACT

Russia has recently developed and improved the system of competitions for high school students in natural science and engineering fields. This is the basis of scientific and technical creativity of students.
Scientific and technical creativity - one of the most important areas of work with children in the field of education, which can more fully implement a comprehensive solution to the problems of training, education and personal development.
Science and technology policy is implemented mainly through the organization of competitions for school children. These competitions involve participation of students with their work and the results of scientific research. These competitions are funded by the government or private companies, or in co-operation between of them.
In St. Petersburg, became widely celebrated contest of scientific and engineering creativity high school students funded by the government of the city. Of the projects that won this year include the following titles " The problem of utilization of energy saving lamps ," " The ability to use solar panels as a source of electricity in the summer for vacation homes in Russia ," " Ways to reduce the toxic effect of heavy metals on plants oats and barley "" The study of the impact of detergents , as the Component wastewater to water bodies , "" Rubbish chance "," Qualitative detection of the major impurities in the water samples from the river Neva , Fontanka and Murinsky creek ".
The report will be given information about the work of some of the most famous in Russia competitions for schoolchildren. All-Russian "Baltic Science and Engineering Fair" of school children held this year for the tenth time. International scientific conference schoolchildren "Elevator to the future ".

KEYWORDS

Science and technology policy, Triple Helix, Scientific and engineering creativity, Project management

IMPROVEMENT THE SAFETY OF NUCLEAR POWER PLANT OPERATION

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ABSTRACT

The accident at a nuclear power plant (NPP) may result in an environmental disaster for elimination of which need huge amounts of money (for example, more than 100 billion dollars to eliminate the consequences of the accident at the NPP "Fukushima-1" in 2011). Due to destruction of protective barriers during the accident with steam and water flows from the reactors may be released into the external environment radioactive elements (radionuclides of iodine, strontium, cesium and other). They contaminate the area around the nuclear power plant and propagate through the air and subterranean waters. In strong winds and heavy rainfall, it is very hard to localize the contamination. This leads to impossibility of life in the vast area, growth in the number of oncological diseases and other long-term problems. Therefore, one of the most important aspect of the safe operation of nuclear power plants is the sustainability of the structural elements of reactors to different kinds of impacts (primarily thermal) in emergency situations. That is why the main parts of nuclear reactors are made of alloys of several metals to give them increased strength.
To improve the efficiency and safety of nuclear power is needed to improve the functional properties of these materials, so now there is an active investigation of zirconium and alloys of it. Creation of new alloys is costly, that is why much of the work currently underway in the direction of improving the existing alloys. Mathematical modeling of physical processes occurring in the accident at the plant show that in the case of exposure to heat, like on the NPP "Fukushima-1" protective structure on the basis of improved alloys would allow to win time to take defensive measures and reduce the scale of the tragedy. The obtained results are very important for the design of protective structures, because to conduct a full experiment that shows reality impossible.

KEYWORDS

Nuclear power plant, Zirconium, Ecological safety, Mathematical modelling.

SPECIFIC FEATURES OF METHODS FOR EXPRESS CONTROL OF LIQUID AND VISCOUS MEDIA IN ENVIRONMENTAL MONITORING

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ABSTRACT

Technological advances lead to emergence of factors and enhancement of factors that have a negative impact on the environment. Solid media are more stable and therefore air and aquatic environments experience the strongest influence.
In this situation the role of express control of liquid and viscous media becomes extremely important. Devices for analysis of such media (spectrometers etc.) are expensive and require laboratory conditions. So it is more reasonable to analyze liquid and viscous media in which a deviation from the normal condition has been revealed.
The requirements to the express control methods are reliability and accessibility; they must not affect the condition of the medium tested. At present three methods are used:

1. Chemical, i.e., indicator testers. The drawback of this method is that each tester is used to control one-two impact factors.
2. Optical, i.e., exposure of a medium to UV, visible, and IR radiation. The medium must be relatively transparent. The drawback is a limited number of media that can be tested by this method.
3. The method based on the nuclear magnetic resonance (NMR). By measuring relaxation constants T_1 and T_2 of a liquid or viscous medium, it is possible to find very quickly the deviation of its aggregate state from the “normal” one. The only condition for application of the NMR method is the presence of protons or nuclei having magnetic moments in the medium (fluorine, lithium, and sodium). The NMR method is almost universal because more than 90 % of liquid and viscous media contain protons. The disadvantage is a large weight and a high cost of the magnetic system for detection of NMR signals.

At present a considerable research effort is directed towards modification of the devices for the optical and NMR methods. The authors have developed a small-size NMR spectrometer for express control of liquid and viscous media that can be connected to a laptop to process results of measurements. Our studies have shown a high efficiency of the NMR method for express control of liquid and viscous media as compared with the chemical and optical methods. A further modification of small-size NMR spectrometers can reduce their cost and make the method marketable.

KEYWORDS

Environmental monitoring, Express control, Liquid/viscous media, NMR

ASSESSMENT OF BIOLOGICAL ACTIVITY OF FINE FRACTION FROM HÖGBYTORP LANDFILL BY OXYGEN UPTAKE MEASUREMENTS

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ABSTRACT

Enormous amount of waste in landfills can be regarded as a potential source for energy and raw materials and for that reason there is a growing interest in utilization of deposited materials, usually referred to landfill mining. Beside of valuable raw material, landfills contain huge amounts of fine soil-like fraction, which, depending on the landfill, may account to more than 50 % of total mass of the excavated material. Fine fraction has been recommended as potential substrate for landfill cover and biocover or it may be classified as waste that must be backfilled, creating extra costs.
The comprehensive characterization of fine fraction is decisive for its beneficial usage. In addition to physico-chemical characterization, the determination of biological activity is crucial indicating biodegradability and stability of this fraction.
The objective of this study was to estimate the biological activity of fine fraction excavated from Ragn-Sells AB landfill site at Högbytorp (60°32'N, 17°37''E, situated 40 km north-west of Stockholm). For this purpose 7-day cumulative oxygen uptake (respiration) of the fine fraction was measured with Oxitop® system (WTW, Germany). The Högbytorp landfill was sampled from 4 test-holes, each from 4 different depths. Altogether 16 samples were gathered, screened (<10 mm) and analysed in the laboratory.
The variability of oxygen uptake between fine fraction samples from the same landfill is discussed. The results are compared with the recommended value for material suitable for biocover construction.

KEYWORDS

Landfill mining, Fine fraction, Biological activity, Oxygen uptake

STUDYING OF WATER SALINITY REDUCTION USING PHYTOREMEDIATION METHOD BY THREE PLANT SPECIES AND ANALYZING THEIR BEHAVIOR

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ABSTRACT

Treatment and reuse of water in wetlands are considered as an alternative, cost-effective, economical and environment-friendly method. In most cases, salinity degree of purified water is increased especially in arid and semiarid regions. Using phytoremediation method can help to solve the said problem to a great extent In this study, tests with different salinity densities were conducted on three species of saline plants *Frankenia Thymifolia, Atriplex CinereaCinerea, Festuca Ovina* within 60 days in order to assess ability of reducing water salinity. Then, trend of electrical conductivity reduction, percentage of salinity removal and behavior of plants in different salinity levels were analyzed statistically. The trend of electrical conductivity reduction was reduced in each three species of plant with the increased salinity level, so that maximum rate of salt intake for *Frankenia Thymifolia* in electrical conductivity stood at 4500 Micro-Siemens/centimeter (approx. 20%), for *Festuca Ovina* in electrical conductivity at 2600 micro-Siemens/centimeter (approx. 17 percent) and for *Atriplex CinereaCinerea* plant in electrical conductivity at 5,000 micro-Siemens/centimeter (approx. 14 percent).
Of course, reducing ability of salt absorption in each species of the plant had its own specific reason. For example, *Atriplex Cinerea* plant faced fadedness and reduced performance due to the less compatibility with the water-logging environment. *Festuca Ovina* plant faced paleness and reduced performance due to the outbreak of salinity stress. In addition, *Frankenia Thymifolia* plant faced paleness and reduced performance due to the completion of capacity of salt accumulation in its tissues. Accordingly, *Atriplex Cinerea* plant showed maximum rate of reduced salinity than the other two species of the plants in interval of increased salinity. In the same direction, *Frankeni Thymifolia* plant showed maximum rate of reduced salinity in efficiency of reduced salinity after stoppage of increased load of salinity due to more durability of this plant in this efficiency period.

KEYWORDS
Frankenia Thymifolia, Festuca Ovina, Atriplex Cinerea, Electrical Conductivity, Statistical Analysis

STUDY ZnO NANO PARTICLES AND ACTIVATED CARBON PRODUCED FROM AGRICULTURAL WASTE EFFICIENCY ON REMOVING DIRECT BLUE 71 DYE

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ABSTRACT

The Azo group has been one of the chemical structures in classifying dyes which is important due to its cancer causing and negative effects on the environment and interference with the ecology of the water bodies. In this study photo catalytic process was used due to its unique features in decomposition of pollutants to mineral compounds and also the physical process of agricultural waste adsorption to remove DB71 in 3 ways of adsorption / photo catalytic, photo catalytic/adsorption, and simultaneously adsorption and photo catalytic. The results have shown that in all 3 systems in pH=9 with initial dye concentration of 50 mg/L, 100 percent removal efficiency were achieved with optimal ratio of AC/ZnO in the presence of two adsorbent of walnut and almond shells of 0.75/0.096 and 1/0.096 (in adsorption/photo catalytic), 0.024/0.75 and 0.024/1 (in photo catalytic/adsorption) and 0.75/0.288 and 0.75/0.288 (in simultaneous adsorption-photo catalytic), respectively. In the optimum conditions in all the three systems, COD removal was obtained 47.22, 49.6, 42.21, 39.18, 62.23 and 63.15 percent respectively after 30 hours.

KEYWORDS

pH, Dye removal, COD, Consolidated, DB71, Slurry.