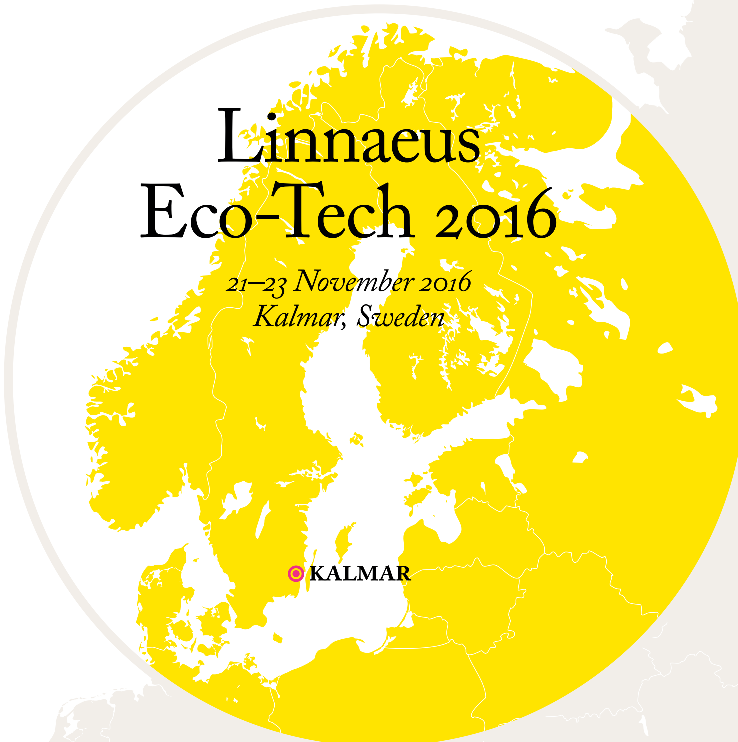
Linnaeus Eco-Tech 2016

21–23 November 2016
Kalmar, Sweden



Book of Abstracts

The 10th International Conference on
Establishment of Cooperation
between Companies and Institutions
in the Nordic Countries,
the Baltic Sea Region and the World.

20 YEAR ANNIVERSARY

EDITED BY:
STINA ALRIKSSON, JELENA LUNDSTRÖM,
WILLIAM HOGLAND

Linnæus University

Linnaeus ECO-TECH 2016
Kalmar, Sweden, November 21-23, 2016

PROCEEDINGS

LINNAEUS ECO-TECH 2016

INTERNATIONAL CONFERENCE
ON
NATURAL SCIENCES AND TECHNOLOGIES
FOR

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

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

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PREFACE

The Baltic Sea catchement area is approximately 1.8 million km^2 and contains fourteen countries, nine of which at the shores of the Baltic Sea. In the end of the 1990's, big gaps existed in terms of economic development among the countries in this region. Nevertheless, a strong feeling of historical connection established itself during hundreds of years demanding action to reduce this gap. During the last twenty years, these differences have been reduced and the distances have been shortened mainly thanks to the development of new means of communication. In 1997, the City of Kalmar celebrated its 600^{th} anniversary of the union between the Nordic countries and the first Kalmar ECO-TECH Conference was organized. A majort goal of the University of Kalmar in Sweden (HiK) was to promote research and education cooperation among the countries around the Baltic Sea to obtain an improved sustainability. The strategy established by HiK to reach this goal was to closely cooperate with the local actors in trade and industry, Kalmar ECO-TECH embracing both this goal and the strategy. Thereafter, Kalmar ECO-TECH, later named Linnaeus ECO-TECH, has been held every second year, except for 2010 when Kalmar University and Växjö University were merged together to form the Linnaeus University. Twenty years has passed since the start and we might have the feeling that we have not done enough for the environment and perhapws have not met the goal for a sufficient sustainability. Can we ensure that the pollution of the air, soil and water is decreasing? If not, what can we improve in the future? How can we develop our message to the new generation and recruit youngsters to become environmental engineers and environmental scientists that will perform better in the future?

During all its years, the main objective of Kalmar ECO-TECH has been to promote cooperation between the academia, trade and industry in the Baltic region and expand ths usage of a cleaner technology by engaging companies, industries, city-engineers and administrators. The overruling goal has been to solve the existing environmental problems through technological solutions but also to point at new ways of thinking, producing, consuming and recycling and/or reuse. More and more obvious the environmental issues have risen from being just local and regional to a global concern. Pollution has an ever more transboundary nature and affects everyone. Consequently, the Kalmar ECO-TECH themes have changed over the years (**Figure 1**). In particular, since 2005, the conference has opened up not only to the Baltic region but to the whole world. During the last decades, 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. The ECO-TECH' 07 session paied special attention to gaseous emissions related to climate changes and renewable energy from waste. **Table 1** shows some events connected to Kalmar ECO-TECH when the Linnaeus University, formerly University of Kalmar, participated. One activity worth to highlight is the Youth Environmental Conference ECOBALTICA that has been held in Saint Petersburg every second year since 1996 in cooperation with the Assembly of Young Scientists of St. Petersburg, the State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, and St. Petersburg State Technical University in Russia and this year in Moscow at the Federal Agency for Scientific Organizations (FASO). Constantly, this international conference has been devoted to youngsters by open up the possibilities for undergraduate and graduate students from the countries in the Baltic Region to present their theses and other academic projects, to meet senior researchers and representatives from the trade and industry sectors and develop their business and academic skills.

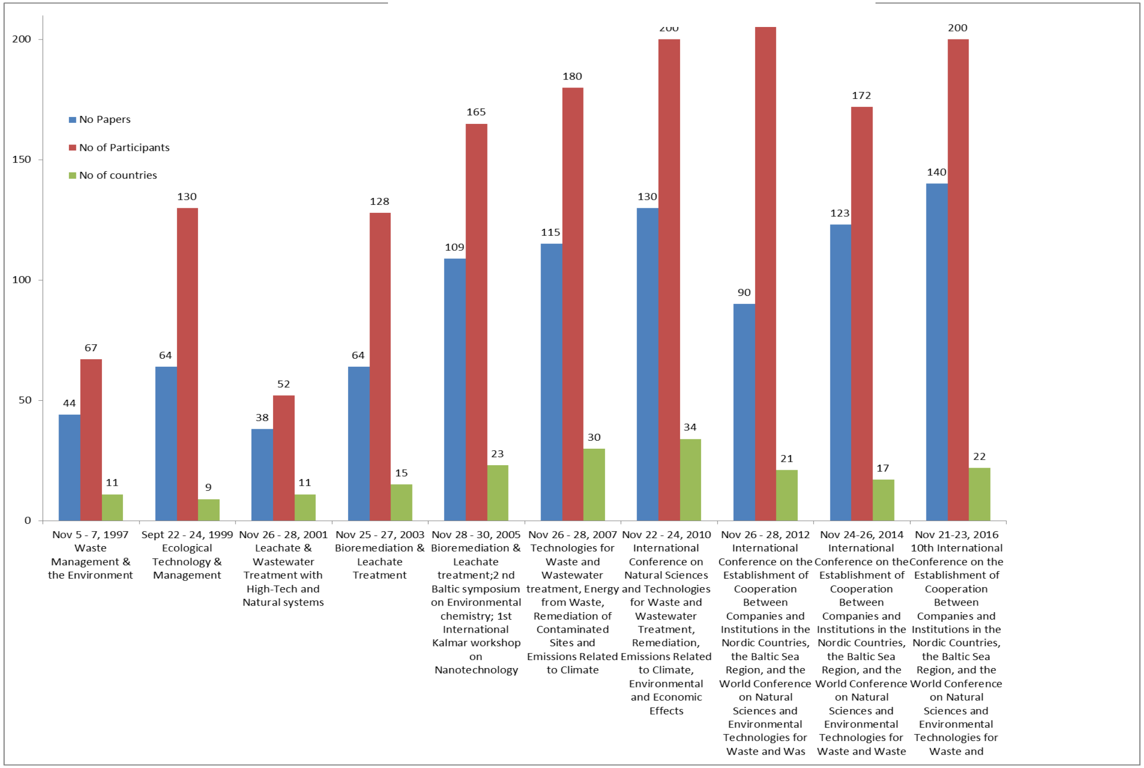

Figure 1. Kalmar ECO-TECH’ 1997, 1999, 2001, 2003, 2005, 2007, 2010, 2012, 2014, 2016. The themes are highlighted and the number of different papers, participants and countries are given.

Table 1. Events organized during 1996-2016 related to the sustainable development in the Baltic Sea Region, mostly in cooperation with Kalmar or Linnaeus University.

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 and his Team at the University of Kalmar
2-5 Dec, 1999	The 6th Danish-Polish Workshop on “Biomass for Energy”, Starbienino, Poland	Technical University of Gdansk, Poland, Roskilde University Centre, Denmark, Free University of Berlin, Germany, Poitr Kowalic, William Hogland
14-15 Dec, 1999	Seminar on “New Environmental Technology for Processing Landfill Leachate”, Siauliai, Lithuania	Dr Lennart Mårtensson, University of Kristianstad, Sweden
25-29 Jun, 2000	The 1st International Workshop of the Baltic Test Team: Global International Waters Assessment-GIWA UNEP/GEF	GIWA UNEP/GEF, University of Kalmar, Marcia Marques and William Hogland
26-30 Jun, 2000	The Youth Environmental Conference ECOBALTICA´00, St. Petersburg, Russia	Vaslii Rud, International Director and co-organizer William Hogland; State Committee on Higher Education of the Russian Federation, the City Administration of St. Petersburg, St. Petersburg State Technical University, St. Petersburg, Russia
12-16 Aug, 2000	The 2nd International Workshop of the Baltic Test Team: International Global International Waters Assessment-GIWA UNEP/GEF	GIWA UNEP/GEF, University of Kalmar, Marcia Marques and William Hogland
7-10 Dec, 2000	the 7th Danish-Polish Workshop on “Biomass for Energy, Starbienino, Poland	Technical University of Gdansk, Poland, Roskilde University Centre, Denmark and Free University of Berlin, Germany, Piotr Kowalic, William Hogland
18-20 Dec 2000	The 3rd International Workshop of the Baltic Test Team: Global International Waters Assessment-GIWA UNEP/GEF	GIWA UNEP/GEF together with Professor William Hogland and Marcia Marques
17-18 Sep, 2001	The First International Symposium: Environmental Problems in the Baltic Region States, Environmental Friendly Treatment Technology for Waste Water in the Baltic Sea Region, Šiauliai, Lithuania	Dr Lennart Mårtensson University of Kristianstad, Sweden
26-29 Sep, 2001	The First Baltic Symposium on Environmental Chemistry	Professor Toomas Tenno, University of Tartu, Estonia
26-28 Nov. 2001	Kalmar Eco-tech´01 Leachate and Wastewater Treatment with High-tech and Natural Systems	Professor William Hogland and his Team at University of Kalmar

21-25 Oct, 2002	The Youth Environmental Conference ECOBALTICA 02, St. Petersburg, 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
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, Kalmar University 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	Professor 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 Eco-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 – “Plattform 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 Landfill Mining project Vika Landfill seminar, Katrineholm (2013-04-25)	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 the Federal Agency for Scientific Organizations (FASO) Organizing: „Waste Management Association of Latvia" (LASA) in cooperation with Environment Protection Department, the Ministry of Regional Development and Tekniska Verken, Linnaeus University, RGS 90, LundaHydro AB Tekniska Verken, Linnaeus University, RGS 90, LundaHydro AB
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 Seminar on Landfill mining, Sätra Gård, Sweden 23 april 2014 International PhD course in Landfill mining I (21-25/4) – II (24 July) , Sätra gård, Sweden, 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 University and Lappeenranta University of Technology Ragnsells and Linnaeus University Ragnsells, Linnaues University and Estonian University of Life Sciences
2015	The Elsevier Atlas Award was delivered 28 of May 2015 in the Netherlands International Summer School on Waste Management and Circular Economy, 9 June to 12 June 2015, Lappeenranta FINLAND Mining in Sludge Landfill: characterization of sludge from drinking water treatment, and metal extraction (PhD Course). SWEDEN, June 12–18, 2015. Landfill Mining and waste characterisation. ESTONIA (PhD course), June 18-22, 2015.	The Elsevier Atlas Award for "Research for a better world" article "Solid waste management challenges for cities in developing countries" by Lilliana Abarca Guerreroa, Eindhoven University of Technology and Costa Rica Institute of Technology, Ger Maasa, Eindhoven University of Technology, and William Hogland, Linnaeus University, (doi:10.1016/j.wasman.2012.09.008). Organised by: Mika Horttanainen LUT Environmental Technology, Finland; William Hogland, Linnaeus University, Sweden; Mait Kriipsalu, Estonian University of Life Science, Estonia Organised by: William Hogland, Linnaeus Universtiy and Kenneth. M. Persson, Lund University, Sweden and Sydvatten; Mait Kriipsalu, Estonian University of Life Sciences (EMU); Estonia Organised by: Kaunas University of Technlogy; William Hogland, Linnaeus University; Mait Kriipsalu, Estonian University of Life Sciences

2016	BOVA Intensive Master Course Waste to Resource in Baltic States in 2020 24th-29th April 2016, Estonia	Organised by ASU (Kaunas), LLU (Jelgava), EMU (Tartu) and Linnaeus University Sweden
	International Scientific-Practical Conference Modern Engagering Technologies and Environmental Protection 19-20 May, 2016, Kutaisi, Georgia	Akaki Tsreteli State University, Kutaisi, Georgia
	International Science Environmental Conference Eco-Baltica, Moscow, Russia, 21 October, 2016	Organised by Alexey Glynushkin, William Hogland, Vasiliy Rud at the Federal Agency for Scientific Organizations (FASO)

In the Linnaeus ECO-TECH 2014 Conference, 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, which still are available in different sinks such as landfills, sediments of rivers, ocean, etcetera. 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 handled in an environmental friendly way. The long-term goal is to apply such an innovative approach in an environmentally and economically efficient way, making use of the accumulated knowledge, including reused and/or recycled materials being bound in urban and rural structures. This year, we are grateful 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 Ann-Christin Bayard from Sustainable Sweden South East all of shich made it possible to organise the Swedish workshop: "Remediation of Oskarshamn harbor – new knowledge and new possibilities.

The Kalmar ECO-TECH sessions involved many influential persons who contributed to make the conference possible. Particularly I would like to mention Prof. Vasiliy Rud, St. Petersburg State Polytechnical University that has cooperated in organizing both the Kalmar ECO-TECH in Kalmar and the ECOBALTICA conferences in St Petersburg. The idea behind the Kalmar ECO-TECH was originally formulated together with Åke Erlandsson, Environmental Manager at AB Gustaf Kähr in Nybro. Note that the first Conference in 1997 was made 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. Other important contributors have been Hans Dahl, Kalmar Vatten och Renhållning and Lars Kylefors, Vatten och Samhällsteknik as well as Ragn-Sells plus the Swedish Association for Waste Management actively have supported the Conference. Bernth Norén at the XL-laboratory, University of Kalmar has been a big help providing many good ideas to improve the contents of the program.

The Linnaeus ECO-TECH has been possible to carry out thanks to the financial support of the following institutions: AB Gustaf Kähr, Brofästet Hotel & Conference, E.ON, Flexus Balasystem, IVA – The Royal Swedish Academy of Engineering Sciences, Kalmar Energi, Knowledge Foundation, KSRR, Linnaeus University, Länsstyrelsen Kalmar län, 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.
The memorable 10-year celebration in 2007 of what now is the Linnaeus ECO-TECH, was held the same year as the University of Kalmar celebrated its 30th year Anniversary. Kalmar ECO-TECH' 07 was our humble tribute to this event. Similarly, the Linnaeus Eco-tech 10 on 22-24 November 2010 was our tribute to the establishment of the Linnaeus University on the 1st January 2010 as a fusion between the University of Kalmar and Växjö University. The Linnaeus ECO-TECH 2012 meant an opportunity to strengthen the Linnaeus University by moving towards the established goals of internationalization of the Småland Region. In this conference, the Triple Helix concept was highlighted as well as urban mining, landfill mining, glassmining and harbour 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 were given to Joacim Rosenlund, the administrative secretary of the conference, the colleagues from LNU Malin Bolander and Anna Gustavsson, and the Environmental Science and Engineering Research Group involving: Marcia Marques, Fabio Kaczala, Amit Bhatnagar, Eva Kumar, Henric Hansson, Henrik Svensson, Sawanya Laohaprapanon and Muhammad Assim, and in particular 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.
The Linnaeus ECO-TECH 2014 featured the Triple Helix concept and the concept "Beyond the Zero Waste" was introduced which encourages recovery of all materials lost during the entire life cycles of different products manufacture and still available in different sinks such as landfills, sediments of rivers, and ocean, etcetera. All the waste, materials and chemical compounds lost such as sludge, slag, harbour sediments and other residuals can, in principle, be returned to the anthropogenic loops and the toxic substances could be removed from the circuits and handled environmental friendly. The long-term goal is to apply such innovative approach in an environmentally and economically efficient way, making use of the accumulated knowledge, including the reuse and/or recycling of materials bound in the urban and rural structures. On this occasion, the administrative secretary Jelena Lundström, the staff of the Environmnetal Science and Engineering Research Group (ESEG): Fabio Kaczala, Joacim Rosenlund, Yahya Jani, Parisa Hassanzadeh and Ann-Christin Bayard from Sustainable Sweden South East made it possible to organise the workshop in Swedish: "Remediation of Oskarshamn harbour – New knowledge and new possibilities".
Since the last conference in 2014, the activities of ESEG has been more and more directed towards "Beyond the zero waste" concept involving research and several, international PhD courses. During one of the PhD courses in Glass mining, segventeen nations were represented. The cooperation with Ragnsells, Glafo and Gothenburg Univeristy has increased around Glass mining. Nowadays, Ragnsells is sponsors a PhD candidate in glass mining for ESEG. The Glass mining project sponsored by the Swedish Institute Baltic Sea Unit has played an important role in this research area. Landfill mining activies have continued in Sweden and Estonia. A new profile of landfill mining was entered in cooperation with Sydvatten for test excavations of landfilled fresh water sludge. An international PhD course was held in field sampling and extraction of Al and Fe from landfill fresh water sludge. The course was carried out in cooperation with Estonian University of Life Sciences, Lund University and Linnaeus University. The project Life Sure – Sediment uptake and

remediation on ecological basis opened the area of harbor, bay and lagoon mining. The project is carried out in cooperation with Kalmar municipality and Techmarket Sweden AB (TechMarket). This has raised the question on construction of “Bank Account” landfill cells for sorting of fine material fractions as in ash, sludge, bottom sedeiments and polluted soils for later recovery when economic methods for extraction of for instant metals and nutrients will exist. Also the IWAMA project (Interreg Baltic Sea Region) lifts the municipal wastewater treatment plant sludge as a resource for recovery and energy utilisation.
The cooperation with the floor manaufacturer AB Gustaf Kähr continues. Very soon a demo-plant for the treatment of industrial process water and upgrading of stormwater for industrial use will be implemented in industry. A phytroremediation project in cooperation with the local waste management company KSRR is also running and will result in a doctoral thesis in the beginning of 2017. Another doctoral degree thesis on the Triple concept will be presented in februay 2017.
During 2016, Jelena Lundström continues to head the administrative work as the project assistant for the conference. The staff of the Environmental Science and Engineering Research Group consisting of: Fabio Kaczala, Joacim Rosenlund, Yahya Jani, Richard Mutafela, Juris Burlakovs, Charltotte Marchand, Marco Tadeu Gomes Vianna and Ann-Christin Bayard at Linnaeus Unviersity as well as Jan Stenis from LundaHydro AB have played an important role for the organisation of this 20 years Anniversary conference of Linnaeus Eco-Tech. Stina Alriksson is acknowledged for editing the book of abstracts and proceedings.

Thanks to everyone who contributed to making all the events come true!
Thank You Sponsors!

William Hogland

Chairman of Linnaeus Eco-Tech Conference since the auguration
Professor in Environmental Engineering and Recovery (PhD)
Linnaeus University

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Han	Yu	Lund University	Sweden
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Olena	Zinchuk	Union of the Baltic Cities Sustainable Cities Commission	Finland

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Christina Dahlgren	Section Manager, Communications Office, Linnaeus University	Sweden
Johan Persson	Lord Mayor of Kalmar	Sweden
Vasiliy Rud	St. Petersburg State Polytechnical University	Russia
Catherine Bakang Mbock	Former Minister of Social Affairs and Minister of Women´s Affairs	Cameroon
Ulrich Kral	Vienna University of Technology	Austria
D. Jose Antonio Valbuena	Director of Environmental Division of the Cabildo de Tenerife	Spain
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Mats Waltre	KK-stiftelsen (The Knowledge Foundation)	Sweden

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INVITED SPEAKERS AT OPENING CEREMONY

COST ACTION: MINING THE EUROPEAN ANGROPOSPHERE

U. Kral
Technische Universität Wien, Austria

Abstract

COST is the longest-running European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. The COST Action "Mining the European Anthroposhere" starts on the 4th March 2016 and runs for 4 years. The objective of the talk is to present the COST Action and to highlight the relevance for conference participants.

Description of the COST Action: Traditional mining continuously shifts raw materials from the geosphere to the anthroposphere. These materials accumulate in anthropogenic deposits (e.g. cars, buildings) and pose a resource potential that includes the secondary materials of tomorrow. To provide information on the future availability of primary materials, inventories of geogenic deposits (resources) and the economically extractable shares (reserves) have been developed. In contrast, information on the availability of secondary materials is lacking. Even though the amount of materials in the anthroposphere has risen dramatically in the last few decades, the resource potential in anthropogenic deposits has not been explored in an adequate way. This prevents, firstly, a comparison of resources/reserves between primary and secondary materials and, secondly, integrated information on the availability of materials from reaching future commodity markets. To overcome this gap, this COST Action aims to actuate the reporting of material resources/reserves in the anthroposphere. The focus is on (1) construction and demolition waste, (2) waste regained from landfills and (3) solid residues from waste incineration. Today, there are large differences concerning the recovery of secondary materials from these three types of waste across Europe due to isolated national research, waste management technologies and policy strategies. A pan-European approach is needed to establish a common knowledge base for the assessment of resource potentials on various spatial levels. By means of coordinating national research activities in European countries, this COST Action is striving for a breakthrough in the integrated assessment of primary and secondary resource potential, which is a prerequisite for effective resource management.

HOW TO DEAL WITH THE RESOURCES OF OUR PLANET – REUSE OR ABUSE? NUMEROUS GLASS WORKS ON A LOCAL SCALE

Björn Lindbom
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Abstract

Since several decades it is a well-known fact that mankind and the industrial activities of man, withdraws resources from the crust of the earth at an alarming pace. Alarming, since the reuse of withdrawn material is very limited, at least for a numerous number of industrial branches.

The question of reusing material has been brought to the attention in general in Sweden and elsewhere, but it has been specifically high-lighted in rather a small part of Sweden – the "Kingdom of Glass". In this area, within a radius of roughly 150 km, about 50 former and still existing glass works are located. Some sources indicate that there can be up to 50 more glass works in the region. The presence of the latter 50 is, however, difficult to prove since they were shut down a long time ago and the remnants from them are very limited, foundations have been covered and even built on since the glass work was shut down.

The glass works estates often consist of old and abandoned buildings, contaminated soils and glass deposits. It can easily be stated that, in general, the former glass work sites are heavily contaminated with metals and heavy metals, mainly arsenic, led and cadmium. The contaminants pose a threat to the environment and all these former glass work sites are subject to environmental investigations and, if appropriate, also remedial actions. In that context it would be beneficiary for the environment, and also suitable from an economic standpoint, to thoroughly investigate the possibility of extracting material for reuse, rather than having the waste dumped at waste treatment facilities.

This paper will in short describe a task presented by the Swedish Government to the two County Boards Kronoberg and Kalmar, both located in the "Kingdom of Glass".

THE OPEN RESEARCH PLATFORM NOVA FoU (R&D)

Marcus Laaksoharju
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Abstract

Nova Center for University Studies, Research and Development (Nova) in Oskarshamn gives university courses, conducts research and performs business development (www.novaoskarshamn.se). Nova is contributing to the long-term growth in the region by creating networks between academia, business and society.

Nova FoU (R&D) is the research platform at Nova, a collaboration between Swedish Nuclear Fuel and Waste Management Co. (SKB) and the municipality of Oskarshamn. Nova FoU facilitates external access for research and development projects outside the nuclear business to the SKB facilities, data and competences in Oskarshamn. The aim of Nova FoU is trough research create local and regional spin-off effects in favour for the society and business. Nova FoU provides access to the following SKB facilities:

- Äspö Hard Rock Laboratory (HRL)
- Bentonite Laboratory at Äspö
- Canister Laboratory in Oskarshamn
- Site Investigation Oskarshamn (Laxemar)

The Nova FoU platform also offers access to the harbor remediation project in Oskarshamn which is the largest environmental project in Sweden.

The number of research projects at Nova FoU has increased steadily during the seven years of operation. The actual situation year 2016 is:

- 34 ongoing scientific projects representing a value of 55 million SEK
- 160 researchers use Nova FoU as a research platform
- 10 domestic and international universities in addition public organizations and companies conduct research trough Nova FoU
- 46 peer review publications per year

The Nova FoU research platform is used for the following type of research:

- Geosphere projects with an environmental and fundamental natural science focus
- Geotechnology used in infrastructure projects such as underground construction of e.g. tunnels
- Geothermal research for energy production from deep (1-7 km) boreholes
- Demonstration, education and public relations that are an important part of the Nova FoU activities. The aim is to inform about the unique technology and know-how in e.g. nuclear technology and to attract new research projects to the open research platform Nova FoU.

Nova FoU can be regarded as the rehearsal for the planned National Geospehere Laboratoriy (NGL) project which will transform Äspö HRL into a national and international research infrastructure.

COLLABORATION AND INNOVATION TOWARDS A SUSTAINABLE WORLD

WHY COLLABORATION MATTERS FOR THE ENVIRONMENT: TOWARDS A MODE 3 OF KNOWLEDGE PRODUCTION IN ENVIRONMENTAL SCIENCE

Joacim Rosenlund
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Linnaeus University,
Sweden

Abstract

Contemporary knowledge production has been recognized having two trends: Increased collaboration between university and other sectors and increasing emphasis on the relevance of research. Environmental problems, due to their complexity, often require collaboration between scientists and non-academics, but the collaboration itself can become a challenge. During a four year PhD project these issues were explored, considering both the micro level of interaction and the general trend of environmental science in Sweden. Rather than a triple helix and a Mode 2 this can be described as a Mode 3 of science. In Mode 3 different ideas for knowledge production coexist and also consider the natural environment as an in important part of this. During the research process a model for collaboration was developed with the emphasis on dialogue and interaction between sectors. This model can used to be able to define common goals and can form a common meeting ground for environmental scientists and non-academic participants.

Keywords

Collaboration, Triple helix, Mode 3, Interactive research, Environmental science

20 YEARS OF CO-OPERATION BETWEEN SWEDEN AND RUSSIA: ECO-TECH AND ECOBALTICA CONFERENCES

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Abstract

Co-operation between University from Kalmar city and Saint-Petersburg State Polytechnic university and now with Federal State Budgetary Scientific Institution "All-Russian Research Institute of Phytopathology", Russia which start in 1996 help for development understanding between Sweden and Russian. This topic we show benefit of this co-operation for Baltic region.

Twenty years of cooperation between Russia and Sweden is of course not only ECO- TECH and ECOBALTICA. However, including the conferences ECO- TECH and ECOBALTICA. This cooperation was initiated and for several years was carried out without any agreements and based on human trust of key stakeholders.

Only 1999 in Kalmar was signed a Memorandum of Understanding between University of Kalmar (now - Linnaeus university) and Saint-Petersburg State Polytechnic University.

1. To initiate and develop co-operation for Cooperation ECO-TECH and ECOBALTICA conferences created a new philosophy of scientific youth conferences, which then was recommended a long time used in Russian universities, on the recommendation of the coordinating councils of Youth Affairs of Russia.

We kindly thanks to the Academician of Russian Academy of Sciences Michail Sokolov (Moscow) and also to the Academician of Russian Academy of Sciences Yuriy Vassiliev (Saint-Petersburg), professor William Hogland and professor Marcia Marques Gomes (both - Linneaus University) for support.

Keywords

Co-operation, ECO-TECH, ECOBALTICA.

APPEARANCES OF ECOSYSTEM SERVICES IN ENVIRONMENTAL IMPACT ASSESSMENT – LEARNINGS FROM TWO SWEDISH CASE STUDIES

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Jenny Edholm
Paul van den Brink
Anna Longueville
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Abstract

Ecosystem Services is an increasingly used concept to understand and describe the dependencies of socio-technical systems on the ecosystems in which they exist. We have studied to what extent ecosystem services are appearing in Environmental Impact Assessments (EIA) in two Swedish cases, the improvement of ecological status in a river used for small scale hydropower and the mining operations of the MM mine. In neither of the two cases ecosystem services have been intentionally included in the work with the EIAs. The goal of the studies has been to examine to what extent ecosystem services are appearing anyway in the EIAs, to what extent data in the EIAs are sufficient to perform more structured ecosystem service assessments, and if the use of a more structured ecosystem services review during the EIA process could have contributed positively to the EIA work.

Both EIAs in this study holds some information on impacts on ecosystem services, and more information on affected ecosystem functions that could be translated into ecosystems services and probably to full ecosystem service reviews with additional data gathering. Cases of ecosystem functions and services impacting other ecosystem functions and services, sometimes in several stages, were found, indicating that such functions or services could be of special importance to protect and / or support.

Keywords

Ecosystem services, Environmental Impact Assessment.

PLANNING TO BUILD SUSTAINABLE? -THE CASE OF STORSJÖ STRAND

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Abstract

The municipality of Östersund is presently developing a new township called Storsjö Strand close to the town centre by the lakefront of the lake Storsjön. The ambition is that the new area should be a good example of more sustainable building engineering and societal planning. Mid Sweden University was engaged to follow the process in action research setting, and to enhance the learning process. A triple helix process intending to better achieve such outcomes was presented at the Eco-tech 2014 conference. The process has now moved to a stage where the first two buildings are erected.

This paper reports on present status with a focus on how the sustainability goals have been transferred through the chain of involved organizations and individuals, developers and contractors, but also how the goals affect the production of the building, regarding materials, methods and costs, based on interviews . We have observed connections between sustainability outcomes, and the combination of quality of the goals set for the project and the types of processes for achieving them. So far, it seems like the sustainability goals partly have been transferred through the process. The process will be followed until the buildings has been in use for some time

Keywords

Sustainable buildings; Building processes; Integrated Planning.

MICROPLASTCS THROUGH THE LENSES OF ECO-INNOVATION

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Abstract

Microplastic represents one of the largest anthropogenic environmental challenges to date and in the future. Constituting a problem with many severe challenges, e.g. microplastic can accumulate across the food chain positioning all living organisms in risk of pollution. Estimations show that between 4.8 and 12.7 million tonnes of plastic entering oceans anually and between 100 and 250 million tonnes might be accumulated in oceans by 2025. Eco-innovation can be a solution to these obstacles. This paper presents how eco-innovations can impose a sustainable plastic production initiative by providing tools for rigorous environmental focus both operational and strategic.

Various approaches have been utilized within eco-innovation. We utilised the eco-compass by Fussler, which consists of a six dimensional hexagon (figure 1), surrounding business operations, constituting a holistic representation of important environmental concern. Some of the core elements the hexagon covers: Mass or material intensity, Energy intensity, Service extension, and Resource conservation – it involves concepts to stimulate the reduction, reuse and recycling of materials required on all levels of business operations.

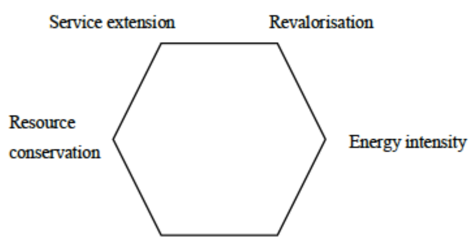

Figure 1 - elements encompassing eco-compass

Plastic is used in large selection of products. Figure 2 shows examples of plastic wrapping as a natural part of a product delivery and experience. We have shown that Eco-innovation provides the ability of a business to focus its operations within the eco-compass hexagon by:

- Attention to a future business landscape with scarcer resources
- Being solution-oriented as it enables businesses to the challenges of tomorrow
- Proactively moving towards a anchoring of eco initiatives that increases manoeuvrability

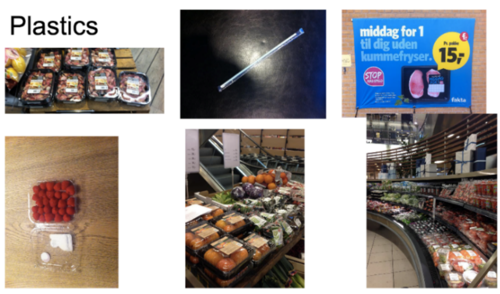

Figure 2 - selection of consumer food product w. wrapping

Innovations must have the perspective to provide smaller pressure on the environment instead of just focusing on the market.

Eco-innovation enables innovation(s) that are sustainable in a larger perspective. The eco-compass provides much needed perspective to future business practise. However, eco-innovation is challenged by prevailing business regime – short-term financial goals.

RESEARCH ON URBAN HYDROLOGY AND URBAN STORM DRAINAGE DURING THE PAST 50 YEARS – EXEMPLIFIED BY THE ACTIVITIES AT THE DEPARTMENT OF WATER RESOURCES ENGINEERING (WRE) AT THE LUND UNIVERSITY

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Abstract

The institution was inaugurated in 1966 and a couple of years later, projects started on the urban influence on the hydrological processes. One of them was a small catchment immediately west of Lund, Värpinge and the other one was the catchments that were supposed to be influenced by the building of the Malmö airport Sturup that was on its way to be built. Measurements of Precipitation, Evaporation, Groundwater levels, Soil moisture and Runoff were carried out. The Värpinge catchment was supposed to be developed by a new township – but that did not happen. The reason for not building was that the area has the most fertile farmland in the whole country. So – instead monitoring started in an already developed area in Lund, Klostergården, some few km away from Värpinge. The hypothesis was that the two areas should have been similar hydrologically before urbanisation. The results of the projects have been published by many researchers, but apart from a number of PhD-dissertations mostly in the departments own report series.

In the mid 1970-ties more detailed studies started on the urban runoff from impermeable surfaces. Totally nine small catchments all with 100 % impermeable surfaces (asphalt) were studied. The flow was measured at the point of entering the stormwater sewer. Rainfall and runoff were measured with a one minute resolution These studies were the main input for an international workshop at the Institute of hydrology in Wallingford, Uk. The outcome of the workshop was used for building the Uk simulation model for urban runoff.

Another project focusing on rainfall intensities was started at the same time. Ten rainfall gauges were installed at different locations in Lund – all measuring with a one minute resolution. The results showed that a single measuring point does not get a good average of intensities variations for an area, especially not during heavy rainstorms. Example on and consequences of these variations were shown and discussed at an engineering conference in Toronto 1980.

In the late 1970-ties a major study was undertaken on the water balance of the town Lund. Based on data and experiences from the above projects a number of new measuring stations were set up. The river Höje å runs through the outskirts of Lund and receives the water from stormwater sexers as well as the outlet from the sewage treatment plant. Practically all these outlets were monitored. Luckily there were already flows measuring stations in the river, upstream and downstream from the cities influence. Flow proportional water samples were gathered for all outlets. Most of the combined sewer overflows were recorded and also the water quality. The results have been published in many places and also as dissertations.

Now 30 years after the above projects many similar projects are running or being started. Hopefully todays researchers have the chance to read above the old project and don't have to start from scratch. Much of the problem is that the old studies are not digitalised and thus may not be found on the internet. Also the "grey" literature – conference proceedings and institutional reports may only be reached via libraries. Hopefully the new generation may be guided by earlier experiences and thus not make the same mistakes that has already been made. So – why not avoid old mistakes when there are so many to make that are new.

INNOVATION IN URBAN PLANNING FOR A CIRCULAR ECONOMY-THE ECO-CITIES

ECO-CYCLE MODELS AS SUPPORT IN URBAN PLANNING FOR A CIRCULAR ECONOMY LEADING TO ECO-CITIES

Björn Frostell
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Abstract

The rapid development of population and economic development challenges resource supply and waste management in the global economy. This has led to the increasingly popular concept of a circular economy. In a circular economy, physical resources (materials and energy) circulate to a great extent – waste materials are recycled into new products and energy is used at different levels, all in an effort to decrease the material and energy input per product and service unit delivered to society. With an increasing fraction of the world population living in cities, this concept is especially important in reshaping cities to become eco-cities. Eco-cities are here understood as cities that function in harmony with ecosystems and having a sustainable physical resource supply, a sustainable infrastructure and a sustainable waste management – all based on circularity. This challenging future requires new approaches to urban development, revised planning methods, new infrastructure solutions and new (proactive) monitoring approaches and new means of handling rest materials, waste and effluents. The session Systems Thinking for Innovation in Urban Planning for a Circular Economy – The Eco-City gathers researchers, city officials and industrial representatives interested in future urban development with an emphasis on creating ecologically sustainable urban areas. The intellectual basis for the session is to look at the city as a complex organic system, metabolizing physical resources under the influence of social forces and where the physical metabolism will have to become more efficient in the future.

PLANNING FOR PHYSICAL RESOURCE METABOLISM TOWARDS ECO-CITIES

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Abstract

Many of the present problems that we are facing arise as unanticipated side effects of our own actions. Often, the solutions implemented to solve important problems create new problems. To avoid unintended consequences, understanding complex systems are essential to devise policy instruments as well as to improve environmental management. In addition, monitoring the environmental performances of physical resource management in urban metabolism or any kind of societal development is very important to understand the development trend and identify the upcoming threats. Mainstream monitoring approach mostly covers emissions to air, water and land, i.e., the outflows from the societal metabolism. However, it is important to monitor inflows and stocks to the societal metabolism to take a proactive response and address the sustainability challenges and possibilities.

The state/impact-based monitoring approach (e.g., monitoring lake water quality) has developed during last few decades and is now deeply rooted in practice. This mainstream approach is indeed the fundamental way to manage the environmental problems. However, this approach is a reactive response, since the society takes necessary measures when the impacts are perceived. Instead of the focusing on the mainstream monitoring approach, we propose to monitor physical resource stocks and flows in terms of environmental pressure in a life cycle perspective. Thus planning for stocks and flows monitoring are essential in order to manage urban metabolism towards the Eco-City.

Based on monitoring environmental performances and to avoid unintended consequences, future city planners will have to understand the complexity of managing future stocks and flows. First, static accounting plays a key role in mapping the stocks and flows in the preliminary discussion on the understating of complex systems. Material flow analysis, LCA, Input-output analysis, computational equilibrium modeling analysis are capable to portray stocks and flows in urban metabolism as well as to introduce initial complexity and inter-connections between the systems. In addition, these static analyses are suitable for monitoring environmental performances. Furthermore, dynamic modeling approaches on top of the static modeling allow us to understand systemic complexity of the metabolism to analyze future scenarios for devising and testing policy instruments. In conclusion, urban planner should integrate future physical resource metabolism in their planning.

SUSTAINABLE GREEN CITIES SUPPORTING A SUSTAINABLE WORLD FOR ALL

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Abstract

The Sustainable Up-Cycle Project is based on a progressive co-creation between the Northern and Southern Hemispheres (Sweden & Brazil), combining both technologies and laws toward an innovative Blue Up-Cycle Bio-Economy: Zero Waste (Sweden) + Sustainable Architecture (Brazil) = Renewable Energy (Sustainable World for All). Our Project model is geo-politically applicable on both a local and global level and feasible and multipliable in our 5,572 Brazilian cities and can also be replicated throughout the world on all five continents.

Sweden is the actual green leader, recycling 99.7% of its garbage (Zero Waste), and Brazil has developed synergic and innovative green laws (federal, state, municipal), favorably supporting: – 1. Reutilization of all waste into new clean elements, which can be actualized on three levels – Sustainable Art, Architecture & Environment 2. Creating more constructive jobs for lower economic communities.

This synergic local/global Green Sustainable Project is now essential in order to contribute to the solution necessary for a balanced life in all regions of the Planet. By creating Sustainable Eco-Sanctuaries in all municipalities and rural areas we are incrementing the real possibility of achieving the principal requirements expressed in the last Paris COP21 (December 2016); protection & augmentation of forests, green areas and reduction of CO_2 emissions, lowering the heating of the world atmosphere.

1. Proposal is to establish a new World Synergy Net - Man / Biome – reuniting people and nations as a National / International Organic Sustainable Cities (NIOSC)/ UNICOS, BR.

2. Attracting as Co-Creators, all World ChangeMakers from all sectors: Scientists / Entrepreneurs / Ecologists / Artists / Educators (beginning with early childhood education), together working toward RENEWABLE SUSTAINABLE ENERGY

This local / global Sustainable Proposal is currently being analyzed by Ashoka and LEGO Foundation to be implemented in a city environment as a model of green sustainable community living.

For a Sustainable World for All!

TOWARDS A SUSTAINABLE GLOBAL PHYSICAL RESOURCE MANAGEMENT

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Abstract

Current approaches to physical resource management in systems of production and consumption and waste management face several sustainability challenges. Indeed, the current isolated approaches in different systems for waste management, waste reduction and resource management appear to be insufficient in a global sustainability perspective. Furthermore, current approaches fail to recognize issues relating to global equity and justice.

Addressing broad sustainability challenges linked to increasing inflows and outflows of physical resources is a vital challenge in today's globalized production and consumption chains with their multitude of actors and institutions. These actors and institutions have an important role in a sustainable global physical resource management system. This research explores such actors and institutions and their roles and responsibilities to foster a holistic approach to physical resource management that includes the global sustainability concerns associated with: increasing inflows of physical resources to the human activity system and increasing outflows of (waste) resources to the natural stocks assimilating these outflows.

TOWARDS A SUSTAINABLE BUSINESS MODEL INNOVATION FOR A CIRCULAR ECONOMY – THE CASE PLASTIC SHOPPING BAG COLLECTION AND RECYCLING SYSTEM IN STOCKHOLM

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Abstract

Lately, the concept of circular economy - as an economic strategy to transform the current predominantly linear system of production and consumption in to a circular one - has been popularised in both developed and developing economies. From an environmental perspective, circular economy proposes an improved environmental protection as well as economic incentives through new approaches to product and system design prolonging the products' lifetimes. Recent research on circular economy has highlighted a lack of the necessary infrastructure to support the reuse or recycling of post-consumer discards. Further, current established business models practices are also not compatible with the upcoming circular economy. In current predominantly linear production and consumption systems, various products end-up in mixed-waste streams and are often managed through incineration and/or landfilling. This considerably reduces the longevity of embedded physical resources in the products (such as energy and materials). In this study, a business model for a separate collection and recycling of plastic shopping bags in Stockholm is analysed. The study: (1) investigates the potential environmental and social benefits of, if any, the proposed separate collection and recycling system over the existing system; and (2) explores the social, legal, financial and other barriers to such a business model to aspire towards a circular economy. A preliminary investigation of the proposed business model highlights a great potential to improve the longevity of other plastic resources in society through a similar business model.

Keywords

Sustainable business; plastic packaging; Shopping bags; Circular economy; Recycling

COMPARISON OF DIFFERENT TYPES OF PHOTO VOLTAICS AT ONE SITE

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Abstract

In May 2015 A4 Campus AB made a 30 kWp solar cell installation in cooperation with Mid Sweden University at one of the university buildings in Östersund. Four different types of solar cells were being installed each type with a power of about 7 kW; two types of polycrystalline silicon panels, one monocrystalline silicon type and one thin film (CuInSe2) type. The three types of crystalline panels were equipped with individual optimizers making individual panel follow up possible. A one year evaluation shows the installed thin film panels produces more electricity (as Wh per installed W) than do any of the installed crystalline types. The efficiency of the thin film panels is relatively higher compared to the crystalline panels those days when the insolation is lower, which might indicate future climate change should be taken into consideration when choosing which type of solar cells to install (for northern Sweden more rain is being predicted). Each one of the crystalline types are installed as a matrix with 2 or 3 rows. The lowest rows of each type produces more electricity compared to the row above. This might be caused by an increased temperature of the air flow behind the panels. However, during the period November to April the production especially of the lower rows is reduced due to snow coverage. For multiple row installation this phenomenon should be taken into consideration for calculations for optimal layout (1,7-1,9% reduction per row for 3 rows).

Out from the follow-up made it can be seen that the evaluation of offers from different manufactures is rather complex and the yearly production cannot be easily calculated of from the specified efficiency. A 6% difference in power output from crystalline types can be seen at an insolation close to 1.000 W/m^2 and the difference in efficiency given in the specifications is in the range 15,2% to 15,8%.

AN ECONOMIC INSTRUMENT FOR IMPROVEMENT OF EXPLOITATION OF NATURAL RESOURCES

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ABSTRACT

A cost structure is proposed for improving the exploitation of natural resources featuring reduction at the source of the residuals from traditional mining on a national and global scale. The 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 which here are used to allocate shadow costs to residuals which gives economic incentives to reduce the wastes at the source. A case study exemplifies the practical application of the proposed theory in the Swedish context. It is concluded that the presented methodology is useful for increasing the cost-effectiveness of the traditional exploitation of natural resources. The equity of the distribution of such facilities is improved on all administrative levels. The methods are suitable information support tools for decision-making in the management of natural resources with emphasis on the economy of residuals from all the mining and excavation. The profitability, the technology used and the environmental conditions can simultaneously be improved for a certain nation as well as for the whole globe by implementation of the current findings. A single monetary key factor enables continuous reviewing, monitoring and evaluation of the mining of different natural resources.

WETLAND SYSTEMS AND PHYTOREMEDIATION

PHYTOENVITECH – CLEANING SITES BY USING PLANTS – THE TECHNOLOGY FOR TOMORROW

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Abstract

PhytoEnvitech AB is a company in the Cleantech and Greentech industry sectors, founded in 2014. PhytoEnvitech AB uses various special plants for cleaning soil and water from heavy metals and organic contaminants. This technology has been developed at Stockholm University for more than 20 years, tested both in laboratory and in field. As a fully mature technology it is now in commercial use by the company. The technology is both economically and environmentally beneficial and can remediate very large sites.

PhytoEnvitech AB technology is based on cultivation of plants that either removes, degrades or stabilize contaminants. The company handles all stages in the cleaning process; analysing the site, cultivating plants and finishing up the site. All according to a plan tailored for the specific requirements to each site.

Examples of PhytoEnvitech AB activities are: 1) cleaning soil and water from heavy metals and organic contaminants, 2) cleaning agricultural soils to reduce cadmium in food crops, 3) prevent release of metals from mine tailing into recipients and 4) prevent leakage of contaminants from deposits. During the cleaning process the site may be constructed as a park that can remain after the remediation.

LONG-TERM PERFORMANCE OF A CONSTRUCTED WETLAND SYSTEM FOR MUNICIPAL WASTEWATER TREATMENT IN UKRAINE

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Abstract

Long-term performance of a full-scale constructed wetland system receiving domestic wastewater effluent in Kharkiv region, Ukraine was evaluated. The system (capacity of 40 m^3/d) consisting of three constructed wetland units – vertical filtration, horizontal filtration, and subsurface flow – was established in 1998 as an experimental site, and from 2001 it has been operating at a full capacity. More than 360 laboratory measurements were analysed in 1998-2014 for BOD5 and COD, 350 - for suspended solids content, 230 - for ammonia nitrogen and ortophosphate contents in the wastewater at different treatment stages in full-scale constructed wetland system and different seasons. The basic Stritter-Phelps equation was applied to model decomposition of pollutants. Hydraulic residence time was calculated following the Dupuit's equation. Differences between decomposition coefficients derived at different scenarios were analysed with use of Fisher's F-criterion and Student's t-criterion. The Principal Component Analysis of decomposition coefficients carried out for series obtained at vertical, horizontal flow and free-surface systems separately have shown that more than 95% of explained variance is attributed to joint influence of season and temperature. Differences in input concentration did not significantly influence decomposition coefficients. Mean values of pollutant content at different units and the coefficients derived from both data reorganized according to the calculated hydraulic residence time (true time series), and data taken without such sorting, i.e. 'pseudo'-time series, were not significantly different (t- and F-tests). Model has been validated with the use of data on treatment performance from published sources on similarly designed constructed wetlands in temperate climates. The highest removal efficiency (80-99%) has been observed for organic matters and pathogen microorganisms in the wastewater, while nutrients were removed less effective (37-50%). The highest efficiency is achieved when vertical, horizontal flow and free-surface systems operated together. Performance efficiency of studied constructed wetland system remained quite stable over whole period of operation for 18 years.

BIOMASS FROM WETLANDS AND OTHER VALUABLE CONSERVATION AREAS AS SUBSTRATE FOR INDUSTRIAL BIOTECHNOLOGY

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Abstract

Biomass from wetlands has historically been an important resource, but today it is difficult to take advantage of this biomass, besides being used as feed on the farm. A very important goal is to find rational and economical viable way to make biogas from wetland biomass, including biomass from other conservation worthy areas of high biodiversity, such as roadsides harvested frequently. Moreover, the residues from biogas process used as bio-fertilizer to the fields, so that nitrogen and phosphorus is returned to the farm land. The biomass can be used for the production of biogas or for extracting valuable chemicals in bio refineries. These valuable chemicals may be potentially useful for making future plastic materials, i.e. bio plastics. Major focus will be on biogas technology, and above all, methods for the pretreatment of recalcitrant substrates such as biomass containing high levels of lignocelluloses, i.e., to make the material available to the biogas-producing bacteria. The work is based on an involvement of research in the areas of environmental engineering and landscape science and includes studies of biodiversity and water treatment function of the landscape. Finally, it is important to stress that mowing of wet meadows mostly will result in a better capacity of such meadows to retain nutrients from water passing through them. Wetland with wet meadows and similar vegetation types will be more efficient in cleaning water and thereby fight eutrophication in the recipient. Summing up, the main advantages using harvest hay (mowing) from wet meadows and roadside meadows as substrate for biotechnical industry are:

- Raw material for bio plastics
- Cheap and easy handled fertilizers to agriculture
- Important for biodiversity
- Better function of wetlands as nutrient traps fighting eutrophication of the sea

Keywords

Biomass, Wetlands, Roadsides, Biogas, Bioplastics, Biodiversity

THE USE OF AN INTEGRATED PLANNING GUIDE TO STEER PHYTOREMEDIATION PROJECTS TOWARDS SUSTAINABILITY USING THE EXAMPLE OF *AMARANTHUS* TO REMEDIATE TOXAPHENE POLLUTED SOILS IN CHIANDEGA, NICARAGUA

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Abstract

Soil pollution by pesticides is a serious problem, especially in developing countries where incentives are limited to remediate these soils. Toxaphene was a widely used insecticide during the 1950s – 1980s, but even after a total ban on its use in 2001 there are still many harmful consequences that can be observed. High levels of toxaphene on agriculture fields in Nicaragua continues to be a threat to local inhabitants and wildlife and to the surrounding ecosystems. Phytoremediation is one of the methods used for cleaning polluted soils. It requires growing plants in-situ and relies on their ability to absorb and accumulate or degrade toxic elements. Some advantages are environmental safety and cost-effectiveness.

Amaranthus was investigated as a primary candidate for the phytoremediation project. Beside this, some other plants, such as Cucurbita pepo, Spinacia oleracea, Medicago sativa, were reported to be able to successfully absorb common persistent organic pollutants. In addition, uptake mechanisms and patterns of distribution of toxic elements in plants were studied to determine further use of plants.

To assess the viability and sustainability potential of implementing Amaranthus for phytoremediation, an Integrated Planning Guide (IPG) was used. The IPG uses a number of principles and concepts to provide guidelines for bioremediation actions. As a result, several conclusions and suggestions were produced, the most important being: Amaranthus has a potential for toxaphene uptake and has a high yield and historical significance; locally available poultry manure can be used as a fertilizer for Amaranthus; a monoculture should be avoided while growing Amaranthus; local community is the main driver of success and beneficiary of the project. Further research should be undertaken on this matter to improve the understanding of key factors for the success of the project.

Keywords

Phytoremediation; Toxaphene; Amaranthus; Integrated Planning Guide; Developing countries;

PILOT SCALE ECOPILING OF PETROLEUM HYDROCARBONS AND TRACE ELEMENTS CONTAMINATED SOIL USING *MEDICAGO SATIVA* AND *HELIANTHUS ANNUUS*

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Abstract

Soil pollution is a major concern and many contaminated sites are tainted with a mixture of organic and inorganic contaminants. This pilot scale study evaluated the application of aided-phytoremediation as sustainable management strategy for the decontamination of petroleum hydrocarbons (PHC) and trace elements (TE) contaminated soil. The treatments were based on the use of alfalfa, (Medicago sativa), sunflower (Helianthus annuus) and organic matter (compost) in the constructed Ecopile (1.5 m^2 x 70 cm height). Total TE and PHC concentrations in soil, TE concentration in root and shoot plants were analyzed at the end of the first growth season (5 months).

The main soil contaminants were PHC (alkanes and polycyclic aromatic hydrocarbons (PAHs)), cobalt, copper, lead, mercury, zinc and barium. At the end of the 5-months experiment duration, PH C10-C40, PAH-L, PAH-M, PAH-H, Pb and Cu concentrations in Ecopile planted with M. sativa were significantly reduced as compared to the unplanted treatment. M. sativa co-planting with H. annus did not affect TE contaminant removal from soil. Moreover, M. sativa co-planting with H. annus did not affect PAH (M and H) degradation but had lower treatment performance for PH C10-C40 and PAH-L as compared to the treatment with M. sativa in monoculture. Residual risk assessment after the Ecopiling trial showed a positive effect of alfalfa and sunflower on earthworm's development. This study underlined the benefits of the Ecopiling option based on M. sativa and H. annuus cultivation for remediating PHC and TE contaminated soils.

Keywords

Aided-phytoremediation; Phytotechnologies; metals; risk assessment, Ecopile.

WATER CONSUMPTION PATTERN AND LAND AMELIORATION EFFECTS OF SELECTED SALIX PLANTS UNDER FIELD CONDITIONS

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Abstract

Short rotation willow coppice (SRWC) has being used in many countries either as a vegetation filter for wastewater treatment or as an alternative to fossil fuel. Numerous researches reported the ability of SRWC to take up pollutants such as heavy metals and excess nutrients from the soil. However, no study or field experiment has been done for growing SRWC in semi-arid areas irrigated by mineralized marginal or saline water. The purpose of the current paper is to evaluate the possibility using saline water in wasteland in semi-arid zones to grow SRWC for the purposes of both land amelioration and ecological restoration. A field experiment was undertaken to explore the new approaches of using the saline resources (saline water and saline soil) with five selected species of SRWC (3 Swedish and 2 Chinese Salix species). The contents of the project are to evaluate feasibility of cultivation of SRWC with saline water; to investigate Salix species' adaptation, drought-resistance, salt-tolerance; to determine safety standard of saline water use and water consumption of different Salix species and finally to provide feasible, scientific decision-making guidelines for saline water use and environmental restoration in arid and semi-arid areas.

SOLID WASTE MANAGEMENT

THE NEED FOR SINKS IN MODERN WASTE MANAGEMENT SYSTEMS

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Abstract
Today`s anthropogenic material turnover is huge and is expected to increase worldwide. After utilization, materials either become recycling products, or they leave the material loop as non-recyclable waste and emission flows. To accommodate these materials without jeopardizing human and environmental health, limited natural sinks like air, water and soil are available. Thus, appropriate man-made sinks (end-of-pipe technologies) have to be provided and utilized by the waste management sector, where natural sinks are missing or overloaded.

The objective of the presentation is to design a modern waste management system with respect to limited sink capacities. The waste sector in Canton Zürich (Switzerland) acts as case study, whereat the focus is on cooper (Cu), zinc (Zn) and polycyclic aromatic hydrocarbon (PAH). From a methodological point of view, substance flows into sinks are inventoried with the tool material flow analysis. Next, the substance flows are assessed, based on a distance-to-target approach, with respect to environmental and resource oriented goals. Finally, an indicator ω aggregates the assessment results and indicates whether the current waste management practice overloads available sink capacities or not. The indicator relates the actual to the critical flows into sinks. If constraints are indicated, measures are developed and evaluated to fulfill environmental and resource oriented goals.

The results show for the year 2013 that the waste sector directs 14 tons per capita (t/cap) materials into sinks (10 t solid waste/cap, 4 t off-gas/cap), which includes 6.5 kg Cu/cap, 2.8 kg Zn/cap and 0.1 kg PAK/cap. The results indicate a) that the disposal of excavated soil to gravel-pits (ω=∞) and of construction & demolition waste to landfills (ω=4) is limited, b) for Cu, that the input to agricultural soil (ω=4), the disposal of bottom-ashes to landfills (ω=2) and of scrap from incineration plants (ω=2) exceeds critical limits, and c) for PAH, that 90% of all PAH-fractions enter recycling products and landfills, which is in conflict with future quality standards. To overcome the constraints, the most effective options are to a) increase landfill capacities and to use excavated soil for landscape design, b) to recover Cu from bottom-ash and c) to transfer old asphalt to new constructed thermal treatment plants.

Concluding, the need for sinks is huge and the waste sector plays a key role for the utilization of man-made sinks and protection of natural sinks. The long-term planning of appropriate sink capacities effects the control of waste flows and the design of recycling and disposal technologies. The new indicator is a measure for the performance of waste management system with respect to limited sink capacities and supports monitoring and a reporting of in an easy manner.

Keywords
Sink, Final sink, Material flow analysis, Impact assessment

WASTE TO RESOURCES: MOVING TOWARD THE 2030 SUSTAINABLE DEVELOPMENT GOALS

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Abstract

The United Nation's Sustainable Development Goals (SDGs) set an ambitious umbrella framework for regional and national governments around the world; addressing a breadth of areas such as providing for economic growth, reducing harmful pollution, improving resource efficiency and waste management, eradicating poverty, and enabling access to necessary infrastructure, housing and services. In working toward these goals, nations need to reconcile the potential of inter-goal conflicts arising from policy and steering mechanisms that only work toward specific goals.

In reviewing the development of European waste policy, action has concentrated on achieving the broad societal goals of improving sanitation and reducing negative environmental and health consequences. Moving forward, many regions and nations have also begun to address waste considering multiple goals that strive for triple bottom line improvements via promotion of, for example, the circular economy. This raises the question, are the tools and political objects of past waste management regimes fit for the new functions and goals that are expected of future systems?

This article investigates the policies and calculative tools that are a product of historic developments and assesses whether they are still relevant in their current state in light of our collective SDGs. Waste management principles (e.g. the waste hierarchy, the proximity principle, and the polluter pays principle) are evaluated in the context of the SDGs. Similarly, key calculative tools, such as resource efficiency indicators (e.g. GDP/domestic material consumption), are evaluated in the context of the multiple SDGs. We argue that many of these principles and tools need to be reconsidered to support action toward the SDGs and to prevent inter-goal conflicts. Suggestions for adaptations of principles and tools are outlined and discussed. Such evaluation can benefit both European countries and emerging countries looking to "leapfrog" toward modern and balanced sustainable development and waste management.

Keywords

Circular Economy; Policy Principles; Resource Efficiency; Waste Hierarchy; Resource Transition

RECYCLING PROGRAM - MOTIVATOR OR BARRIER FOR RECYCLING

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Abstract

Participation of households in waste separation at source is essential for achieving high recycling rates and diversion from energy recovery and landfill. To engage inhabitants in recycling is therefore an important objective for the national as well as the local waste management. Source separation of waste, however, requires much effort from the individual.

Recycling programs should be designed so that they facilitate and motivate people to actively participate in waste separation and recycling. Perceived barriers for recycling can discourage people to participate, and it has even been reported that recycling programs function as a barrier instead as a motivator for recycling.

The aim of this study was to show the perception of the local waste management of inhabitants in Sweden and Bulgaria to reveal if the recycling programs were perceived as a barrier for recycling.

As members in the European Union, Sweden and Bulgaria have similar waste objectives and legislation but different performance in the waste sector. A questionnaire in Swedish and Bulgarian language was submitted to university students, 111 from Sweden and 112 from Bulgaria. Frequencies and the Theory of Planned Behaviour were used as evaluation tools. The results showed that dissatisfaction with waste collection services could prevent people from participation in waste separation and recycling even if these people had positive attitude to and possessed knowledge on recycling.

Keywords

Barriers for recycling, Recycling program, Recycling behavior, Waste separation, Municipal solid waste

SOLID WASTE COMPOSITION STUDIES AS A TOOL FOR PLANNING AND EVALUATION OF SOURCE SORTING SYSTEM. EXPERIENCES FROM LAST TWENTY YEARS IN SWEDEN

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Abstract

Household waste recycling programs have been introduced and different waste-sorting and collection systems have been developed in Sweden during recent decades. Evolution and comparison of the different systems was made difficult by the lack of comparable data. A number of different methods for solid waste composition studies were used in parallel for twenty years ago in Sweden. Nordtest (Nordic Innovations Centre) provides a standard method for sampling and characterization of municipal solid waste (Nordtest, 1995). Based on the Nordtest standard, a waste management company in Sweden (NSR AB) has implemented a procedure for characterization of solid waste, regularly used in their waste treatment lines since 1997. The NSR-method has been developed with regard to practical experiences. Loads of ordinary waste transport vehicles are used for sampling, and sorting is done manually into 20 components. In a joint project between Luleå University of Technology, NSR AB, The Swedish Sustainability Foundation and RVF, a manual for household waste composition analysis was suggested, designed for Swedish conditions in 2005.

This manual has been revised in 2013 and is now used by Envir AB as a standard method that enables evaluation of different collection systems by determining error ratio in source sorted fractions. A step-by-step manual goes through the procedure: 1; preinvestigation and analysis design. 2; Collection of samples using ordinary collection vehicles. 3; Sample splitting. 4; Sorting and classification into 9 primary and 22 secondary categories. 5; Evaluation of data and presentation of results. The method has been developed over the last 10 years and are used more and more to evaluate a collection system or to compare different collection systems such as curbside collection or drop-off systems in different municipalities in Sweden.

Keywords

Waste composition studies, Household waste, Curbside collection, Drop-off, Error ratio, Recycling, Source separation, Waste management

FORECASTING DAYLIGHT LAMPS WASTE AND WASTE THAT HAS MERCURY IN ITS COMPOSITION GENERATION USING SHORT AND EXTRA SHORT DATA SETS: CASE STUDY OF LITHUANIA

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Abstract

Considering Lithuania's situation on daylight lamps waste and waste that has mercury in its composition generation data it is clear that amounts of these waste declared by Environmental protection agency mainly comes from industry, business and service sectors. Lamp waste that is generated by households often ends up in municipal solid waste flow if not being separated in larger quantities in special collection sites. Since mechanical biological treatment facilities are only beginning to be established in Lithuania it is hard to say what the real amount of daylight lamps waste could be.

The goal of this research is to explore how mathematical modelling methods that were previously used by authors on Lithuania's medical waste generation data will work whilst processing and forecasting daylight lamps waste and waste that has mercury in its composition generation data.

Two developed data sets consist of 10 observations that differs only in the number of independent variables: one includes variables considering household consumption (total 7 independent variables) and other – not (total 4 independent variables). Tests on the performance of artificial neural networks (ANN), multiple linear regression (MLR), partial least squares (PLS), support vector machines (SVM) and four nonparametric regression methods were conducted on the collected data sets.

The best and most promising results were demonstrated by generalized additive (respectively R^2 = 0,97368 and R^2 =0.99938) in both cases. There was also more model that performed with higher than 0,9 coefficient of determination, but other statistical indices weren't as good as previously mentioned methods.

Keywords

Forecasting, daylight lamps, mercury, waste generation, mathematical modelling, generalized additives.

ADVANCED ECOTECHNOLOGY IN AGRIBUSINESS: HOW TO RAISE SALES IN RUSSIA

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Abstract

The development of agriculture in Russia is the task of the national level. Agricultural business 2020 to fully provide internal market with domestic products. And to feed not only themselves, but also become the world's largest supplier of environmentally friendly and quality food. Waste – the remnants of raw materials, prefabricated steel the cuts and other products formed during or at the completion of the production process, not used in direct connection with this activity and have lost their consumer properties.

Trade eco equipment for processing of waste of agricultural production and farming activities can be considered as new business.

In order to understand why this business can be promising in Russia analyze the situation and lay out all for small businesses and aspiring entrepreneurs on the shelves. The definition of eco goods we often understand foods, household chemicals and all, the list of environmentally friendly products does not end there because there are plenty of other groups of goods which can be environmentally friendly. There is the problem of promoting growth in the use of mechanisms and technologies for waste processing in agriculture. However, this approach will require serious educational projects and the creation of showrooms and trade missions operate directly in the centres of concentration of agribusiness.

However, the ecological business is not only a waste, and the creation eco net production and suppression of various pathologies plants. This business can be very popular. This business can develop small businesses in rural areas. This business meet to attract young people . This business can bring in new fresh information technology thanks to the arrival of young people. Russia is also very important to attract to the small agribusiness educational courses for managers. This will show the importance of environmental issues in the agricultural business, choose technologies and equipment for solving such problems. It is an environment that will help to create absolutely new to the Russian marketplace with the participation of young scientists, students and teachers in Alliance with the real business.

We want to express our gratitude to the teacher of chemistry Marina Alexandrovna Smirnova (middle school № 71, Saint-Petersburg) for the formation of interest in research and environmental safety.

Keywords
Ecology, Advanced technology, Plant.

WASTE-TO-ENERGY

ORGANIZATION OF INDUSTRIAL STORAGES IN VIEW OF RISK OF FIRE ACCIDENTS

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Abstract

Highly diverse strategies are employed in the organization of commercial/industrial storages around the globe and dependence of key storage parameters on severity of fire accident is not well established. This experimental study is aimed to perform scale down fire experiments to see the effect of key storage parameters such as; dimensionless building ventilation level (GF), dimensionless distance between storage units (D*) and number of storage units (N) on fire performance. These parameters were varied using central-composite-orthogonal test plan of 15 experiments in which each parameter was varied at three levels. GF is defined as the ratio of width of opening between two adjacent walls to the gap between two opposing face walls and varies as 0.25, 0.5 and 0.75, respectively. D* is defined as ratio of center to center distance between two adjacent fuel pans "D" to the diameter of fuel pan "d" and varies as 2, 3 and 4, respectively. Similarly, N was varied as an array of 2x2, 3x3 and 4x4, storage units. In each experiment, 20 ml of Kerosene oil was taken in glass crucibles (diameter = 5 cm) and ignited with a specially designed igniter to limit the ignition delay time below 10 sec. All the experiments were video tapped. The value of maximum flame height (H) was measured using IMAGEJ 1.49v and burn out time (BOT) was estimated from the video films. The parameter GF found to have strongest effect on BOT and H. Changing the value of GF from lower level setting (0.25) to higher level setting (0.75) caused an increase in the value of BOT by 158 sec and decreased the flame height by 27 cm. Furthermore, data suggests that D* contributes in increasing the margin of fire safety by increasing BOT but does not contribute significantly in limiting the flame height. On the other hand, BOT found to be indifferent with respect to the settings of "N" but flame height found to strongly depend on the settings of "N". The importance of two-way interactions of studied parameters on BOT and H is also discussed in the article.

Keywords

Fire Whirls, Multiple fire points, Fire interaction, Storage structures, Fire safety, Flame height, Burn out time, Interactive burning, Fire whirl, Industrial storage

TREATMENT AND UTILIZATION OF WASTE INCINERATION BOTTOM ASH – FINNISH EXPERIENCES

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Abstract

In order to decrease landfilling of municipal solid waste (MSW), number of waste incineration plants have been constructed in Finland for the past decade. The total amount of MSW has decreased but different technical, environmental and legislative issues related to the treatment and utilization of municipal solid waste incineration (MSWI) bottom ash (BA) have raised concern within the waste sector and the policy makers in the country. In this paper, the results of a three year research project are shortly summarized, in which the recovery and utilization of MSWI BA has been comprehensively studied in the country. During the project, a modern Dutch dry treatment technology called ADR (Advanced Dry Recovery) was used. The process separates efficiently non-ferrous and ferrous metals from the BA and generates mineral fractions of different grain sizes. At the moment, these mineral fractions are of no value and they mainly end up in landfill sites where high amounts of taxes need to be paid (70€/t in the year 2016 in Finland). The presented research project took the first steps in order to create actual products from this waste derived material in different applications such as road construction and concrete industry in Finland. It is certain that the work on this matter has only started but the results presented in this paper are promising and offer interesting point of views for the other countries struggling with the same issues.

Keywords

Municipal solid waste incineration bottom ash; Treatment; Utilization; Finnish practical experiences;

THE DISCOVERY OF SEMICONDUCTOR PROPERTIES OF PLANT AND HUMAN SKIN: THE ABILITY TO REDUCE THE ENVIRONMENTAL RISK FROM SEMICONDUCTORS INDUSTRY

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Abstract

Since the advent of the electronics industry, the harm to her environment is constantly increasing because there and receiving components, and processes to produce semiconductor structures, and the If only to list what components of our environment are suffering, it is evident that:

1. Interregional pollution (water and air) ;

2. Direct withdrawal of land areas, often considerable, disruption and even destruction of natural landscapes, change patterns, growth stresses in the rock masses, the violation of the regime of surface and groundwater, distortion gravity, geophysical fields, creating geochemical anomalies.

3. Thermal power plants, which : - pollute the atmospheric air by oxides of carbon, nitrogen, sulfur, accumulate a considerable mass of solid waste slag;

Hydroelectric significant changes, however, if you create a large reservoir, which leads to the flooding of arable lands, settlements, changes in groundwater, sinking, swamping, salinization and sometimes a change in the composition of aquatic flora and fauna.

4. The forest area drastically reduced under the blows of the growing needs of wood and arable areas.

5. PR and production of minerals formed large career, up to several hundred kilometres. After this the required reclamation.

Keywords

Heterophotoelements, Thin film, Photopleochroism, CIGS, Solar radiation, Luminescence, High efficiency, Photoconverters.

BIOGAS

ANAEROBIC DIGESTION OF LIME PRETREATED CATTLE MANURE IN A HYBRID UP-FLOW ANAEROBIC BIOREACTOR

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Abstract

Modernization of livestock farming due to increasing food demands in modern ages resulted in new environmental problems. Animal manure is one of the major solid wastes of livestock farming. High chemical oxygen demand (COD), biological oxygen demand (BOD), total solids (TS) etc. are the main characteristics of cattle manure. High load anaerobic digestion can be one of the most efficient solutions. Up-flow anaerobic bioreactors are the most desired candidates for conducting digestion in short hydraulic retention times (HRT). High total solid content of cattle manure causes major problems for transmission lines and pumps in modern systems. In this study, effect of lime pretreatment as an effective method for solid precipitation were investigated. In addition, the effect of lime on characterizations of pretreated cattle manure such as pH, COD, total suspended solids (TSS) were discussed. The impact of lime pretreated manure on an active pilot size hybrid bioreactor was studied. lime Optimum lime concentration (6 g/L) was considered while pH increased due to lime addition. A hybrid bioreactor consisted of an Up-flow anaerobic sludge blanket and a packed bed reactor was used for anaerobic digestion. A settling tank for active biosolid recycled and a gas collector system was used for completing the pilot scale anaerobic digester. The COD concentration was reduced by 30% after introducing lime pretreated wastewater to the system. The COD removal was retained up to 60% after 7 days of feeding. The HRT for hybrid system was set at 30 h and pH of the feed stream was adjusted to 7.8 after lime pretreatment. The bioreactor was successfully recovered and behaved very stable condition.

Keywords

Anaerobic digestion, Lime, UASB, UAPB, Cattle manure

ETANOLIX 2.0 – CONVERTING INDUSTRIAL WASTE TO ETHANOL IN OIL REFINERY

ETANOLIX 2.0 – CONVERTING INDUSTRAIAL WASTE TO ETHANOL IN OIL REFINERY

Linda Werner
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Abstract

St1 Refinery AB is part of the St1 Group. St1 is an energy company engaged in renewable energy, in the form of the production of biofuels and wind power, as well as in the production and sale of oil-based fuels and fuels. The company operates in Sweden, Finland and Norway.

St1 Refinery AB produces about a fifth of Sweden's demand for fuels. The refinery in Gothenburg has an annual throughput of about 4 million tons of crude oil and has about 200 own employees and about 50 contractors. The refinery is certified according to ISO 14001 and EMAS.

The Gothenburg refinery has been characterized by innovative thinking and practices, especially in the environmental field and in terms of energy optimization. Today, the refinery is one of the most energy efficient in the world. By using waste heat from the refinery, thus minimizing alternative fuel for heat production, large amounts of emissions of CO_2, sulfur, nitrogen oxides and soot are reduced.

Today St1 has a management system concerning “Biofuels” describing how to comply with the Swedish legislation implemented from the European Renewable Energy Directive and the Fuel Quality Directive.

The refinery’s Etanolix 2.0 project is granted by the European Commission, LIFE12 Environmental program; with the main objective for the first time demonstrate the sustainable production of waste to ethanol integrated with the production process at an oil refinery.

The project involves the demonstration of an energy integrated pilot installation which is the first complete system for production of bioethanol using industrial residues as raw-material and based on the proximity principle.

The ethanol plant is a prototype pilot installation, built to enable energy integration with existing oil refinery processes which means that synergies e.g. like heat and cooling from the refinery and water systems can be used from already existing processes. The ethanol is used as a bio component to be blended into transport fuels to be used in vehicles.

Approx. 20% of the EU's total CO_2 emissions originate from road transport. The availability and sufficient quantity of renewable fuel for the transport sector is a crucial step towards reducing our dependence on fossil fuels and stopping global warming and the increase in GHG emissions originating from this sector. The project is addressing this issue as well as the problem of food waste and presents an outstanding solution for “Waste to fuel” based on a wiser resource use, where food waste is seen as a resource for renewable fuel (ethanol) production.

WATER MANAGEMENT IN A CLIMATE-CHANGING WORLD

CLIMATE CHANGE, VULNERABILITY AND ADAPTATION: CASE STUDY OF THE PYGMIES AND MBOROROS PEOPLES

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Abstract

Climate change is at the heart of discussions to achieve the Sustainable Development Goals (SDGs) of 2030. Like the COP 21 held in 2015 in France, conferences and forums around the world determined the causes of climate change and proposed solutions to correct its anthropogenic component.

The recommendations of the various scientific meetings bringing together academics, researchers, governments, practitioners, Non-Governmental Organizations (NGOs) have shown the transversal nature of the problem to fight against the harmful effects of climate change and ensure fair access of all the common property of mankind. In this world of communicating climatic change vases, we are entitled from now on to assert that "humanity rhymes with vulnerability".

This social ethics debate can be constructive only with the prospect of the evaluation and the distribution of the social damage, the costs of the inferred multisectorial effects, the evaluation of the investments of solidarity to be implemented to decrease externalities in the context of major projects for the achievement of the 2030 SDGs.

The case study of Pygmies and Mbororos peoples illustrates the vulnerability literally. It raises the challenges of the adaptation and highlights the importance of the social dimension as lever of the social inclusion. The Pygmies, who depend on the nature and manage it since millenniums, play an important role in the ecosystem protection.

The first part will present the forms of vulnerabilities experienced by these populations. In the second place, on the basis of the acceptance of the diversity as richness, it will be question, to show the commitments of social inclusion taken by these developing countries at the national and regional levels as well as the strategies of social accompaniment which protect these populations victims of social upheaval (national parks, nature reserves, protected or complex areas of areas protected from the natural world heritage) and from the poverty.

Finally, we will present the social dimension of development projects in the defence and the respect of the fundamental rights of these populations to face the adverse effects of climate change.

Keywords

Ethics - Diversity - Social Dimension - Social Inclusion - Fundamental Rights.

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EXTREME RAIN AND CLOUDBURSTS NOW AND IN THE FUTURE IN SWEDEN

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Abstract

The existing precipitation networks in Sweden are sparse and most measurements are restricted to one reading per day. Therefore, it is a delicate task to estimate the severeness of extreme rainfall based on observed events.

The effect of relatively small cloud bursts may cause for example local flooding and land-slides and damages amounting to millions of kronor. The ongoing climate change increases the global temperature but it also changes the precipitation. Exactly how this change in precipitation will manifest itself varies a lot geographically.

In the Baltic region most climate models show a general increase of the precipitation. But, there may also be dry periods and a higher temperature increase the evaporation that in turn makes the dry period worse.

The present climate models in operation are rather course and their description of small scale precipitation phenomena such as cloud bursts are not good. This causes uncertainty in the prediction of how intense rains will develop in the future. At the moment so called down scaling methods are used and the results of that show that the cloud bursts will be more extreme in the future.

EFFECTS OF WATER SCARSITY, FOOD PRODUCTION AND MIGRATION

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Abstract

Recent UN Reports show that most countries in northern and eastern Africa and the Middle East are facing water shortage today. The percentage of renewable water resources withdrawn is extremely high. The population growth in most of these countries is estimated to be very high the following decades due to a very young population and a high fertility, even if the fertility is believed to decline. Thus, the population is estimated to grow by 50% in several countries (e.g. Egypt and Ethiopia) within the next 30 to 40 years and in some countries to double or even triple (e.g. Iraq and Mali) during the same period of time.

The hydrological situation will not be improved in northern and eastern Africa and the Middle East. In fact, the global warming is believed to make the situation worse. Since most of the available water is used for food production, the situation might become disastrous. Studies have shown that there is a correlation between poverty and inter and intra-state conflicts. Thus, migration within and from poverty and conflict areas will most likely increase.

In 2015 more than one million refugees came to Europe. This was only a small part of the total number of refugees. The majority remained in the region. Given the hydrological situation and the estimated population growth, people will continue to try to escape from conflicts and poverty. Thus, the migration from northern and eastern Africa and the Middle East to Europe will most likely increase in the future even if the large scale conflict in e.g. Syria will come to an end.

Efforts must be made not only to stop the conflicts in the area, although this is a prerequisite for other measures needed. A more efficient use and reuse of the available water resources must be introduced. Most of the countries in the region lack any type of cooperative water management framework. A more effective large and small scale farming to produce food is also of vital importance. More crops suitable for the climatic conditions must be introduced. Furthermore, family planning is important, even if the fertility is believed to decrease in the future. Efforts are already made in these areas, but much more is needed to give people in northern and eastern Africa and the Middle East reasonable conditions to stay in their own countries.

THE EFFECTS OF WASTE TREATMENT TECHNIQUES ON CLIMATE CHANGE

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Abstract

The relevance of different solid waste management techniques, in relation to global warming, has recently been discussed. Due to increasing waste volumes, waste management has a growing impact on the flux of carbon dioxide and other greenhouse gasses from the urban system to the atmosphere. This includes plastics, synthetic textiles and rubber, a.s.o. On average, about 30 % of the CO_2 emissions from waste incinerators has fossil origin, In RDF (Refuse Derived Fuels), where e.g. food has been separated, the percentage of fossil carbon is even higher, and can be over 50 %. This is e.g. the situation for much of the waste imported from abroad to Swedish incinerators.

Recycling of plastics and other fossil material 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. With new landfill mining techniques, the stored plastics can be important future resources to produce new products. If incinerated, waste with fossil origin is a major source of emissions of fossil CO_2. Also, during reduction of NOx from the stack-gases from waste incineration, N_2O is often a by-product emitted to the atmosphere. N_2O is approximately 35 times as potent as an agent for climate change compared to CO_2.

The use of compost or fermentation residues as soil improvement adds long-lived organic carbon to the soil, and thus increases the long-term storage. Environmentally controlled landfills, and different types of landfill bioreactor cells, 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. In modern, strictly controlled reactor landfills around 80-95 % of the produced biogas can be collected. 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 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. Long-lived organic matter in a landfill further helps to immobilize e.g. heavy metals and decrease leaching.

To this should be added the benefits of replacing fossil fuels with the collected biogas.

Landfill gas, extracted from about 50 landfills in Sweden, today generates over 310 GWh in energy, of which about 25 GWh as electricity. The use of this biogas substitutes fossil fuels. However due to the restrictions on landfilling of residual waste in Sweden, the magnitude of this resource will decrease significantly over the next decade.

WATER PURIFICATION BY ACTIVATED BENTONITE CLAY

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Abstract

The water purification as the one of the most important ecological problem needs new effective techniques and materials. Previous investigations had shown good perspectives of different clays uses in target area. Group of scientist from Kyiv, Ukraine developed quite good and cheap method of bentonite clay modification for increasing of its surface area and its modification. Here sanitary bacteriological and chemical investigations of water purification by modified benonite results are reported.

The research task was to examine the possibility of natural water purification from different types of pollutants by modified clay. For that purpose water probes for investigations were taken from 3 different lakes in Kyiv into sterilized bottles without contact with air. Water temperature was 0-1°C. For investigations of metal removal additional pollutants were added. After interaction with bentonite dispersion during 10 minutes water was filtrated and examined on sanitary bacteriological parameters and different cations contents.

It was found that even after quite short interaction bentonite remove up to 100% of iron, copper and in two cases from 3 – zinc. Also, during purification concentration of nickel, cobalt and manganese decreases on 40-50% so it is expected that after longer interaction or uses of few-steps purification systems the 3d-metals could be fully removed from the water.

One more result of interaction of water with modified bentonite was found is downturn of water hardness on 10-40%, so during purification process removing of cationic-type pollutants did not cause losing of water drinking properties due to hardness exceeding.

Sanitary bacteriological investigations shown that water interaction with modified bentonite provide to reducing of total bacterial amount. Unfortunately clay did not shown very high efficiency against Enterococci so for full water purification additional reagents could be added.

Keywords

Water purification, Bentonite, Heavy metals removal

MUNICIPAL WASTEWATER TREATMENT

THE SEWAGE WASTE WATER TREATMENT PLANT OF TOMORROW - REUSE OF WASTEWATER

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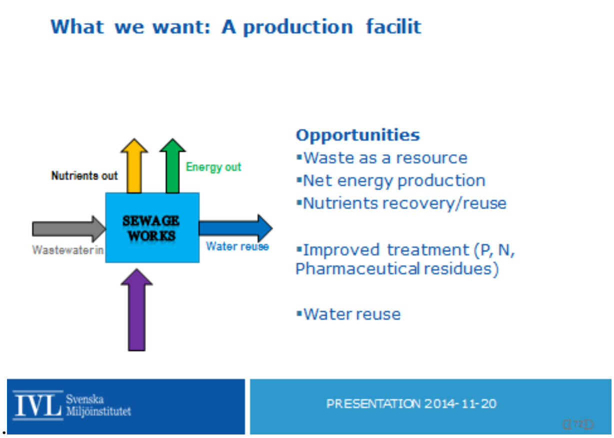
Abstract

An increasing proportion of the world´s population moves to the cities. The challenges are the ability to provide access to clean water, good living environment, food, energy and transport. Additionally, waste and waste water has to be treated in a sustainable way. Water availability is limited in many countries and this is exacerbated by the global rise in temperature in combination with a strong urbanization. Therefore an entirely new thematic approach is required where sewage and waste are seen as resources that turned into commodities in a production plant.



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During pilot project, we have therefore proven partial solutions that will lead to a production plant for water that, after removal of drug residues, metals and other priority substances, can be recycled for different purposes, bioenergy that can be produced from sewage and organic waste, phosphorus and other nutrients that can be returned in its pure form. Based on the

positive pilot results we are now establishing a full-scale demonstration for the use of a sieve filtration followed by an ozone step and a polishing treatment of effluent with activated carbon/sandfiltration. The quality will be carefully evaluated and, if possible, the water at the end of the trial period will be reversed into the circuit by artifical infiltration to the ground water. The process will be optimized from a resource point of view. Biogas will be produced from sludge and fish residues. The reject water will be treated with Anammox technology in pilot scale.

A success for this demonstration, will result in a Swedish innovative export product that will contribute to a strong increase in exports and a large number of new jobs

SPATIAL QUALITY OF MUNICIPAL WASTEWATER FLOWING IN WADI AL ZOMAR AND INFILTRATED THROUGH THE WADI BED

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Abstract

Wadi Zomar is one of the most polluted wadis in Palestine, where more than 25,000 m^3 of untreated sewage from Nablus East is discharged. In this research, the quantity and quality of wastewater flowing in wadi Zomar was assessed during dry and wet seasons, and also the infiltrated wastewater through the top soil, at four stations along the 30 km length of the wadi. The results revealed that about 1,800 m^3 and 10,000 m^3 of flowing wastewater was infiltrated during dry and wet season, respectively, representing 43% and 16% of the total wastewater flow. The surface fluxes of COD, BOD, N and P along the wadi in wet and dry seasons at the four stations decreased due to self-purification processes and infiltration into the subsurface. In the dry season, the decrease in fluxes from Station1 to Station 3 ranged from 57to 69%. In the wet season, the decrease from St.1 to St.3 ranged from 40 to 70%, which was significantly less than in the dry season. Out of the total N, P, COD and BOD loads that entered section 1(St.1-St. 2), high percentages infiltrated (31, 34, 29 and 27) % in the dry season and (7, 21, 3 and 5) % in the wet season. Therefore large quantities of organic matter, nitrogen and phosphorus infiltrated through the soil bed until as deep as 2.0 m. These pollutants may infiltrate deep into the ground, depending on the chemical and biological processes and may finally reach the groundwater. The sediment samples results at St.1 and St.2 showed high values of some heavy metal such as (Cu, Ni, Pb and Cr). Heavy metals may be very mobile in the soil if they are present in the leachate as organic metal complexes. Therefore, natural processes occurring in the wadi system are not adequate for environmental protection, especially of groundwater quality.

Keywords

Wadi, Municipal Sewage, Infiltration, Pollution fluxes, Groundwater pollution, Self purification

WASTEWATER AND STORMWATER MANAGEMENT

BIOTECHNOLOGICAL APPLICATIONS FOR ELECTRONIC WASTE WATER PROCESSING

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Abstract

Many elements as copper, selenium, tellurium and rare earth elements are strategic elements in high-tech electronics. Many of them are essential trace elements in living organisms, but also a potential toxin with very low threshold concentrations. Environmental biotechnological applications using bacterial biomineralization have the potential not only to remove these metals from contaminated waters, but also to sequester them in a reusable form. Biomineralization of many metals has been observed in phylogenetically diverse microorganisms isolated from pristine and contaminated environments, yet it is one of the poorly understood biogeochemical processes. Microbial respiration of metals and metalloids is unique as the microbial cells are presented with both soluble and insoluble (Me0) forms as terminal electron acceptor. This presentation will highlight biomineralization of metals, metalloids and rare earth elements and its potential biotechnologies in bioremediation and wastewater treatment.

Keywords

Copper, Selenium, Tellurium, Wastewater Treatment, Biomineralization

STORMWATER MANAGEMENT - BYPASS TECHNOLOGY

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Abstract

The water quality in a river is influenced by the discharge from the sewerage network. Through increased efficiencies of the wastewater treatment plants, the main deterioration comes from combined water overflow.

In view to a reduction of the discharge from combined water outflow the increase of the influ-ent to a wastewater treatment plant can be an efficient solution. The main bottleneck on the waste water treatment plant is the final clarifier with the limited capacity regarding sludge discharge from the biological stage.

Through bypassing the aeration with combined water and a direct feed of the combined water into the final clarification the specific sludge volume loading, which is significant to the effi-ciency of the final clarification, will not be raised. But the adsorption capability of the aerated sludge, the sedimentation effect of the final clarification, and the partial recirculation over return-sludge can be used for an elimination of suspended solids, COD, ammonia and phos-phate from the combined wastewater. In large-scale tests in Wilhelmshaven (160,000 PE) removal efficiencies for the elimination in the bypass of 75 % of COD, 60 % of ammonia and 89 % of suspended solids were reached. In comparison with conventional procedures for combined water treatment (e.g. storage volumes, soil filter) the bypass technology has got the possibility to achieve a highly efficient and economical combined water treatment by using the capability of existing clarifiers.

In the frame of the presentation the basics for this advanced solution will be explained and the results from the technical application will be demonstrated.

RECENT ADVANCEMENTS IN THE TREATMENT AND MANAGEMENT OF URBAN STORMWATER

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Abstract

Climate change in Sweden requires more climate commitment. To facilitate modern urban stormwater management a number of challenges must be addressed. Urban flooding will increase due to continuous urbanization, densification of urban areas, changing land use, and climate change including changing rainfall patterns. More resilient and sustainable urban flood mitigation systems are needed, using natural detention and drainage. Integrative and multi-criteria aspects in the legal and organizational system must also be addressed.

In this paper, the big Formas-funded SUrF project is described (Sustainable Urban Flood Management), as well as the basis of sustainable urban drainage systems (SUDS). The overall objectives of SUrF are to increase sustainability of the built environment with respect to flood risk and to propose steps towards improved urban flood management in Sweden. SUrF is a multi-disciplinary research project at Lund University with partners also from Malmö, water utilities, insurance companies and local city developers. The nominal project duration is 1 October, 2015 - 30 September, 2018. Sustainable flood risk management has to take a systems approach and promote a flexible use of a smorgasbord of techniques for each specific case. Non-structural components like stakeholder participation and social learning also are also important parts of any flood management system. Furthermore, such systems will always be dependent on urban design and economic considerations. All in all, a functional system has to involve several professions and therefore in order to do meaningful work we have a multidisciplinary approach to our research.

Treatment of stormwater is a neglected area. The quality of stormwater is normally not an issue from a regulatory point of view and few countries demand point-of-discharge treatment for stormwater flows. Methods to treat stormwater through sedimentation and filtration will be reviewed and one specific technology to treat it through floating filters will be presented and the pro´s and con´s of such an approach be highlighted.

THE EFFECT OF PH ON NITRIC NITROGEN ACCUMULATION IN A FRESHWATER DENITRIFICATION SYSTEM

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Abstract

Denitrification is a widely used biological nitrogen removal process, in which nitrate is reduced step-by-step to dinitrogen gas. As nitric nitrogen accumulation (one of the intermediate compounds) in a denitrification system has been previously reported by many researchers, the aim of this research was to elucidate the effect of pH on the aforementioned process. Nitrite accumulation was researched in short-term batch tests (6 hours), where pH, concentrations of acetate, different nitrogen compounds and mixed liquor suspended solids (MLSS) were measured. The results showed a spontaneous increase in the pH value towards 9.5, while the percentage of accumulated nitrite rose as well. This could be the result of pH inhibition to nitrite reductase, which cannot sufficiently reduce all produced nitrite on high pH values. As this aforementioned effect could be used together with the deammonification process to turn nitrate (a product of the anammox process) into nitrite (a substrate of the process), the knowledge obtained in the current study brings us one step closer to a complete nitrogen removal system.

Keywords

Denitrification; Nitric nitrogen accumulation; Freshwater; pH

GASOLINE-CONTAMINATED GROUNDWATER: ECOLOGICAL RISK ASSESSMENT (ERA)

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André Luís de Sá Salomão
Marco Tadeu Gomes Vianna
Vinícius Martins L. dos Santos
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Abstract

In order to assess the ecological risk resulting from an accidental gasoline spill in the vicinities of an environmental protected area with a marshland and a shallow aquifer, groundwater sampling using low-flow technique was conducted during three campaigns in an eight-month period. The study included eight monitoring wells installed in the affected area and a ninth monitoring well used as a control installed in the same aquifer in an area considered not affected by the accident. Two lines of evidence (LoE) were integrated to estimate the risk. Physic-chemical parameters, BTEX compounds (benzene, toluene, ethylbenzene, m- xylene, p-xylene and o-xylene) and metal concentrations were used to integrate the Chemical LoE. Acute (Aliivibrio fischeri, Daphnia similis and Danio rerio) and chronic (Desmodesmus subspicatus) assays, as well as genotoxicity and endocrine disruption biomarkers in Oreochromis niloticus were applied to build up the Ecotoxicological LoE. Results from the Chemical LoE indicated extreme risk in all sampling campaigns in groundwater samples from three out of eight monitoring wells (GW4, GW7 and GW8), which exhibited free-phase gasoline. Lead was also found in concentrations exceeding the Brazilian intervention levels in well GW6. Results from the Ecotoxicological LoE converged with those obtained with the Chemical LoE and a high mortality was observed when individuals were exposed to groundwater from GW4, GW7 and GW8 monitoring wells. These wells were considered to be in the hot spot of contamination and therefore, this area should receive priority for remediation efforts. The results indicate that BTEX in groundwater may pose a threat to the ecosystem and residents in the region. This information is considered useful for further evaluation, risk management and future remediation efforts in the area.

Keywords

Ecological risk assessment, Groundwater, Gasoline spill, Biomarkers

SIMULTANEOUS CATTLE MANURE WASTEWATER TREATMENT AND POWER GENERATION BY MICROBIAL FUEL CELL IN CONTINUOUS PROCESS

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Abstract

Cattle manure is one of the most abundant lignocellulosic resources, which contains large amount of cellulose, hemicellulose and lignin. These compounds can be employed in MFC as rich sources of energy for electricity production. In this study, the performance of a laboratory scale microbial fuel cell (MFC) fed with cattle manure was investigated. Once the system hs reached to steady state and stable condition, the power production, produced current, COD and nitrate removal, coulombic efficiency (CE), coulombic recovery (CR), harvest rate and pH variation were investigated. In order to enhance the treatability of manure in MFC, the anolyte was continuously transferred into cathode for further treatment. The results revealed that an acceptable current and power density can be achieved by constructed MFC which was equal to values reported in literatures. The maximum power density reached to 1.2 W.m-3 for the continuous operation, with external resistance of 200 Ω. The results also showed a good capacity of the process for COD and nitrate removal of about 60 and 63%, respectively. The pH indicated negligible change over the process.The proposed design of MFC showed a great performance in simultaneous wastewater treatment and power generation.

Keywords

Microbial fuel cell, Cattle manure, Current generation, COD removal, Nitrate removal

DEGRADATION OF ORGANIC WASTEWATER BY A DOUBLE-WORKING ELECTRODE ELECTROCHEMICAL METHOD

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Abstract

Electro-chemical method for organic wastewater treatment is based on the organic matters degradation by electrode in electrochemical cell under electro-catalysis. This degradation process is implemented by the direct oxidation of organic matters on the surface of electrode, indirect oxidation of organic matters by the strong oxidizing agent produced by electrode, the application of fuel cell and so on.

In this work, a novel double-working electrode electrochemical cell for organic matter treatment was introduced and tested. In this cell, Ti-based anode is employed for the production of strong oxidant and carbon based cathode is used for synergistic effect. The result showed that compared to the traditional single working electrode cell, the double-working electrode cell showed better removal performance and energy-saving potential. Besides, during the whole running time, the pH value of the solution was controlled closed to neutral by the double-working electrode method.

Keywords

Electrochemical; Organic water treatment; Double-working electrode; Ti-based anode

SUN CORAL EXOSKELETON FILTER IN AN ENGINEERED ECOSYSTEM FOR PHOSPHORUS REMOVAL FROM TREATED SEWAGE

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Abstract

Constructed wetlands (CW) and engineered ecosystems are efficient to treat wastewater and stormwater runoff. However, CW require large areas to achieve a good performance and besides, several investigations have reported insufficient phosphorus (P) removal by these systems, according to the discharge threshold limits established by most environmental legislations. The performance of natural and locally available materials as adsorbents for P removal from wastewater is therefore, an important research subject. Currently, two exotic species known as sun coral currently spread along 2,000 km of the Brazilian coast pose a severe threat to the marine biodiversity and to oil platform structures, which have motivated the Brazilian authorities to establish enforcement measures aiming at sun coral control. These species have exoskeletons with high concentrations of calcium carbonate and our previous lab-scale experiments have proved that exoskeleton-based adsorbent effectively removes P from wastewater, being a suitable material to be tested as a polishing step in full-scale treatment plants. In the present investigation, a sun coral-based filter (SCbF) constructed with fiberglass was installed as final treatment unit in a decentralized wastewater treatment plant named "engineered ecosystem", constructed to treat sewage generated by an university campus of Rio de Janeiro State University-UERJ located in Ilha Grande, Rio de Janeiro/Brazil. The SCbF improved the P removal capacity of the system from 44% to 96%. The SCbF proved to be potentially an excellent strategy for P removal from sewage, particularly for decentralized systems and an attractive use of the sun coral exoskeleton extracted from the Brazilian coast and from other coastal areas where this invasive species requires control.

Keywords

Engineered ecosystem, Phosphorus removal, Adsorption, Sun coral-based filter.

SMART ENERGY AND SLUDGE MANAGEMENT IN WWTPs

POTENTIALS OF ENERGY OPTIMIZATION AT WASTEWATER TREATMENT PLANTS IN THE BALTIC SEA REGION

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Abstract

Wastewater treatment includes energy consuming processes. Due to ending of fossil resources and climate change approaches for reduction of energy consumption are encouraged. In practice energy decrease also provides lower operational costs. Still the achievements of the past decades regarding high level nutrient removal have to kept or further improved. Operators of wastewater treatment plants can choose from a large variety of solutions. But as each WWTP has its specific design and boundary conditions, the first step is to carefully analyze the process.

The Project IWAMA aims at improving the wastewater management in the Baltic Sea Region by capacity development of the operators and implementation of pilot investments in energy efficiency and sludge handling. In this article the planned actions regarding efficient use of energy at highest feasible nutrient removal rates are presented.

Keywords

Energy-Nutrient-Nexus; Nutrient removal; Energy optimization; Wastewater treatment.

IWAMA PERSPECTIVES FOR SLUDGE MANAGEMENT

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Abstract

The technologies of sludge treatment and trends of final sludge usage as a fertilizer, disposal or incineration differ in the countries of Baltic Sea region. Various definitions of applicable sludge quality and historical trends in the choice of sludge treatment technologies leads to enormous variations in sludge management practices. The EU Baltic Sea Region project IWAMA aims to enlighten the relationship of technological and economic feasibility of sludge management practices.

The project has two major action focuses. Firstly, comparative benchmarking of sludge management in a wider selection of WWTP-s and thorough auditing of selected plants addresses the sludge management in a dual approach will be performed. Sludge quality is measured and assessed during the sludge audits considering technological and regional peculiarities.

Secondly, the pilot investments are planned to study a selection of knowledge gaps in the novel sludge treatment approaches and facilitate the conceptual understanding and applicability of these technologies. Piloting of the sludge management technology addresses also the issue of nutrient discharge in large WWTPs via introducing an advanced sludge water treatment process.

The presentation gives an overview about the actions and studies planned for the sludge management in the frame of IWAMA project.

COMBINED TREATMENT OF SEWAGE SLUDGE AND SOLID WASTE ORGANIC FRACTION – THE DUPLEX-TECHNOLOGY

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Abstract

The energy demand of the wastewater treatment is contributing with a significant share to the running costs. Through optimization of the technology and the process control, the specific energy demand can be reduced to < 20 kWh/PE · year. Only with the technology of anaerobic digestion of the sewage sludge and additional co-substrates a complete covering of the energy demand is possible. The treatment of the additional organic residues in the digester increases the specific gas production, contributes to a good economy of the wastewater treatment and solves at the same time an organic waste problem. As co-substrates a wide range of organic residues are available, like grease, residues from food production (slaughterhouse, fruit juice, diary etc.) and agricultural residues or products. Also the organic fraction of the solid waste is an effective co-substrate after a suitable pre-treatment.

For application of this technology for smaller plants, a compact technology with an integrated digester has been developed (H-Batch system) and applied. By using the organic solid waste fraction as substrate (DUPLEX-technology) an energetic autarkic operation is possible for wastewater treatment plants larger than around 15,000 PE. This technology can especially been applied where the infrastructure for the waste water treatment and the solid waste treat-ment has to be developed at the same time.

INTERACTIVE WATER MANAGEMENT: INTRODUCTION TO THE IWAMA PROJECT AND THE CONCEPT BEHIND IT

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Abstract

In WWT, singular solutions do not suffice anymore for improving the nutrient removal. Instead, a comprehensive approach to WWT processes is necessary when the goal is to continue nutrient reductions for meeting the stringent HELCOM recommendations. Approaching WWT in BSR from the wider perspective, two urgent challenges arise: insufficient sludge management and the need to improve energy efficiency.

Efficient municipal WWT produces vast amounts of sewage sludge. In the countries located in the Baltic Sea watershed the amount of sludge generated is about 3.5 mln t of d/s annually – this is expected to increase to almost 4 mln t by 2020. The sludge concentrates nutrients, heavy metals and poorly biodegradable trace organic compounds as well as potentially pathogenic organisms present in wastewaters. Meanwhile there are no common technological solutions for the sludge treatment and disposal in the region because of different national legislations and varying sizes of the plants. Moreover, WWT operators have often difficulties in choosing technology and operating sludge treatment facilities and in evaluating their efficiency in relation to removal of hazardous substances and nutrients.

Water utilities are typically the largest consumers of energy in municipalities, often accounting for 30-40% of total energy consumed. Pursuing energy efficiency of the water sector systems can significantly reduce operating costs. All steps of WWT and sludge disposal consume massive amount of energy for pumping, mixing and aeration of water, wastewater or sludge. At the same time, energy is becoming a very important cost factor in WWT given its increasing costs in the recent years. Despite sector´s high energy consumption, smart energy management is not applied. There is 15-30% potential to save energy while simultaneously improving the nutrient removal. It can be estimated that improved control leads to 5-10% higher degree of efficiency. The importance of energy consumption optimisation, energy recovery processes, efficiency of equipment and technology operations are vastly growing in the field of WWT as the energy demand of the sector will rise in time due to population growth, increasing requirements for effluent quality and residual water reuse.

IWAMA project aims at improving wastewater management in the Baltic Sea Region by capacity development of the operators and implementing pilot investments to increase the energy efficiency and advance the sludge handling.

REMEDIATION AND MINING: Part I & Part II

WEEE MANAGEMENT: SYSTEMATIZATION PROCESS IN COSTA RICA

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Abstract

This paper presents the steps followed in Costa Rica to implement a waste electrical and electronic equipment (WEEE) management system, its challenges, successes and limitations. It explains in detail the two phases in which a strategy for WEEE management was developed and implemented. The process resulted in the approval of a WEEE Decree that prohibits discarding WEEE together with household waste, the creation of a National Executive Committee with representatives of importers, consumers and government, which will establish the quotes, treatment fees, among others. Another outcome was the development of a strategy for the implementation of WEEE management for the country, the creation of awareness on the population about their responsibility on WEEE management and the example set up for other Latin American countries. The paper provides conclusions in relation to the regulation and the required consistency with the existing National waste legislation in order to reduce approval times. Additionally, the importance of the participation of stakeholders representing different electric and electronic equipment (EEE) sectors with the purpose of obtaining consensus on the agreements.

Keywords

E-waste; WEEE; systematization; Extended Producer Responsibility, Costa Rica

WASTE MANAGEMENT IN ZAATARI REFUGEE CAMP / MAFRAQ - JORDAN

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Abstract

Jordan population have increased 3 million in the last five years. 1.5 Million are refugees from Syria. 800 thousand are inside refugee camps in the northern part of Jordan. 100 thousand are situated in Zaatari camp which is located 10 kilometres east of Mafraq city. This enormous influx increased solid waste volume generated by 480 tons daily. The additional waste generation has exacerbated pre-existing pressures on waste management, in which service capacities in northern municipalities were already exceeded, funding already fell short of need, and collection supplies were already inefficient. USAID estimated the total fiscal cost for municipal governments originating from the Syrian refugee crisis amounted to around $25.4 million in 2013 and $33.0 million in 2014. The main problem in the camps nowadays that people live under very bad conditions and the generated waste is creating environmental and health problems. Different organization together with Jordanian government work to find solution to these problems. Unfortunately these efforts is restricted by the limitation of funding.

According to the political and economical situation the crises will not be solved and refugees will not return back home soon. Thus, these campus are gradually evolving into a permanent settlement. Proper waste management is critical to preserving refugees' health and well-being and to protect the environment. The aim of this paper is to identify the challenges facing waste management in Zaatari camp. Furthermore, to suggest proper solution through comparing different waste management solutions considering the existing waste management in Mafraq area.

RESISTIVITY-IP TOMOGRAPHY FOR MAPPING OF OLD WASTE DUMPS AND CONTAMINATED GROUND

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Abstract

Buried waste and contaminated ground are widespread in connection with old waste dumps and derelict industrial ground. Several problems are associated with such areas, for example contaminant leakage that can threaten ecosystems and drinking water resources. Buried waste can create severe problems such as subsidence and health hazards when redeveloping areas previously occupied by landfills, due to lack of documentation of the extent and contents. Furthermore it may be desirable to map variation in waste composition for landfill mining purposes. Investigation by drilling and mechanical sounding risks to miss important anomalous zones in the complex 3D structures that are typically encountered in such contexts. Combined DC resistivity and time-domain induced polarization (DCIP) tomography has proved to be a powerful tool for mapping buried waste and contaminated ground in 3D, and can also be used for monitoring (4D) of for example contaminant and gas migration in the ground or inside the waste body. The resistivity typically provides useful information related to the geological setting and contaminant plumes. The IP response (chargeability) generally delineates the extent of the waste, and reflects variations in waste composition. Degradation and precipitation of contaminants can also lead to detectable changes in resistivity-IP responses. Recent technical development within the framework of large research and development projects1 opens new possibilities to extract enhanced information on the subsurface from DCIP tomography. On the data acquisition side hardware development allows IP measurement using 100% waveform, which speeds up surveying and at the same time increases the signal-to-noise ratio. In combination with multi-channel data acquisition equipment and the use of non-traditional electrode arrays this can speed up surveying manifold, and thereby make it more time and cost efficient. A novel signal processing methodology can double the spectral content of time-domain IP data, which in combination with inversion (inverse numerical modelling) algorithms for spectral model interpretation allows creation of more nuanced images of the subsurface. This in turn leads to enhanced models of the subsurface that are expected to open up for refined characterisation of buried waste and contamination status.

[1] MaLaGa: http://malagageophysics.com/; Geoinfra: TRUST 2.1: http://trust-geoinfra.se/; GEOCON: http://www.geocon.env.dtu.dk/

Keywords

Waste, landfill, contaminants, resistivity, induced polarisation, tomography.

PHYSICOCHEMICAL CHARACTERIZATION OF SEDIMENTS AND WATER IN MALMFJÄRDEN BAY, KALMAR AS BASIC INFORMATION FOR DREDGING FOLLOWED BY METALS AND PHOSPHORUS RECOVERY

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Abstract

The Environmental Science and Engineering group (ESEG) at LNU has recently started the project "SURE- Sediment Uptake and Remediation on Ecological Basis" in cooperation with the municipality of Kalmar and the business sector. The project has funds from the EU LIFE program and it has the objectives of showing how feasible it is to restore the ecological status and hydro morphology from an eutrophic sea bay, the Malmfjärden Bay, Kalmar, without creating any disturbances and major environmental/ecological impacts. The project consists of using an innovative method for bottom sediments dredging, followed by dewatering and treatment of both aqueous and solid phase. Besides treatment, the project will investigate potential techniques for metals and phosphorus recovery from the dredged sediments in way that valuables lost from the anthropogenic cycle are "given back" within the beyond zero waste concept.

During these first months of project, a preliminary assessment of the physico-chemical status of the area was carried out with water and sediments being sampled from different points and depths in order to understand how contaminants are spatially distributed in the bay in the current situation. From each sample, sediments and pore water were initially characterized in terms of organic matter, water contents, bulk density, metals, COD, TOC, and P. The first results have shown that dried sediments were rich in nutrients such as Fe, Ca, K which are essential for agricultural purposes. In a zero waste vision this is a positive result, in particular because the project's sub-objectives are to demonstrate a process to clean and recycle at least 70% of dredged sediments. Also heavy metals like Cu, Zn, Pb, Cr, Co were found in the sediments. The values were compared to the standard values established by the Swedish Environmental Protection Agency (SEPA) and all the data were in acceptable range imposed except for Cobalt. The average values was 95 mg/kg compared with 30 mg/kg imposed by SEPA. This means that before reused the sediments a treatment is necessary. To conclude, it can be stated that these initial results are very interesting since the main idea of the project is to remediate the area and recover as much as possible valuables from the dredged sediments such as metals and nutrients.

Keywords

Dredging, Sediments, Metals, Phosphorus, Resource recovery, Remediation.

FROM LANDFILL MINING TO GLASS MINING AND LAGOON MINING IN SWEDEN

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Abstract

In 1994 the landfill mining concept was introduced in Sweden influenced from the USA where it had been practiced for decades and many conferences held. USA was visited and the first landfill mining manual was imported. During 90s several test excavations for research were carried out with the focus on separation of valuable materials for recovery as well as efforts were made to develop new machinery for landfill mining and material sorting. Sorting in three fractions was made and a test was also performed to backfill fractions and irrigates the material for biogas production creating a landfill bioreactor. The first ideas about the fine fraction reuse also appeared; this fraction might valuable metals and the first XRF testing was carried out to determine potential. The first international landfill mining seminar was held in Sweden and it was believed that there should be landfill mining boom. The reason of this opinion was that Sweden has 4 000-6 000 old landfills/dumps existing, in the Baltic Sea Region it makes 75 000 -100 000 and in whole EU up to 500 000. However, it didn´t happened nevertheless at the end of the first decade of 21st century several international conferences and seminars were initiated in UK. Landfill mining was also introduced in Asia and the first landfill mining manual for use in Asia was written. The interest of landfill mining has increased significantly in the Baltic Sea Region and Belgium where in Flanders there exist about 2 000 old dumps that are a hinder for future land use exploitation. Many landfill mining PhD courses were held in cooperation of Baltic Sea Region countries, with students representing up to 17 nations. The Zero Waste approach started to be introduced in a daily manner and its importance for the circular economy was outlined. The concept Beyond the Zero Waste was introduced on ideas about construction of Bank Account landfill cells technique for potential saving of valuable soil fractions/sediments/sludge for future economy utilization. Opportunities for recovery of metals and nutrients from sea sediments and glass waste were conceptualized as glass mining, harbor/bay/lagoon mining. Still there are excavation and remediation projects carried out just for moving polluted masses from one place to another and no sorting is scheduled; ideas for future utilization and recovery are existing in present without applied use. Remediation in old manner creates risks for environment and economic resources are wasted. The Governmental tools for economic steering of real landfill mining projects need to be adjusted as stakeholders are interested in the concept. The paper gives a historical journey for introducing landfill mining in Sweden, the Baltic Sea Region and EU.

KEYWORDS
Landfill mining; Glass mining; Harbor mining; Lagoon mining; Circular Economy; Beyond the Zero Waste

LANDFILL MINING

HOW WOULD I EXCAVATE MY NEXT LANDFILL?

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Abstract

Landfills contain large amounts of potentially valuable materials. This is also recognized by the European Innovation Partnership who has confirmed that Landfill Mining (LFM) fulfils the criteria to be recognized as "Raw Material Commitment (RMC)". RMC has to deliver innovative products, processes, services, technologies, business models or ideas that can be brought to the market or that would bring wider societal benefits. To be able to handle LFM as a bank of materials, one must critically review previous experiences in full-scale excavation works.

At Kudjape landfill, Estonia, about 55 000 m^3 of previously disposed waste was excavated and screened to extract fine fraction as final cover material. Coarse material was used in various experiments as waste-to-energy in Tallinn mass-burn incinerator, waste-to-solid recovered fuel for Kunda Cement factory, waste-plastic-to-oil, and also waste-plastic-to-plastic products. The project was developed according to all legal rules for public procurement, well documented and monitored, and also three years of aftercare has passed. The aim of the current study is to critically review the lessons learned during all steps of project development. Administrative, technological, financial, environmental and personal risk, as well as innovation aspects will be discussed.

Keywords

Landfill mining; Leachate; Stormwater; Landfill gas; Emission; Methane degradation layer; Safety; permits; Authority

RISK ASSESSMENT EXECUTION MODERN LANDFILL STRUCTURES IN FINLAND

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Abstract

The Structural Risk Assessing (SRA) method has been developed and presented in Finland, based on the inadequate results of landfill risk assessment. The SRA method helps to define which risk factors have been identified in the designing phase and how their impacts have been taken into account. The SRA method has been used in two landfills during the environmental permit process. The first case was innovative surface structure and the other one was hazardous waste bottom structure.

The premise of the innovative surface structure risk assessment process was to find a solution for light weight structure that is fulfilling the environmental protection demands and is cost-effective structure. The surface structure should be possible to open as e.g. landfill mining purpose. Life-cycle expectancy was dated over 50 years. The cost-efficiency of the chosen structure was 14 % more affordability per hectare compared with Government recommendation. The cost-efficiency will increase if the structure will be opened in the future, because the structures are thinner and easier to excavate.

The hazardous waste landfill bottom structure life-cycle expectancy was dated over 50 years. In the landfill structure analysis should be taken into account the leachate management and in leakage situations the leachate content, human delineated factors and waste prospects in the risk assessing. The cost-efficiency of the structure was 43 % more affordability per hectare compared with the structures have been typically used in hazardous waste landfills. The most significant effect on the total cost-efficiency was possible to use by-products as a part of the structure.

The risk assessment by the SRA method gives a relatively wide range of information to landfill management. Landfill mining or pyrolysis could be commonly used technics already in the near future. Therefore, landfills should take apart of the risk assessment process as the material source.

Keywords

Landfill; Contaminant transport; Geological barrier; Environmental protection; EC Landfill Directive; Structural Risk Analysing method.

TECHNOLOGICAL AND ENVIRONMENTAL INDICATORS FOR RINSING OF MATERIALS RECOVERED FROM LANDFILL

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Abstract

Investigations were carried out in Alytus regional landfill, using waste samples taken from the landfill. Samples were taken from different depths of borehole, made in the landfill. After analysis of recovered materials quantities and composition two waste fractions were selected for an experimental study: textiles and plastics. These fractions were washed with distilled and tap water. Ash content and volatile substance in textile and plastic waste were determined before and after washing. Permanganate oxidation (ChDS(Mn)) and heavy metal analysis of filtrate from the landfill was performed. The highest values of ChDS(Mn) were located at a depth of between two and seventh borehole depth meter of the landfill, after washing with water: plastics - 19.27 mg O_2/l and textiles - 28.8 mg O_2/l. In all samples heavy metals (Zn and Cu) were detected, and a number of samples traces of Mn, Ni and Pb were found. After washing, ash content of the two factions decreased by an average of 10% and amount of volatile fraction increased. According to this analysis it is evident, that washing improves energetic properties of materials (if it is used for energy generation), recovered from landfills, and contributes to the reduction of environmental pollution.

Keywords

Landfill mining; Waste analysis; ChDS(Mn); Energetic properties; Energy recovery.

COMPOSITION OF WASTES AT AN EARLY EU-LANDFILL THE TORMA IN ESTONIA

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Abstract

Landfills represent a continuous environmental threat due to the emission of different greenhouse gases, which are the main responsible for the climate changes, and the contaminated leachate that affects the surface and ground water recipients. The circular economy approach appeared as a suggested solution to reduce the depletion of the Earth's natural resources and the environmental risky effects by considering all the lost resources like wastes including the landfills as potential secondary resources. It is well known that characterizing the landfill waste composition is an essential step in specifying the recycling methods. In the current research the waste composition at one of the early landfills following the EU regulations (the Torma in Estonia) was studied. The results showed that the fine fraction (<20 mm) represents 53% of the total excavated waste materials while the Waste to Energy fraction (plastics, woods etc.) was the highest within the coarse fraction (>20 mm). The present work highlighted that mining landfills can be a good solution either for the shortage of primary raw materials like metals or as a source for recovering energy.

Keywords

Landfill mining, Waste composition, Characterization of landfill, Circular economy, Torma landfill

GLASS MINING

RECOVERING GLASS AND METALS FROM GLASS DEPOSITS

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Abstract

Kingdom of glass is located in Småland and it has a long history of glass making. Glass factories has come and gone leaving a large amount of glass deposits in this region. Full lead crystal contains 30 weight% lead. We have developed a technique to separate out lead from deposited lead glass. The result is a metal fraction containing lead and a glass fraction that can be modified for future use.

The technique has been developed in a scale of 0.2 dm3 with very promising results. The lead content in the glass can be reduced from 30% to 0.1 weight%! It is not only the majority of the lead is transferred to the metal phase, but also arsenic and antimony. Equipment has been installed to increase the processed volume to 6 dm3 and thus the technique will be verified in a larger scale.

The technique will work as long as there is enough lead to create a metal phase. This sets a demand of sorting out glass and ensuring a certain amount of lead. It is rarely only glass that has been dumped so limits for how much non-glass materials that can be tolerated in the process are necessary. An experimental design for determining an estimate of the possible levels of soli, sand and peat has been initiated.

This is a new possibility of recovering metals and glass from excavation sites. A necessary continuation is an industrial scale test and identification of a suitable glass product before the technique will be reality.

ASPECTS ON PHYTO-REMEDIATION OF RADIONUCLIDES FROM WASTE DEPOSITS

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Abstract

There are several waste dumps containing radioactive material such as tailings from uranium mining, ashes from forest industries wastes from gypsum industries etc. One type which has not been considered in this aspect is waste from glass factories. There are a large number of such waste deposits in Sweden. Radioactive elements such as Uranium have been used for making yellow/green glass. Such uranium was often depleted uranium i.e. uranium after extraction of 235U after fabrication of nuclear fuel or nuclear weapons. Thorium uses for special glass such as lenses to improve quality. Thorium oxide is highly refractive and low dispersion; this translated into cheaper high-quality glass by allowing manufacturers to make lenses of lesser curvature. From nuclear tests and the Chernobyl accident 137Cs has been deposited also on the waste dumps. Generally large areas following the Chernobyl and Fukushima accidents have been contaminated. Other natural radioactive elements such as 210Pb, 40K are either present in the raw materials or deposited from the atmosphere. Remediation will be necessary and it is also of interest to recover metals from economical point of view. Such recycling might result in new tailings containing higher concentrations of some elements. Phytoremediation is an attractive method which might also be effective for radioactive elements. The Indian mustard (Brassica juncea) has shown to take up U. Red maple (Acer rubrum) has been used for decontamination of 137Cs, 90Sr and Pu. Hemp (Canabissativa L.) is proving to be one of the best phytoremediative plants. There are specie of hemp with less toxins and allowed to plant. Tobacco (N tabacum L.) has been used for cleaning of U in mine tailings.

Keywords

Phytoremediation, radioactive elements, 137Cs, U.

A BRIGHT SOLUTION TO A DARK PROBLEM

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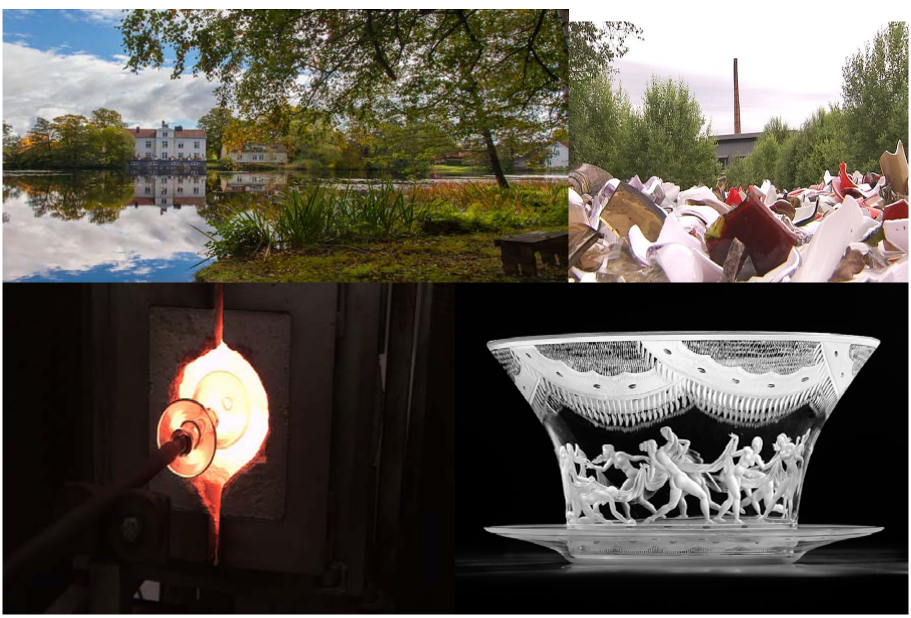
Abstract

Orrefors is an internationally renowned place, famous for its beautiful, handmade art and utility glass. Up to 500 000 people a year used to visit the small village of Orrefors, to see glassblowers make history and to buy the exquisite glass made here. The glass factory shut down 2011 and today Orrefors a sleeping beauty, with approximately 700 visitors a year.

What few people want to talk about is the pollution of Orrefors and all other glass areas in the region. But it´s still there.

At the intersection between the regional, municipal, local business and the citizens of Orrefors an idea has emerged; how to develop Orrefors from a poisoned and disused glassworks area into a thriving glass-, culture- and eco-park, in order to attract national and international visitors to the area and create a better future for the residents. We want to bring Orrefors back to the future.



CHARACTERIZATION OF WASTE FROM GLASSWORKS TOWARDS RESOURCE RECOVERY – THE CASE OF MADESJÖ DUMPSITE

Richard Mutafela
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Abstract

The ‘kingdom of crystal glass’ in Sweden’s Småland region enjoyed the fame of crystal glass production for centuries, leading to the current array of dumpsites of glass and other wastes (raw material remnants) from glassworks that currently characterize the region. Most of the dumpsites have heavy metal burdens with leaching capabilities to soil and ground water. As such, excavation of the masses with subsequent resource recovery, in this case metals like lead (Pb), would be beneficial both as a remediation measure as well as a way of reintroducing discarded materials into the resource loop. As a case, Madesjö dumpsite was sampled at 9 different points, two levels per point, resulting in a total of 18 samples. The samples were subjected to X-ray Fluorescence scanning (XRF) and leaching tests with further analyses for Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), and metals using ICP. This was taken as a preliminary step in understanding the properties of the waste under consideration so as to achieve viable environmental and safety measures during possible excavation and handling of the waste from the site. Whereas the dumps pose an environmental hazard, they contain a rich store of valuable resources (metals), which may be costly to extract.

Keywords

Excavation, Crystal glass, Glass landfills, Heavy metals, Landfill mining, Metal speciation

GLASS MINING AS EDUCATIONAL TOOL: SUSTAINABILITY PERSPECTIVES

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Abstract

Rural and urban landscapes are primary targets for implementation of EU Baltic Sea Regional and Helsinki Commission (HELCOM) Baltic Sea action plan strategies concerning remedial and recycling operations. Sweden is one of the leaders in the world elaborating environmental engineering and sustainability progress. The international project entitled "Phytoremediation park for treatment and recreation at glassworks contaminated sites" (acronym PHYTECO) which gathered under the Tripple Helix concept researchers, municipality experts and businessmen from Sweden, Estonia, Latvia and Ukraine. The aim is to investigate the benefits of prospective environmentally friendly mining in contaminated with glass waste areas thus as the result having elaborated landscape quality, promoted beyond the zero waste ideas on recycling and driven phytoremediation technologies as future state-of-the-art landfill remedial technique. The ongoing project foresees cross-border collaboration on landscape policy and remediation strategy among Baltic Sea countries through share of knowledge and best practice among the involved partners. It intends the clean-up of rural landscapes damaged by old glassworks landfills located at Kingdom of Crystal, Sweden. The final goal is establishing a recreation park at the old Boda glassworks in Emmaboda town that may attract tourists for visiting this place. Hence large efforts are devoted to educational values which were targeted during field course in 2016 where international students of different levels from 25 countries participated. The course took place in Lithuania, Latvia, Estonia and Sweden with active participation of Ukrainian pedagogic forces.

Keywords

Dumps, Glass waste, Remediation, Glass mining, Education

CRITICAL WASTE MATERIALS (METALLURGY)

METALS IN CONTAMINATED MATERIALS – PROBLEMS OR OPPORTUNITIES?

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Abstract

The amounts of metal contaminated materials are large in our society. Some examples of such materials are ashes from waste incineration, polluted soils and sediments. Today, most of these materials are landfilled, on or off shore, which is not sustainable in the longer perspective. In this presentation a background to why it is interesting to study these materials in more detail will be given. In addition, some specific results will be discussed.

Keywords

MSWI ash, Soil remediation, Sediments, Metal recovery, Leaching

CAN EUROPE PLAY A ROLE IN THE COMING MATERIALS TECHNOLOGY BOOM?

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Abstract

From the lithium batteries in our electric vehicles to our ability generate energy from the sun, wind and waves. From the smart phones in our pockets to the MRI machines that can see within us. Such products, that only a decade ago appeared locked in the realm of science fiction, now exist through the application of a new generation of metals, alloys and materials.

To be part of the development of two-dimensional materials that are stronger than steel; permanent magnets that will support frictionless high speed trains; and zero-density foams that form weightless insulation, Europe must have secure access to both raw materials, and highly skilled well-resourced researchers with the confidence to push ahead.

The European Union is far from self-sufficient in most raw materials. This is particularly the case for many of the critical materials that are essential for emerging "green" technologies. As the world shifts to the efficient production, storage and conservation of low carbon energy, it is not iron or copper or lead that have delivered opportunities. For long life light weight batteries for EV's or mobile phones, high purity lithium, cobalt and graphite are essential. Efficient low friction electrical motors and wind turbines require rare earth elements for high strength permanent magnets.

Even though it is unlikely that Europe ever can become self-sufficient in all metals, high quality primary and secondary resources exist in Europe for most of the more important critical raw materials. As the markets for these materials is relatively small, a few small mines can provide all of Europe's needs, and provide secure access, with the lowest possible environmental and social impact.

With sustained investment, Europe can provide leadership in the production of critical raw materials, and benefit greatly from the amazing downstream opportunities these materials will provide to this and the next generations.

LESS MAY BE MORE – IMPROVING CHALCOPYRITE BIOLEACHING KINETICS VIA SEQUENTIAL INOCULATION OF ACIDOPHILIC MODEL SPECIES

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Abstract

Biohydrometallurgy, or bioleaching, describes a more environmentally friendly technology to extract metals such as copper via the microbially promoted oxidation of insoluble sulfide minerals to water soluble salts at low pH. As high grade metal ores start to become depleted globally, in recent decades this technology has steadily gained interest. To date, up to 20 % of the world wide copper production can be attributed to biological leaching from chalcopyrite (CuFeS2) in heap operations. However, a major drawback to overcome during the operation of such bioleaching heaps is the long lag phase typically occurring after constructing the bioheap, lasting up to three years until the release of dissolved metals. The objective of this study is to find ways to shorten this period and thus, accelerate the release of copper from chalcopyrite. In experiments with three acidophilic model species, namely Acidithiobacillus caldus, Sulfobacillus thermosulfidooxidans, and Leptospirillum ferriphilum, the rate of initial copper release has been observed to strongly correlate with the oxidation/reduction potential of the leach liquor. To influence this parameter in a way that would likewise be feasible in large scale, laboratory bioleaching experiments have been inoculated with the model species in different orders and combinations and the effect on lag phase and metal release was recorded. Preliminary results show that inoculation of L. ferriphilum, an obligate iron oxidizer, raises the redox potential to levels detrimental for copper leaching rates. In contrast, S. thermosulfidooxidans oxidizes iron at a lower rate, seemingly allowing for more selective dissolution of copper containing crystals. A. caldus appears to play a supporting role in the beginning phase of mineral dissolution. To understand the mechanisms and principles underlying these results further work is planned, including sequencing of RNA transcripts and proteins from these bioleaching environments.

Keywords

Biohydrometallurgy; Bioleaching; Chalcopyrite; Acidophiles; Copper; Sequential inoculation strategy

TRACE METAL MOBILITY IN A BLACK SHALE AREA IN CENTRAL SWEDEN

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Abstract

Black shales of marine origin formed under anoxic conditions contain trace metals like Mo, U, Ni, Zn and As in elevated amounts. The mobility and availability of such metals have been assessed in a black shale area of Cambrian age in the southern Storsjön area in central Sweden. The assessment has concerned the levels of trace elements in soil, plants and water and its possible effect on animals and humans. Soils contain more or less the same amounts of trace metals as the black shale itself in the central parts of the studied area. Plants, and notable red clover have elevated amounts of Mo and the ratios of Cu/Mo are low with a risk for molybdenosis, secondary Cu-deficiency common in cattle. However the use of Cu-fortified concentrate used by the farmers seems to effectively counteract this effect. A metal hyperaccumulator, Alpine pennycress, is found in the area with 0.8 % of Zn in dry matter. U is elevated in water and groundwater but the presence of limestones in the area makes U less uptakeable by humans and this seems not to be a sizeable problem. Arsenic (As) is mobilized under reducing conditions in another Precambrian black shale area in northern Sweden. In this area there is a pronounced topography with no wetlands and below the permissible limit in water and groundwater. As is tied to ferric hydroxides on soils and it is neither taken up by plants nor leached away with water. On the whole there seems not to be any real problems with the trace metals in the area.

However, mining of the shale has been planned for the extraction of several of the metals. About 700 Mt of black shale is planned for mining over a 30-year period. Even then after extracting, there will be left 20-30 % of the metals in the waste material. This is probably a very serious long tern threat. If the waste is placed in a wetland area there is immediate risk of mobilizing the arsenic into the water. If it is placed, as per another plan, in elevated parts of the terrain several of the other trace metals will be leached out over decades to come. In addition the risk of metal release there will be a massive destruction of an unusually beautiful landscape where people have made their living for more than thousand years.

Keywords

Trace metals, Arsenic, Molybdenum, Wastewater, Groundwater, Black shale

CRITICAL METALS FROM WASTE ELECTRONICS: METALLURGY AND BIOLEACHING

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Abstract

The annual growth rate of waste electric–electronic equipment (WEEE) is about 3–5%. This is the fastest growing waste stream in municipal wastes. Along with their environmental pollution, their high content of major, trace and precious metals in particular are regarded as a potential secondary resource when compared with ores. The main contributing metals in such electronics applications are the rare earths and platinum group metals. At present, the strategic restriction by the supplier countries made the virtual hype in the global market and will negatively impact the EU's economy. Therefore, to ensure the uninterrupted supply of such materials as well as to propose the effective mitigation of electronics waste issue, development of methodology is extremely necessary. This fascinating research area of electronic recycling attracted the separation and environmental chemists around the globe. There is growing technological potential for high metal recoveries by using mechanical, hydrometallurgical and bioleaching processes that are promising options for the treatment of WEEE.

Keywords

Critical metals; Natural resources; WEEE; Hydrometallurgy.

HARBOR MINING

SWEDEN'S LARGEST NATIONALLY FINANCED REMEDIATION PROJECT, THE REMEDIATION OF THE OSKARSHAMN HARBOR, A DEMO SITE TO DEVELOP NEW TECHNOLOGIES AND START NEW ENTERPRICES

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Abstract

The harbor of Oskarshamn is contaminated with more than 1000 tons of heavy metals, which have been accumulating since the end of the 19th century. The sediments also contain about 70 grams of dioxin of which 0.1-0.3 grams migrate to the Baltic Sea every year. This amount should be compared with the yearly total discharge of dioxin from the Swedish Industry, which is estimated to about 2 grams/year. In September 2016 Sweden's largest, nationally financed, remediation project is launched in the Oskarshamn harbor. The overall aim is to decrease the dispersion of heavy metals and dioxin from the harbor to the Baltic by 90 %. During the three year remediation, it is possible to use the remediation project as a test bed for new techniques and methods.

The municipality is seeking possibilities to use the remediation site as a demonstration- and testing ground to support the development of new environmental-friendly and innovative enterprises and to encourage scientists to engage in research concerning treatment of contaminated sediments. The municipality has a long tradition of cooperating with scientist and development of new technology, being involved with the work at the Äspö laboratory for storage of nuclear waste. It is in the same manner that the remediation project wants to offer possibilities for scientists and entrepreneurs to test new methods in a real life environment. The long term objective is to aid the development and establishing of environmental enterprises in the municipality or in the region. One possibility is a demonstration project for energy-efficient freeze dredging in difficult environments.

A large remediation site is a good environment for developing new techniques, implementing new methods and for testing new ideas. The project can also act as an inspiring force for developing new innovative enterprises. A large and interesting remediation may also become the base for municipal growth and a good support for the local industry and commerce.

Keywords

Remediation, Sediments, Heavy metals, Dioxin, Test bed

COMBATING INTERNAL LEAKAGE AND RECYCLING OF PHOSPHORUS

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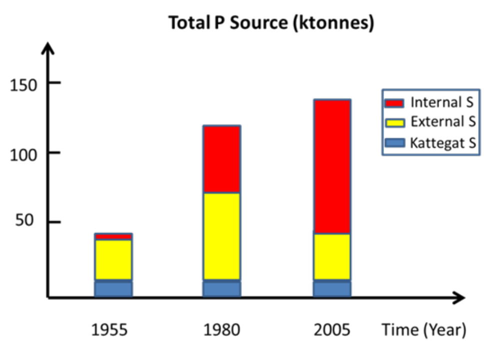
Sweden

Abstract

Internal leakage

The internal leakage of phosphorus is three times larger than the societal leakage into the Baltic Sea. According to HELCOM (the Baltic Marine Environment Protection Commission), it will take another 100 years to restore the Baltic Sea to a level of eutrophication corresponding to the levels of year 1970, provided that the HELCOM reduction targets are fully reached. Thus, further reduction of societal leakage alone will not be sufficient to curb eutrophication within the timespan of one generation.

In the Swedish Budget Bill presented in September 2016, the Swedish government describes for the first time the challenges of internal leakage in the Baltic Sea. As to internal leakage, the new challenges need to be addressed by a wide spectrum of societal fields, such as innovation, policy, economy and regulations.



The external input of phosphorus (yellow) has decreased since the 1980s. However, internal leakage (red) has increased and now account for more than two thirds of the phosphorus supplied to the water volume, according to calculations by Professor Stigebrandt.

The solution

The solution includes a method of retrieving organic sediments and incorporates other measures, like oxygenation, in order to increase oxygen levels and decrease internal leakage in deep basins. The solution will also address the need for a sustainable financing scheme, in connection to involved measures.

The method mitigates eutrophication by removing organic material, which is oxygen demanding and contains phosphorus, from dead areas of the Baltic Sea. This prevents further oxygen depletion in these areas. The method is also designed to oxygenate the bottom water, mitigating the internal flux of phosphorus by binding it to the remaining, underlying, sediment layers. The solution includes treatment processes that will turn the sediment into fertilizer and energy.

FROM SCIENCE TO PRACTICAL IMPLEMENTATION

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Abstract

Putting theory into practice is both challenging and stimulating. This lecture will mainly be based on my involvement in projects, remediation of Oskarshamn harbor basin.
During a long period of time possible measures and technologies to improve the environmental status and reduce the pollution situation in the port of Oskarshamn has been discussed and investigated by experts in several disciplines. Questions and suggestions have been tried in various instances. Finally we have come to the fact that the contaminated sediments should be removed.
During the autumn the contractor has established its plant and started dredging dewater sediments and dispose contaminated sediments. The essential task for the team on sight is to ensure that contractor's actions is carried out according to documents and the conditions that have been set up in the project. Thoughts and decisions taken during the preparatory work are now translated into a practical work.
The challenge of a larger project is to find effective ways of communication between science and practical work, to have a constant dialogue to develop, rectify the workings and effectiveness. What works in a written document does not always work in practice. Fundamental to a good result is that there is acceptance to reevaluate and to have openness to reorientation.
In my work as a supervisor in, I see the importance of guidance and communication. I want to emphasize the importance of good and cheerful conversations, a responsive leader and a responsible and interested working group. To discuss current issue, push for a free-thinking group and guide so that small parts can be added to the whole.
With good experiences from the industry, we work with visual control and shift handovers. This creates calmness in the group and we can discuss issues that surfaced during the day. We also focus on creating structures, documentation and procedures to obtain a uniform way of working as possible.
I conclude by saying that I am privileged to have the opportunity to be a part of this unique project, in its environmental improvement to the Baltic Sea and for the next generation.

WASTEWATER TREATMENT PROCESSES: MODELLING & MEASUREMENT: Part I & Part II

HEAVY METALS AND NITROGEN CONTENT OF CESSPITS SEPTAGE AND POLLUTION FLUXES IN PALESTINE

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ABSTRACT

Reports on the influence of onsite septic systems on ground and surface waters are very scarce. The main goal of this research, therefore, was to assess the pollution loads of total nitrogen (TN) and heavy metals (HM) from cesspits that serve 70% of the West Bank population. Firstly a survey was carried out to collect baseline data from two unsewered Palestinian villages. Secondly, 50 random septage (septic tank sludge) samples were collected from cesspits of various desludging frequencies, and finally 5 infiltrated septage samples were collected from a monitoring and sampling pipe installed at a distance of 1 m from a cesspit. The survey revealed that the average specific water consumption, wastewater production and septage infiltration were 58, 49, and 19 L/cap.d, respectively. The average TN concentration in septage was 297 mg/L, which decreased by 46% during transport through the soil to the monitoring well. The TN specific contribution of septage that was emptied and infiltrated was 8.5 and 3.3 g/cap.day, respectively. The average concentrations of HMs (mg/L) in the septage were Cu (0.24), Ni (0.03), Pb (0.01), Mn (0.47), Fe (12.6), Cr (0.04), and Zn (1.23). Septage content of Cu, Mn and Fe was not in compliance with the Palestinian regulations for wadi disposal and effluent reuse in agriculture. But according to municipal regulations, septage HMs concentrations allow its disposal in municipal WWTPs. There was no clear relation between the HM and TN content of septage and the desludging frequency. The septage that infiltrated contributed to as much as 15% of the total groundwater recharge from precipitation. The specific TN that is infiltrated from cesspits is equal to 29 kg TN/hectare.yr. Therefore, cesspits should be replaced with proper wastewater management system to protect both ground and surface waters.

Keywords

Onsite, Sewage, Cesspit, Heavy metals, Total Nitrogen, Water resources pollution

PHOTOLYSIS AND HETEROGENEOUS PHOTOCATALYSIS FOR REMOVAL OF EMERGING POLLUTANTS FROM WATER

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Abstract

Heterogeneous photocatalysis using the catalyst titanium dioxide (TiO_2) in a photoreaction is one of the advanced oxidation process tested in recent years for removal of pharmaceutical compounds from water. The possibility of using solar radiation is one of the main advantages of this process. The present investigation assessed the efficiency in lab-scale of photolysis only (sunlight lamp) and catalysed photolysis (sunlight lamp and TiO_2) for removal of six pharmaceuticals from Milli-Q water (N=2) after 0 min (control), 60 min and 120 min of treatment. A mix of pharmaceutical compounds in environmentally relevant concentrations (100 µg/l each) included sulfamethoxazole, ibuprofen, bromazepam, diazepam, 17α-ethynylestradiol and levonorgestrel. The detection/quantification method was established with liquid chromatography (UPLC/MS/MS Tandem Quadrupole Mass Spectrometer). Photolysis alone was able to degrade sulfamethoxazole (93-97% after 60 min and below detection limit after 120 min). However, photolysis degraded only a small percentage of hormones such as 17 alpha-ethynylestradiol (0-12% after 60 min and 10-15% 120 min) and levonorgestrel (0-15% after 60 min and 5-8% after 120 min). Photolysis was not able to degrade diazepam, bromazepam and ibuprofen under tested conditions. On the other hand, heterogeneous photocatalysis degraded to below detection limit (<DL) sulfamethoxazole, ibuprofen and 17α-ethynylestradiol already after 60 min and degraded partially diazepam (33-34% after 60 min and 48-59% after 120 min); bromazepam (34-38% after 60 min and 55-59% after 120 min) and; levonorgestrel (37-45% after 60 min and 60-73% after 120 min). These last three can be considered as recalcitrant compounds, due to the molecular complexity and resistance against heterogeneous photocatalysis. This preliminary investigation already provided new information about degradation of both bromazepam and diazepam (benzodiazepines compounds) in water using TiO_2. Future investigations include process optimization for removal of individual and mixed pharmaceuticals from real sewage using heterogeneous photocatalysis in bench scale and then, in a solar pilot reactor.

Keywords

Photolysis; Heterogeneous photocatalysis; Anxiolytic pharmaceuticals; Oestrogen; TiO_2; UPLC/MS/MS.

CATIONIC POLYELECTROLYTES BASED ON NATURAL POLYMER AS DRAW SOLUTE IN FORWARD OSMOSIS PROCESS

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Juin-Yih Lai
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Abstract

Potential of cationic starch (CS) as draw solute in FO process has been investigated in this study. The CS was synthesized by grafting 2,3-epoxypropyl trimethylammonium chloride (ETAC) onto the backbone of corn starch via etherification reaction. The successful synthesis of CS was confirmed by nuclear magnetic resonance spectroscopy (NMR) and their solution properties of CS including pH, electric conductivity, osmotic pressure and viscosity were also explored. The results of FO performance showed that CS has substantial osmotic pressure to draw water from low saline solution and its efficiency was higher at a greater temperature. The maximum water fluxes (Jw) of 4.10 and 2.20 L m^2 h^{-1} were achieved with pure DI water and NaCl (2 g L^{-1}) as feed solutions and 30 wt% CS as draw solute at 45 °C. Compared to the inorganic salt (NaCl), CS has a significant lower reverse flux (Js) due to its larger molecular weight. Moreover, the diluted CS solution was effectively separated by ultrafiltration with the rejection rate of more than 99%. To further increase water flux during the regeneration process, cross flow filltration or other recycling membrane process such as membrane distilltation is suggested. However, in overall, CS is feasible to use as a draw solution in FO process.

Keywords

Forword osmosis; Draw solute; CCationic starch; Reverse solute flux; Water flux

MODELLING EQUILIBRIUM DISTRIBUTION OF IONS AND MOLECULES IN A HETEROGENEOUS SYSTEM OF $CaCO_3$–WATER–GAS PHASE UNDER BOTH EQUILIBRIAL AND NON-EQUILIBRIAL CONDITIONS

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Abstract

In many places, including Northern Estonia, the soil bedrock is limestone, consisting mainly of $CaCO_3$. Equilibrium processes in aqueous medium involving dissolved CO_2 and solid $CaCO_3$ play a vital role in many biological and technological systems. In this study, a model for equilibrium distribution of ions and molecules in the ternary heterogeneous system solid $CaCO_3$–water–gas phase containing CO_2 under both equilibrial and non-equilibrial conditions was developed. The model can be used for the determination of concentrations of all components in the water phase over a wide range of concentrations of CO_2 in water, allowing the assessment of the impact of anthropogenic processes on the natural environment and could be usefully applied in water and wastewater technology. It can also be useful for developing innovative methods for the measurement of aqueous CO_2. As algae in water utilize dissolved CO_2 in photosynthesis, it leads to an increase in pH and bacteria will produce CO_2, which, in turn, leads to a decrease in pH. Therefore the concentration of CO_2 will vary in a large scale in the aqueous environment. The equilibrium concentrations of dissolved CO_2 in the liquid phase at a given partial pressure of CO_2 in the gaseous phase was calculated in the range of $p(CO_2)_G \cong (8.08\times10^{-7} \div 2.37\times10^{4})$ ppm at 25 °C. Quantitative evaluation of the equilibrium distribution of ions and molecules in the system $CaCO_3$–CO_3^{2-}–HCO_3^-–H_2CO_3–CO_2 at an equilibrium with gas phase identified a relevant minimum solubility of $s[CaCO_3]_{min} \cong 0.1$ mmol/L. The model has been experimentally validated.

Keywords

Calcium carbonate, Carbon dioxide, Water, Equilibrium, Ternary system.

USE OF COMPISITE SORBENT ZEOLITE – HUMIC ACIDS FOR COPPER REMOVAL FROM WATER

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Abstract

Zeolite is a natural alumosilicate material widely used as an inorganic ion-exchanger but having relatively low sorption capacity to heavy metal ions. The authors tried to improve its sorption properties via impregnation by humic acids solution. Humic acids themselves can bind metal ions in complexes but their application in pure form is not practical as they are in colloid form.

The composite sorbent was obtained in the result of sorption of humates by zeolite at pH 9.5 followed by precipitation in acidic conditions. A range of concentrations of humates used for sorbent synthesis – 100-200 mg/dm^3 - was determined for maximal removal of Cu^{2+}ions from model metal solutions. The lower concentrations did not provide a significant amount of active sited with a good affinity to heavy metals. The higher concentrations resulted in the worsening of copper sorption due to the filling of pore volume by humic acids and the reduction of sorption surface area. The application of composite sorbent provided 20% lower residual copper concentration compared to non-treated zeolite at sorption from 60 mg/l metal solution.

Sorption process followed pseudo-first (Lagergren) and pseudo-second kinetic models. Calculated specific sorption values were close to experimental numbers. As defined from Weber-Morris diffusion model, the sorption process was limited by intraparticle diffusion. The improved sorption capacity could be attributed to humic acids were precipitated in macropores and provided additional sorption sites. Humic acids due to their large size did not penetrate to micropores of zeolite that's why diffusion coefficients for non-treated and modified sorption materials were equal.

The impact of the presence of Ca^{2+} and Na^{+} ions on sorption efficiency of Cu^{2+} sorption from model solutions was also studied.

Keywords

Zeolites, Humic Acids, Composite Sorbent, Sorption, Heavy Metals, Kinetics, Diffusion, Weber-Morris Model

EFFECT OF LIGHT INTENSITY ON ALGAL BIOMASS ACCUMULATION AND NUTRIENT REMOVAL

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Abstract

Biological wastewater treatment methods can balance wastewater characterizations. Conventional biological methods such as anaerobic digestion are able to handle high organic loads. These methods cannot satisfy the environmental organization requirements. Today biological post treatments for the removal of the remaining organic matters such as COD, nitrogen and phosphorous received special attention. Microalgae are used as post treatment for consuming the remaining organic matters in the treated wastewater. Different species of microalgae are able to treat these effluent. Microalgae are able to fix CO_2 and produce biomass for biofuel production as well. In this study, *Chlorella sp*. was used for biomass production and nutrient removal. Pretreated wastewater was used as culture medium for Chlorella sp. The effect of light intensity on *Chlorella sp*. growth and nutrient removal was investigated. Results showed that the best light intensity for maximum biomass production, nitrogen and phosphorus removal was 4600 lux. Under this condition, *Chlorella sp*. was able to reduce the total Kjeldahl nitrogen and nitrate concentrations by 70 and 85%, respectively. Total phosphorus removal by the algae was nearly 100%. Also, maximum biomass accumulation (2.36 g/L) and specific growth rate (0.473 day-1) was obtained at the end of cultivation. Present research introduced *Chlorella sp*. as a potential strain for biomass production and nutrient removal which was cultivated in pretreated waste water.

Keywords

chlorella sp., TKN, TP, Light intensity

LEACHATE PREDICTION FROM A PILOT SCALE LANDFILL LYSIMETER

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Abstract

The leachate management in a landfill is very important in terms of both quantity and quality. The leachate collection and treatment system in a landfill has to be designed carefully keeping the leachate production minimum. The leachate generation depends upon the climatic conditions of specific location and can be controlled by properties of materials of layers used in any landfill and analyses of water balance. This paper presents the outcome of the study on the water balance of landfill in Nepal using a pilot scale landfill lysimeter. The related leachate production (percolation) as an effect of climatological factors has been assessed. The Hydrologic Evaluation of Landfill Performance (HELP), a computer model has been used to compute estimates of water balances and compared with the actual leachate (percolation) measurement.

It was found out that the percolation generally follows the rainfall trend but the evapotranspiration is more or less similar at certain default conditions. With the simulation carried out, it indicates that the evapotranspiration (ET) is nearly constant and do not exactly follow the rainfall and percolation trend. The percolation or leachate production varied in the range of about 78-86% per year whereas evapotranspiration is about 15 to 21% (18% on an average) of the rainfall amount in this research, the leachate production rate being about 2.63 liters/m2/day on an average, the percentage is compared to be high with other research. The response of average percolation and evapotranspiration with change of hydraulic conductivity values of barrier soil liner is very important. With the change of order of 10-6 to 10-7, there is drastic change in the results. This provides an important design consideration of landfill, where hydraulic conductivity values of barrier soil liner is deciding parameter and should be in order of 10-7 or lesser. When less or no percolation is observed, there will be a leachate mound in the layers above barrier soil liner, which needs to be collected from drainage layer and sent to treatment. Another important parameter observed is field capacity of waste, which has been simulated under various conditions. The FC value of 0.292 vol/vol and hydraulic conductivity (HC) of 0.001 cm/s seems to best fit during statistical analyses.

With the present results, we can say that hydraulic conductivities of the soil are influencing parameters, whereas waste parameters (field capacity and hydraulic conductivity values) have significant impact in water balance. Thus the controlling parameters such as hydraulic conductivity of cover and barrier soil and waste hydraulic properties can change the operation of landfills with respect to water management.

Keywords

HELP model, Leachate, Lysimeter, Simulations, Water balance

WASTE MANAGEMENT ON A GLOBAL SCALE

PERFORMANCE FACTORS AFFECTING SOLID WASTE MANAGEMENT SYSTEM IN DEVELOPING COUNTRIES

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Abstract

Solid waste management is a challenge for the cities' authorities in developing countries mainly due to the increasing generation of waste, the high costs associated to its management, the lack of understanding over a diversity of factors that affect the different stages of waste management, the linkages necessary to enable the entire handling system functioning and governance issues. The objective of a research done in 22 developing countries in 3 continents was to determine the stakeholders' action/behavior that have a role in the waste management process and to analyze influential factors that affect the performance of a waste management system. A combination of methods was used in this study in order to assess the stakeholders and the factors influencing the system in those cities. Data was collected from scientific literature, existing data bases, observations made during visits to urban areas, structured interviews with relevant professionals, exercises provided to participants in workshops and a questionnaire applied to stakeholders. Descriptive and inferential statistic methods were used to draw conclusions. The outcomes of the research are a comprehensive list of stakeholders that are relevant in the waste management systems and a set of factors that reveal the most important causes for the systems' failure. The information provided is very useful when planning, changing or implementing waste management systems in cities.

Keywords

Integrated solid waste, Management, Generation rate, Quality, Stakeholder, Influential factor, Developing countries

THE IMPORTANT ROLE OF LANDFILLS IN THE CIRCULAR ECONOMY

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Abstract

Circular economy is about creating an economy where the resources we take in use, is kept in circulation (recycled) after end of use rather than being burned in an incinerator or end their life in a landfill.

Disposal and Landfilling is not always the worst option, and European countries that still landfill 70-80% is not a sustainable solution. It is a fact that landfilling of waste contributes negatively to the environment and climate agenda, but is mainly because some countries still allows depositing of biodegradable waste that produces landfill gas such as methane. Contaminated leachate and other environmental pollutants, we can basically manage and treat properly, if you are committed to operating the plants optimally and comply with national, European rules and standards.

As long as hazardous substances can accumulate in the environment and still is permitted for use in products and goods, as long there will be a risk that the substances is released into the environment when they are subsequently reused or recycled.

We as a society have a commitment to phase out and eliminate these substances (possibly the entire product) from the circulation and the economic cycle. But unfortunately this principle doesn’t work very well with the objective of promoting recycling at any price and the circular economy, where as much as possible should go back into the circuit.

There are many advantages (and necessities) connected to the circular economy. In Denmark and some other countries, it is old wine in new bottles. Recycling and reuse is not new to us. Focusing on fulfilling European recycling targets without at the same time ensuring the quality of recycling can lead to an unacceptable impact on the environment and human health. The hazardous and harmful substances must as soon as possible be removed out of the "circulating" stream

The circular economy and way of thinking must be combined with opportunities for decontamination and disposal of heavily contaminated flows, which it from an overall resource point of view does not pay to treat and "recycle". A that point landfills play an important and natural role in the circular economy, and contributes to better resource management of materials that should not be, can or should be recycled and which MUST be removed from the recycling circuit and -cycle.

The vision and thinking of no waste going into landfills is beautiful but also unrealistic. Instead of considering the landfill of waste as a problem, we need to think in new directions and developing the area and strategies where landfills are incorporated and get a place in the circular thinking, which my presentation will focus on.

Keywords

Landfill, Landfill Mining, Temporary Storage, Landfill Aftercare, Risk assessment, Circular economy, Landfill strategies

USING THE INTEGRATED PLANNING GUIDE FOR THE SELECTION AND DESIGN OF A MULTI-PROCESS STRATEGY FOR THE BIOREMEDIATION OF TOXAPHENE AND HEAVY METAL CONTAMINATED SOIL IN CHINANDEGA

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Abstract

The application of pesticides and inappropriate soil management during intensive cotton farming in Chinandega (Nicaragua) has left the soil with high residues of toxaphene and several other toxic metalloids and heavy metals from the overuse of chemical fertilizers. Remediation of soil is complex and most effective remediation approaches are relatively expensive and uses technologies that are energy-intensive.

The selection of appropriate and low-cost approaches for soil remediation requires a structured and systematic process to ensure reliable outcomes with low environmental impact, especially in developing countries where the cost and the energy content of remediation measures are a limitation. The Integrated Planning Guide which is a fusion of the concepts of Ecological Engineering and the Framework for Strategic Sustainable Development was used in the identification and design of some applicable and efficient approaches for the clean-up of soil in Chinandega.

This resulted in the design of a multi-process bioremediation strategy that meets the sustainability criteria of the Integrated Planning Guide and that has the potential to degrade toxaphene and remediate heavy metals and metalloids in the soil using Jatropha curcas L. for phytoremediation in combination with bioaugmentation, biochar as a soil amendment, and the use of biochar and alginate as carriers of toxaphene degrading inocula.

Keywords

Ecological Engineering, Framework for Strategic Sustainable Development, Toxaphene, Bioaugmentation, Phytoremediation, Jatropha curcas L., biochar, alginate

TENERIFE+SUSTAINABLE. WASTE MANAGEMENT MODEL FOR ISLAND TERRITORIES

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Abstract

Tenerife is a first-class mass tourism destination. The island receive 5 million tourists every year, and have a resident population of 800,000 inhabitants. Waste management is a key factor in sustainability and quality tourism. The island generates close to 500,000 tonnes of waste per year. The Island Council is responsible for waste planning, management and treatment for the entire island. Collection of Municipal Solid Waste is municipal competence.

The Island Council, Cabildo de Tenerife, has developed the project Tenerife + Sustainable to implement a new waste management model, based on minimization and circular economy. Tenerife + Sustainable is a holistic project for waste management and social awareness. Our aim is a new culture of waste, focused to reduce the consumption of raw material and combat climate change. The project involves different stakeholders like people, schools and enterprises, among others.

The basis of the project are Sustainable Development Goals, focused to responsible consumption and production, sustainable cities and communities, innovation and climate action, so like well-being and reduced inequalities . Tenerife + Sostenible aims at "doing more and better with less", increasing economic growth by reducing resource use, degradation and pollution, avoiding more landfills.

We adapt this aims to the insular approach. Tenerife is a medium scale island, focused on mass tourism and with a high density of population. Landfills aren´t an alternative; we haven´t enough territory, a high biodiversity and scarce water resources complicates the situation.

Tenerife + Sostenible is a holistic strategy to promote Sustainable Development from waste management. So, European regulations on waste becomes an opportunity for a new culture of sustainability, introducing concepts like circular economy, economy for the common good, waste minimization, reusing and recycling, and innovation to promote green economy and jobs.

BEYOND POLICIES: MANAGING SOLID WASTE IN DEVELOPING COUNTRIES THROUGH STAKEHOLDERS PERSPECTIVE AND INFRASTRUCTURAL DEVELOPMENT

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Abstract

Increased waste production, poor waste management infrastructures, and stakeholder's participation has limited waste management in overseas and developing countries. Specifically, waste management infrastructures have been influenced by conflict (disagreements between stakeholders) over limited land and economic resources. This conflict is evident in both overseas and developing countries where public complaints prevent development of waste infrastructures. In this study, conflict in waste infrastructural development was investigated using workshops, interviews, and questionnaires to understand stakeholders' views on waste management infrastructure.

The scientists used content analysis to identify priority themes that drive conflict and limit improved waste management in developing countries. Interactions were examined between stakeholders (households, scavengers, and government authorities) using the interviews and workshops, and drew conclusions. Findings suggest that, different stakeholders' perception to waste management infrastructural development. While some stakeholders (percentage) are unwilling to release land for waste management infrastructure, others (percentage) are concerned about the economic loss associated with land ownership. We propose three steps to addressing stakeholders concerns, which include effective policies, alternative livelihood, and robust funding. Governments will need to take these pragmatic steps to address current waste management infrastructural concerns.

Keywords

Waste; Conflict; Resources; Infrastructure, and Awareness

MUNICIPAL PARTNERSHIP BETWEEN VÄXJÖ MUNICIPALITY AND AN GIANG PROVINCE IN VIETNAM

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Abstract

Project Green Vietnam is a result of several years of collaboration between Växjö municipality and An Giang province in Vietnam. The project is financed by the municipal partnership cooperation ICLD (Swedish International Centre for Local Democracy). Municipal partnership is a form of cooperation financed by Sida with the purpose to have an exchange of knowledge and to promote the democratic process and a sustainable society.

The three-year project's overall goal is to achieve an improved waste management and planning capabilities that contribute to sustainable waste management in the city of Long Xuyen, An Giang province. The project objective is to guide the development of a Waste Management Plan where relevant objectives, methods and activities are defined. The Waste Management Plan must then lead to an increased capacity to establish a functioning waste management system in Long Xuyen.

It is crucial that there must also be a mutual interest in partnership in which Swedish municipalities and regions benefits from the projects. The benefits could be such as: building the skills of municipal officials and politicians, developing methods, the contribution to a global and sustainable development through good practices, exchange ideas with other experts who have a different perspective, be inspired to new solutions, learning to work on international arena, and creates the attractiveness of the municipality as an employer.

INDUSTRIAL WASTEWATER

MODIFIED BIOMATERIAL SORBENTS AND PEAT FOR METALLOID AND PHOSPHOROUS REMOVAL

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Abstract

The present work investigates metalloid arsenic, antimony and tellurium as well as phosphorus sorption using iron oxohydroxides modified biomaterials (peat, straw, sawdust, moss, reed, and sand). The results were obtained using batch tests, and the sorption was studied as a function of initial metalloid concentration, pH and temperature. The optimal pH interval for the sorption of each studied element could be established and, for example, for Sb(III) is 6.5–9 and for Sb(V) – 3–6, while tellurium sorption using Fe-modified materials is favourable in a wider interval of 3–9. The impact of temperature on the metalloid and phosphorous sorption capacity of Fe-modified biomaterials was tested at four temperatures: 275 K, 283 K, 298 K, and 313 K. The sorption capacity increased with increase in temperature for all of the studied metalloids. The calculated thermodynamic parameters suggest that the sorption process is of a spontaneous nature and endothermic.

Keywords

Antimony, Arsenic, Biomaterial sorbents, Modification, Metalloids, Sorption, Tellurium, Phosphorous

EXPERIENCES OF COLLABORATIVE PROJECTS BETWEEN INDUSTRY AND ACADEMIA

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Abstract
The foundation for development and continuous improvement are increased knowledge, evaluation and monitoring of performance. Environmental issues are not often the highest priority in the business idea for an industrial activity. Therefore, it is particularly critical to establish cooperation between industry and academia in regard to environmental and resource issues.

In order to achieve a successful project it is important that there are clear, common goals of cooperation and understanding for each other's roles. Shortcomings in mutual understanding between partners puts the project at risk of missing its intended goal or purpose. Industry, by its nature, has a different starting point for cooperation than academia. Therefore it is vital that there is a mutual understanding and recognition of the objectives, planning and implementation in order to achieve a successful outcome.

Environmental issues in general and water issues in particular have received considerable attention from different perspectives, financially and morally, but mostly as fundamental resource issues for society and nature. Financial Interests have increased its scrutiny of how industry handles these issues. Therefore, one must be able to show good examples.

Increased cooperation with academia is a way to gain greater knowledge of the environmental impact of industrial processes in order to implement sound environmental practices. Maintaining open and factual communication between various stakeholders, from customers to financial institutions is imperative. And it requires that the industry partner communicates, at a scientific and transparent level, the work being done.

There are several aspects that need to be improved upon to create better cooperation between industry and academia.

- Increase participation in venues of various types and activities where extensive networks can be formed.
- Understand that each cooperation leads to increased knowledge and experience, both in academia as well as industry.
- Collaborative projects and research should have the potential to run long enough as to develop offshoot projects all sharing a common ground. And projects should run long enough in order to achieve the major transformational shifts that take time to mature, both in the necessary decisions to be taken and in their implementation.

Good cooperation combined with the exchange of experiences and knowledge in different areas of expertise offers no limits as to what can be achieved. In this time of great global environmental challenges, each meeting is a like a drop of water, and *one of these drops could be the one that caused the cup to overflow.*

EXPERIENCES OF COLLABORATION PROJECTS BETWEEN ACADEMY AND INDUSTRY

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Abstract

Ever since I began with research I have worked in cooperation with trade industry and usually together with companies and municipalities. It has been a good way to get co-sponsorship for the research and help with measurements and chemical analyses performance. Today many research councils have the demand that the research shall be linked by 50% or more to the industry. The Triple or Quadruple Helix concepts lead to cooperation with trade and industry to solve appearing problems in society calling for being solved. This paper presents experiences of cooperation with several companies: one in the wood floor manufacturing industry, two chemicals suppliers, one utilizer of the wood waste from the industry and producing energy to the industry, two manufacturers of industrial waste water treatment. A special training program was practiced in order to put all participants on the same project knowledge level and overcome tensions among the members of the project team. There were participants of different gender, age, experience and hierarchy level. The project was unique as it gave possibilities for 5 PhD students working in cooperation trying to solve the same water treatment system and for us it is not common that so many students get possibility to work in the same research project. The project will also end up in a Demo treatment plant for processing water and developing wetland system for transformation of stormwater for the use of irrigation of logs. The project ended up in a high amount of scientific and conference papers as well as established new doctors that is crucial target for the academy.

Keywords

Industrial process water; Stormwater; Treatment; Wetland; Reuse of water; Cooperation; Triple Helix

EFFECT OF INDUSTRIAL BY-PRODUCTS AND pH ELEVATION ON HEAVY METAL REMOVAL FROM ACID MINE DRAINAGE

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Abstract

Wastewater produced in the mining industry, so called acid mine drainage, is typically very acidic and high in dissolved metals and, thus, poses serious environmental risks. Wastewater treatment is traditionally done by using manufactured chemicals which is neither environmentally nor economically sound. The use of industrial by-product geomaterials is a low-cost alternative method as these materials are anyway produced in other industries. In wastewater treatment with geomaterials, the heavy metal removal mechanism is based on precipitation and surface adsorption which are highly pH dependent.

In this study, acidic multimetal wastewater from Talvivaara mine was treated with three solid byproducts (steel slag, apatite mine tailings and Sachtofer PR) of Finnish industries; and the effect of geomaterials and incubation time on heavy metal removal from the wastewater were studied. Waste water was incubated with the geomaterials for 1, 7 and 21 days. To equalize the pH in different treatments after incubation, pH of all the samples was raised to 7. Concentrations of iron, aluminum and nickel were measured with ICP-OES, at the beginning of the experiment and after pH rise. As expected, elevating pH was the driving factor for element removal. Among the used solids, steel slag showed the best results in element removal. It removed all or virtually all dissolved iron, aluminum and nickel from the wastewater. Tailings and Sachtofer PR showed poor results regarding heavy metal removal from the solution.

Keywords

Acid mine drainage (AMD), Wastewater treatment, Heavy metals, Geomaterials, Steel slag, Tailings, Sachtofer PR

SUSPENDED SEDIMENT PREDICTION USING WAVELET WITH RBF-ANN AND SVM

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Iran

Abstract

In this study wavelet radial basis function artificial neural network (WRBF-ANN) and wavelet support vector machine (WSVM) model is proposed for daily suspended sediment (SS) prediction in river. These models are achieved by combining discrete wavelet analysis with support vector machine (SVM) and radial basis function artificial neural network (RBF-ANN). Daily discharge (Q) and SS data from Yadkin River in the USA are used. The root mean square error (RMSE), correlation coefficient (R) and coefficient of efficiency (R^2) are used to evaluate the models. Results demonstrated that WRBF-ANN with RMSE =2167.98 ton/day and R^2 =0.91 were more desired than the other model with RMSE =3294.61 ton/day and R^2=0.838. Comparisons of these models revealed that, RMSE and error standard deviation for WRBF-ANN model were about 0.34% less than WSVM model in test period.

Keywords

Discrete wavelet analysis; RBF-artificial neural network; Daily discharge; Suspended sediment; Support vector machine

'ECOLONOMY' DOING BUSINESS AND MANUFACTURING DIFFERENTLY: FRENCH EXAMPLE - POCHECO

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Abstract

Multinational giants may very well carry on playing dinosaurs for a few more years, exhausting non-renewable resources through their arrogance and blindness. We, the people, will probably be able to do nothing about it…for a while. But if the (more or less silent) hordes of small companies and their teams, count for nothing on their own, together we can move things forward and give weight to our actions. We can plan balanced development for our business without basing everything we do on growth. Besides, nothing grows forever.

So then, how can we « ecolonomise » ? I suggest we think about a few simple and efficient rules. A french company called POCHECO has been using them for over fifteen years and they are still here to tell the tale !

Keywords

Ecolonomy, Circular economy concept, Growth, Innovation and environmental entrepreneurship, French company, Waste management, Sustainable development.

EVALUATION OF POTENTIAL IMPACT OF INDUSTRIAL WASTEWATER TO BIOLOGICAL WASTEWATER TREATMENT PROCESSES

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Abstract

Biological processes are the cheapest methods for treating municipal as well as industrial wastewater. However, wastewater from different industries may contain pollutants which are inhibitory biological treatment processes. Reduction of wastewater treatment (WWT) efficiency may lead to increased loads of pollutants in the effluent. In order to maintain the efficiency of WWT processes or to identify the origin of inhibitory compounds, it is necessary to evaluate the impact of wastewater to wastewater treatment processes. Today, several methods are used for this purpose: ISO 8192 for assessing inhibition of oxygen consumption by activated sludge, ISO 9509 for assessing the inhibition of nitrification of activated sludge microorganisms, ISO 9888 for evaluating the aerobic biodegradability of organic compounds. However there are some processes that are not covered with the aforementioned methods and therefore complete impact cannot be found. In this study, methods for evaluation of the impact of industrial wastewater to biological phosphorous removal and denitrification processes were developed and tested. Combination of these five methods will give the basis to predict potential impact of wastewater to biological WWT as a whole.

Keywords

Industrial wastewater; Inhibition; Denitrificaton; Biological phosphorous removal

DETERMINATION OF KINETIC PARAMETERS IN INTEGRATED FIXED FILM ACTIVATED SLUDGE FOR AMOL'S INDUSTRIAL PARK WASTEWATER TREATMENT PLANT

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Abstract

Amol industrial park treatment plant (WWTP) collecting the effluent from a number of industries such as fruit juice and meat processes plant, poultry processing plant, glass industrial unit, paperboard factory, tomato cannery, dairy farm harvest and many more small plants. The wastewater treatment plant was monitored for a period of six months (Winter 2012 and Spring 2013). The aim of the present study was to demonstrate how effectively a well monitored Integrated Fixed Film Activated Sludge (IFAS) system can be operated. The value obtained for the COD removal efficiency range was between 98 to 99 percent. The data obtained were fitted by the kinetic models described in this paper and also the kinetic coefficients such as the endogenous decay coefficient (Kd), the growth rate constant (KS), rate constant (k) and yield coefficient (Y) range were determined between 0.062-0.121 d^{-1} , 54.7-215.2 mg/l, 2.6-10.3 d^{-1} and 0.419-0.502 mg/mg, respectively. Results showed that except Ks other coefficient were in the normal range. There is a direct relationship between the variation of Kd and Ks with effluent substrate concentration. But, the relationship between K and effluent substrate is reversed. Finally, the effect of sludge retention time (SRT) on COD removal and sensitivity analysis was conducted.

Keywords

Attached Growth, Integrated Fixed Film Activated Sludge, Kinetic Coefficients, COD Removal.

POSTER SESSION

MODIFIED SEQUENCING BATCH AIRLIFT REACTOR CAPABILITY IN MTBE REMOVAL

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Abstract

The aim of this study was to investigate MTBE removal efficiency using Sequencing Batch Airlift Reactor (SBAR) and to determine the share of aeration and adsorption processes during the operation. The present study was conducted with a new design of the system (cubic area and embedded baffle). The reactor was applied in 4-h cycles, which included 2 min filling, 210 min aeration, 5 min sedimentation, 8 min draw, and 15 min idle time. One week after start-up, the initial brown granules were observed. During the operation, some granules were formed with the size of 2–6 mm, average settling velocity and density of 0.66 cm/s and 0.06 g/mL, respectively. The results showed that COD removal efficiency was over 94 percent.

Keywords

Aerobic bio-granule, COD, Diameter, Density, MTBE

COMPETENCE APPROACH IN THE EDUCATIONAL PROCESS OF STUDENTS-ECOLOGISTS

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Abstract

An increasing number of international projects, academic mobility, inclusive education students make a tangible contribution to the development of intercultural relations conducive to the formation of a tolerant multicultural society . The use of competence-based approach and new methods of distance education increases the efficiency of training of foreign students-ecologists.

Main methodological approaches used in modern domestic pedagogics, when competence approach are:

- system;
- activity;
- practice-oriented;
- acmeological;
- cultural-ecological .

Most members of the "pedagogical" areas agree that the study of the integral educational process is only possible from the standpoint of system approach, allowing to represent it as a pedagogical system that includes components such as: content of training; training facility; training of students; the forms and methods of teaching; educational and scientific activity of teachers.

Have to agree with the prevailing opinion that the concept of "educational process" is somewhat broader than the concept "pedagogical process", since the education includes, apart from teaching, still a variety of managerial, social, cultural, psychological-pedagogical, medico-pedagogical, economic and other related aspects of educational activities.

The problem of changing paradigm of the educational process for the University today is a major. You can accept a position, according to which – purpose "paradigm of learning" is not to improve the quality of teaching (“teaching”). In fact – it is a means to achieve, and the goal is to continuously improve the quality of learning (“learning”), the productivity of education. This statement of principle student-centered approach to learning is still underestimated by the Russian representatives of the pedagogical science and practice. Competence-based approach defines learning as a base for development of competences included in the primary outcome of the educational activity – that is, a set of competencies which enable students effectively to socialize, to maximize the voi of the creative and intellectual abilities.

It is increasingly clear that the competence approach, which allows to implement new labour market requirements, can be fully applied, if there is no common understanding and certainty in the approach to the content competencies.

Reusable periodicity and the possibility of repeated training and self-assessment helps the student to improve their knowledge and skills in preparation for competition in physics. The teacher gives the task via the Internet in MOODLE system. Student house in the reading room or computer class gets the possibility of multiple repetition and the appeal to the examples and tasks and also to manage their time and to mobilize their abilities depending on the level and complexity of the examples and problems– that is, it is the timing and duration of multiple attempts assignments in physics.

The authors Express their sincere gratitude for the discussion of the results of the work for Professor Dmitry Germanovich Arseniev (Russia).

NUCLEAR MAGNETIC SPECTROSCOPY TO IMPROVE THE SUSTAINABILLITY AND REPRODUCIBILITY OF CROPS

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Abstract

Nowadays one of the actual problems is creating reliable and fast methods of rapid control of condensed matter, which allow acquiring information about the deviation from standard state on site of measurement. Especially it is necessary for various researches with using of condensed mediums, biological solutions and liquid fertilizers and in cases of checking the production quality (e.g. commercial production or customs control).

In this article, one of the possible ways for creating fast and reliable methods of rapid control of liquid mediums used in agriculture is considered. Using small NMR spectrometers allows determining the deviation degree of considered medium from standard state. Further processing of registered NMR signal with wavelet transform gives us a possibility to detect composition and relative components concentrations for a number of researched mediums. Results of the experimental researches of different mediums are shown.

Overview of the different publications showed that the problem of effective rapid testing of liquid media is very relevant for agriculture. Especially when using a liquid fertilizer which have long kept. The researches have shown that usage of compact NMR spectrometers for rapid control of liquid mediums might become the solution for this problem. With measured T1 and T2 relaxation times of the researched mediums, one could designate the deviation degree from normal state on site of measurement with an error no more than 1%. Besides measurements with NMR spectrometer do not change the chemical composition and physical structure of medium. All of this makes the offered method of rapid control using NMR spectroscopy demanded in different areas and shows the necessity of further research for improving its functional capabilities. The promising approach is to use the wavelet transform for processing the detected NMR signals.

Wavelet analysis provides a unique possibility to recognize local and "thin" signal (function) features and to get the spectral components of the signal. It allows using wavelet analysis for processing the NMR signals, which were registered from mixtures of liquid mediums formed by substances similar in chemical composition and physical structure (e.g. a mixture of fertilizer or aqueous solutions of soluble salts). By mixing these mediums there is no dissolving of one medium into another and a conglomerate is forming that has a quite homogeneous character if the mixing have been done qualitatively. Acquired NMR signal from such a mixture is a sum of signals from each component in the mixture.

This is particularly important for environmental monitoring in agriculture.

CLIMATE CHANGE IMPACT AND WATER TREATMENT

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Abstract

In Nepal Climate changes have implications on reduction of snow pack on the mountains, water supply shortages, increase forest fires, increase in extreme weather, increase demand for irrigation, decreases power generation; wells dry up due to lower water table. Climate change seeks the two actions on the mitigation of greenhouse gases and adaptation to the climate change. This paper also describes the climate change issues of Nepal; similarly it deals with the potential threats of climate change to water Supply, agriculture and food security, temperature increase, run-off patterns, glacial melt and floods.

Keywords

Temperature rise, Glacial melt, Water treatment.

ENVIRONMENTAL TOXICITY OF GLASSWORKS LANDFILL SOILS

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Abstract

Following over 200 years of industrialization, soil contamination is a widespread problem in many countries. Contaminants, especially heavy metals and persistent organic compounds, can still be found at high concentrations decades after the emissions have ceased. One important part of this industrial heritage is the heavy metal contamination of soil and landfills around glass factories, with complex relationships between contaminants, the natural hydrogeochemical environment and biota. In southeastern Sweden lies the so called "Kingdom of Crystal", with a long tradition of artistic glass production and elevated concentrations of a range of metals found in soil and landfills of the glassworks sites. Because high total concentrations may not always translate into a high mobility, bioavailability, and toxicity, research on biological effects has been deemed necessary to delineate the severity of contamination.

For the present study, soil samples from landfills and control areas were collected at five glassworks in the Kingdom of Crystal *(*Bergdala, Målerås, Kosta, Johansfors and Orrefors). E*ach landfill site was heavily contaminated with various metals. As, Ba, Cd, Pb, Sb and Zn were the major contaminants, exceeding the guideline values of Swedish legislation.* Total concentrations were found in the range 64-7800 mg As kg^{-1}, 30- 600 mg Ba kg^{-1}, 0.16- 3 mg Cd kg^{-1}, 160-38000 mg Pb kg^{-1}, 0.40-56 mg Sb kg^{-1}, and 45-1100 mg Zn kg-1. To test for biotoxicity, a battery of tests with species of varying sensitivities and exposure pathways were applied. Evaluation of *plant toxicity to* Lepidium sativum *demonstrated the lack of difference between biomass production between the soils from contaminated landfill sites and control areas. Similarly,* elutriates from both metal contaminated and reference soils implied low toxicity to the photobacterium Vibrio fisheri. However, significant reduction in the numbers and biomass of enchytraeids was observed in the landfill sites of Bergdala, Kosta, Johansfors and Orrefors. Also the numbers of nematodes tended to be reduced in landfill sites. Altogether, the obtained results provide a better understanding of the complex historical contamination by evaluating biological responses at different levels.

Keywords

Metal contamination, Glass industry, Biotoxicity, Heavy metals

METHANE EMISSIONS IN PREVIOUSLY EXCAVATED KUDJAPE LANDFILL

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Abstract

Landfills are one of the largest sources of anthropogenic methane. Therefore, the emission of methane should be prevented or reduced to minimum. During the closure project of Kudjape landfill, about 55 000 m^3 of previously disposed waste was excavated and sieved. The main objective was to extract fine fraction and use it for construction of methane degradation cover layer for the whole landfill. The aim of the research was to study the efficiency of methane degradation layer to oxidize methane. Fieldworks were made two years after the cover layer was installed at Kudjape landfill. Methane and carbon dioxide emissions were monitored during a period of nine months. The measurements were carried out six times in twenty-nine measuring points on top of the layer and once at a depth of 50 cm. Additional measurements were done in the area of the highest leakage of methane. All measurements were done by static chamber method.

As the result of the study it appeared that the methane and CO_2 emissions were very small or none. Methane was detected each time only from two measuring points out of twenty-nine and the values were low. Spatially presented results demonstrate slight variations of CO_2 emissions over time. The highest methane emission was spotted through a clearly defined U-shaped area of just 1.9 m^2; located on top of the landfill. According to the results, landfill mining may be considered as a useful tool for sustainable closure of small to medium landfills. Methane degradation layer may well be made from excavated fine fraction. Spots with somewhat higher leakage of methane refer on a need for repair actions.

Keywords

Landfill gas; Methane emission; Methanotrophs; Methane degradation layer; Landfill mining

DO FISH, SHELLFISH AND FISH CAUGHT IN LAKES AND STREAMS NEAR CONTAMINATED GLASSWORKS SITES CONSTITUTE A HEALTH RISK?

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Abstract

In the geographical area ”The Kingdom of Crystal”, in Småland, 26 former glass work sites have been highly classified as contaminated by metals, emissions from glass manufacturing. Characteristic metals from such activities were arsenic, cadmium and lead. Different exposure pathways could be identified, risking the health of the people living near the glass work sites. Such an exposure pathway could be through consumption of self-caught fish and crayfish.

The aim of this study was to collect samples of self-caught fish and crayfish to analyse the concentration of arsenic, cadmium and lead in fish and crayfish caught in the lakes, identified in previously studies.

In total 8 fish samples and 33 crayfish samples were collected. The analyses revealed that the average crayfish sample contained higher concentrations of arsenic, cadmium and lead, than the average fish sample.

In the study exposure assessments were conducted through deterministic methods and also through Probability Bounds Analysis. The calculations indicated that there was a risk of an exposure of arsenic associated to people eating a large amount of self-caught fish and crayfish. The exposure was strongly dependent on how large the consumption was but also the different limits used for comparison in the risk characterization.

Keywords

Fish, Crayfish, Arsenic, Lead, Cadmium, Contaminated glass work sites, Exposure assessment, Probability Bounds Analysis

MAGNETICALLY SEPARABLE Ag_3PO_4/Fe_3O_4COMPOSITE : PREPARATION AND VISIBLE-LIGHT PHOTOCATALYSIS

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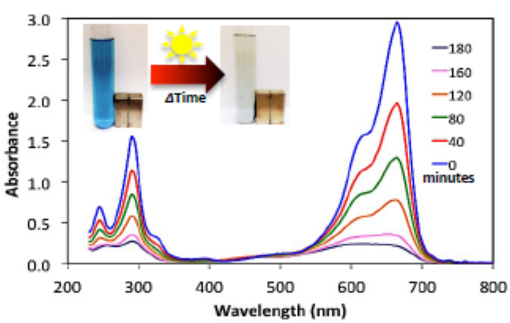
Abstract

In this study, magnetic Ag_3PO_4/Fe_3O_4 visible-light photocatalyst was successfully prepared by ionic exchange followed by coating of Fe3O4 nanopowder on the crystalline Ag_3PO_4 particles. Powder X-ray diffraction (XRD) and field emission scanning electronic microscope (FE-SEM) were used to characterize the powder products and the photocatalytic activity of Ag_3PO_4/Fe_3O_4 was evaluated by decolorization of methylene blue (MB), as a model organic pollutant, under visible-light irradiation. The photocatalytic results indicate that the as-prepared Ag_3PO_4/Fe_3O_4 particles were efficient to degrade organic pollutants under visible light and the photocatalyst itself could be easily separated from the aqueuse solution using external magntic field. This work shows a great potential of Ag_3PO_4/Fe_3O_4 composite particles for environmental purification of organic pollutants.



Keywords

Magnetic separation; Visible-light photocatalysis; Silver phosphate, Ag_3PO_4/Fe_3O_4

APPLICATION OF FENTON PROCESS FOR COD AND PHOSPHORUS REMOVAL OF CATTLE MANURE EFFLUENTS

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Abstract

Advanced oxidation processes (AOPs) are series of new, novel technologies in wastewater treatment. Such processes are able to treat high organic loading rate and toxic wastewaters by means of chemical oxidation. Fenton process, as an important subunit of AOPs, is a kind of newly enhanced methods that is used in wastewater treatment plants (WWTP). The reaction consists of at least two essential chemical compounds: H_2O_2 as an oxidant and $FeSO_4$ as catalyst which are used in oxidation process. For ease of operation (running at room temperature and atmospheric pressure), it does not required long retention time and cost-effectiveness of the chemicals are some of the advantages that are reported in literatures. Results of number of experimental data in different fields of studies such as textile, cosmetic, dye, olive-oil mill and pharmaceutical wastewater proved that it would be capable method in recalcitrant compounds removal like specific antibiotics. It is also able to decrease high organic and inorganic contaminants like phosphorus, heavy metals or particular dyes. In present study, the feasibility of Fenton reaction on COD and phosphorus removal of livestock wastewater is investigated. A COD removal of 84% was obtained at the optimum conditions such as H_2O_2/COD andH_2O_2/Fe^{2+}ratio of 0.067 and 1.23, respectively. In addition, total phosphorus removal was calculated 99%. The results approved that Fenton process can be used as an effective pre- or post-treatment stage or even utilized as a single treatment process.

Keywords

Advanced oxidation processes, Fenton, Chemical oxygen demand, Scavenge; Hydroxyl radical, Cattle manure effluent

ENERGY GENERATION THROUGH WASTE WATER – A PANACEA FOR SUSTAINABLE CITIES: A CASE STUDY OF THE CITY OF LAGOS, NIGERIA

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Abstract
As Nigeria's economic capital and commercial nerve centre, the city of Lagos is undergoing speedy urbanization. With an estimated population of over seventeen million people, Lagos is one of the world's fastest growing cities. One of the prominent natural endowments that has borne the brunt of this rapid expansion is the Lagos Lagoon, a water body that has been used for sewage disposal for more than half a century. The large volume of sewage deposited in the lagoon on a daily basis has escalated due to the rapid growth in the city's population.

Besides adding beauty to the city, the Lagos Lagoon is a veritable source of seafood for Lagosians. As is the case with other sewage-rich, densely-populated cities, the city of Lagos has not fully utilized its bounteous sewage resources to upscale its energy supply needs. Instead, the inhabitants of the city keep contaminating the lagoon. The thrust of this paper is to explicate the repercussions of wanton sewage disposal into the Lagos Lagoon and to highlight the potential which Lagos has to generate massive energy from sewage waste in order to meet its energy challenges and ensure better governance.

From ten separate stations across the Lagos Lagoon, water samples were collected and analyzed to ascertain the existence of pathogenic entities using the techniques of sedimentation, microscopy and culture. These pH levels and Biochemical Oxygen Demand (BOD) of the samples were tested using the pH meter and BOD test apparatus correspondingly. The average numbers of sewage tankers who offload waste on a daily basis in all the sewage disposal sites were recorded. This was used to calculate the average daily sewage waste volume disposed.

The analysis showed that pathogenic organisms like hookworms, Kleibsiella spp., Salmonella spp., Escherichia coli, Giardia intestinalis and Ascarislumbricoides were present. Also, the test revealed a pH of 7.9-8.5 and a BOD level of95-225mg/l at 200C for 5 days. The general outcome is that on the average, tankers in Lagos deposit 720,000 litres of sewage wastes (mostly faecal sludge), and sixty-six per cent of these goes directly or indirectly into the Lagos Lagoon.

This paper shows that sewage disposal into the Lagos Lagoon has made the water body ecologically unhealthy for aquatic plants and animals. It has also decreased the visual appearance of the environment. Further, this cruel practice has exposed some persons that come in contact to the lagoon's waters to pathogenic infections. Extant studies have pointed to the fact that sewage waste is a key energy source, with 1 kilogramme of dry faecal sludge having a calorific value of 17.3 millijoule. The implication of this discovery is that with a daily average of 720,000 litres of faecal sludge disposal into the lagoon, Lagos has what it takes to meet its growing energy demand. The absence of steady energy supply has reduced the quality of life and governance in the city. Thus, the onus lies on government to effectually surmount the energy crisis and improve the life of the denizens. This paper strongly recommends the dynamic use of faecal sludge to save the Lagos Lagoon from sewage pollution and upscale energy supply in Lagos.

Keywords: Sewage, energy, Water, lagoon, Sewage tanker, Governance panacea.

ENVIRONMENTAL APPLICATIONS OF MICROALGAE: A REVIEW

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Abstract

Microalgae are significant biological sources that have extensive range of biotechnological applications. In points of environmental biotechnology, microalgae are beneficial for bioremediation of industrial and municipal wastewater, and as a biological organ for monitoring and assessment of environmental toxicants such as pesticides, heavy metals and pharmaceutical compounds. In addition, microalgae are effective types in removing phosphorus, nitrogen and biosorption of toxic heavy metalsfrom wastewater. As a consequence, microalgae are key factors during the final stage of wastewater treatment when organic pollution like nitrogen, phosphorous and chemical oxygen demand (COD) have to be decreased to minimum level demanded by Environmental Protection Agency (EPA). In addition to wastewater pollutions, increasing levels of CO_2in atmosphere which is caused by the continuous rise of worldwide population and industrialization is become a global concern; that is a major issue facing the world today. This universal problem can be easily solved by use of microorganism such as algae.Microalgae culture has a great potential for CO_2 fixation by their photosynthetic ability. Nowaday, microalgae due to their capability to produce valuable bio-product in the course of culture growth and fixation attracted attention. In this review, microalgae aptitude and applications in environmental processes are discussed.

Keywords

Microalgae, Wastewater treatment, Heavy metal biosoption, CO_2 fixation

DESIGN CONSEPT FOR A PHYTOREMEDIATION PARK

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Abstract
Phytoremediation is a method that relies on plants innate ability to absorb, transform or stabilize contamination. It is an environmentally friendly method that sadly has not yet won ground in Sweden. Brownfield planning is the redevelopment of former industrial areas, a common phenomenon in today's urban planning. These areas often have issues of contamination and are often in the proximity of a city, where there generally is a need for parks and green areas. Parks however don't bare the same possibility to profit the way other exploitation does, and are therefore seldom founded on these sort of sites.

What makes phytoremediation of high interest for us as landscape architects is the opportunity to transform unavailable spaces into available, green areas. The time aspect can be turned into an advantage through the making of aesthetically pleasing, interesting and recreational areas. The use of phytoremediation gives rise to a series of questions regarding the re-use of industrial places holding a history.

When designing a park that works for phytoremediation and meanwhile allows people to visit the site, it should be important to establish a strong concept for the design, specific for the site and its conditions. In a phytoremediation park, the purpose of remediation should be clearly visible and natures amazing ability to clean itself from contamination should be emphasized. The park should also tell us a story about the place and its history with craftsmanship and industry as well as what it has left behind, using existing structures and conditions of the site.

The palette of plants useable for this kind of site is strongly limited and the design of the park is highly dependent on the complexity of the contamination situation. The designer needs to have good knowledge about plants to be able to meet the needs for remediation as well as the aesthetics and the experience of the park.

A suitable guideline for designing this sort of site is to work with the strong impact that can be created by using simple means. For instance, the limitation of usable plants is not necessarily to be seen as a restriction, but an interesting tool for designing. As an example, imagine a dense forest of birch trees. The characteristic colours and patterns of the stem are amazingly striking in a mass planting. A creative formation of the trees can create a variation between openness and closeness, a difference in spatiality with interesting rooms and various ways to move through the park. The intention is to create a stylized form of nature and bring forward the experience and the feelings it evokes in us humans. It could be a narrow path through a dense forest of trees as opposed to an opening or a glade in this forest, or one solitary tree in an open field. Moving through or over the dense vegetation, over or under tree canopy, in a field of sunflowers or an open area where the plants have been harvested to remove the contaminants, affects us in various ways and therefore gives us a high experience. In a dense plantation there is room for a play with geometrical shapes in the placing of the plants to reach aesthetic results, sight lines in specific angles and outlooks towards the surrounding landscape and buildings.

The design concept for a phytoremediation park should be built on mass effect, clean lines and strong contrasts, large shapes and a significant expression. The site should provide an experience of nature in a stylized form, where natures beauty and soothing effect on us is clear.

APPLICATION OF PHYSICAL EXPERIMENTAL METHODS AND TECHNIQUES FOR DIAGNOSIS OF THE ENVIRONMENT AND THE REPRODUCIBILITY OF PLANTS: EXPERIMENT AND RESULTS

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Abstract

The paper investigated the luminescence of green leaves in a living state and detached from the parent plant. This allowed to study the processes of biological decay processes. The results of photoluminescence studies were also mapped to the transmission spectra of these objects.

The rapid development of biological and agricultural Sciences because of the need to feed the increasing world population dictates the importance of in-depth study of the structure and function of living systems. Knowledge of these issues allows us to improve plant breeding, sustainable agriculture, improve the life of mankind. In this regard, increasing the need to use research proven in other scientific questions, methods and experimental techniques. Recently there has been increased use of research methods of various characteristics of the optical properties of plants.

It was found that the photoluminescence band is broadened in comparison with those obtained for the leaves, and as much extends into the long wavelength region of the spectrum. Based on these data, it is possible to draw a conclusion about the complex structure of the centers responsible for radiation. It should also be noted that the emission peak of the flower according to their colour.

In this paper, the authors report on the development of their own research photoluminescence of green leaves, in which it was discovered that they show bright photoluminescence in the red. The photoluminescence spectra for green leaves in all cases represent the two closely spaced bands. It is important to note that the energies of both bands for different types of plants almost did not differ from each other.

Keywords

Green leaf, Phytopathology, Spectroscopy, Photoluminescence, Optical absorption, Optical transmission, Spectral contour, Energy spectrum

THE CONTROL IN THE EXPRESS MODE STATUS OF THE WATER USED IN SUSTAINABLE AGRIBUSINESS

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Abstract

The permanent worsening of the water bodies' ecological condition has been observed in the modern world. The pollution by different toxic matters occurs with the shore of the water body itself as well as the water. Not to allow the rise of the dangerous situations for people, mass death the inhabitants of the rivers and lakes and agricultural crops (under irrigation, etc.) the permanent control of the water condition is necessary. The identify centers of pollution allows a set of measures to clean up and prevent further contamination of the time.

The only objective and effective control is the manual probe sampling. But the capacity for the probes amount of such a sampling is limited. Moreover, the hardware for the taken probes complete analyzing is basically situated in the stationary laboratories and costs very much. Therefore it is desirable to be tasked for the investigation by the gages that include constituting a danger polluting products.

To save the moneys and the time and to manage to take steps in time, the efficient on-site express-control of the taken probes is necessary. In this situation, an inexpensive simple to operate transportable cross functional measuring instrument could become a solution for this problem. Especially there are many problems in the research of the state of agricultural fields. These fields can extend over tens km with the presence of only dirt roads. A portable nuclear-magnetic relaxometer developed by us is one of such instruments. The only criterion of its use is the existence of the sufficient amount of the nuclei with the magnetic moments in the investigated fluid.

The service of the instrument is based on that fact that the parameters of every fluid that allow to diagnose its aggregate state change (the temperature rise and the appearance of other saluted or not matters in it) instantaneously are the longitudinal T1 and transverse T2 relaxation times. The size of the magnetic system were matched in such a way that the instrument could be easily transferred "manually". The amount of the investigated matter doesn't exceed 15 gram. In this case, the temperature of the liquid fluid in the container will grade up to the temperature of the environment, where the container itself has been situated for a long time, within 10-15 seconds. Therefore, the liquid fluid temperature can be measured with high accuracy and also controlled without problems.

The use of this tool will facilitate the ecological monitoring of water bodies and plants, using proven solid state physics, experimental techniques, in fact, increase its efficiency, environmental quality and reproducibility.

LIGHVAN CHAY RIVER SUSPENDED SEDIMENT LOAD FORECASTING: APPLICATION OF WAVELET AND RBF-ANN

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Abstract

Prediction of river suspended sediment load is an important point for operation of a water resources, environmental engineering and hydrologic events. In this study, wavelet radial basis function artificial neural network (WRBF-ANN) model is proposed for daily suspended sediment (SS) prediction in river. This model is achieved by combination of discrete wavelet analysis with radial basis function artificial neural network (RBF-ANN). Suspended sediment (SS) and daily stream flow (Q) data from Lighvan Chay River in IRAN were used for training and testing the model. The root mean square error (RMSE), correlation coefficient (R) and coefficient of efficiency (R^2) are used to evaluate the model. Results demonstrated that WRBF-ANN with RMSE = 1.85 tons/day and R2 = 0.92 could logically approximate the suspended sediment load.

Keywords

Discrete wavelet analysis; RBF-artificial neural network; Daily stream flow; Suspended sediment; Lighvan Chay River

THE EVALUATION OF METHANE OXIDATION LAYER AS GROWING MEDIA FOR PICEA ABIES AND LARIX DECIDUA

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Abstract

During the closure project of Kudjape landfill, about 55 000 m^3 of previously disposed waste was excavated and sieved. The main objective was to extract fine fraction and use it for construction of methane degradation cover layer for the whole landfill. The European larch (*Larix decidua*) and Norway spruce (*Picea abies*) where planted onto the cover layer. It was noticed soon that some of the trees were not adapting to the environment and did not survive.

The aim of the research was to study whether methane oxidation layer is suitable as growing media for trees and which landfill characteristics have influence on their growth. The research included field works and data collection from previous studies. Spatial models were created to visualize various tree-growth related parameters and analyse the influence of anthropogenic cover material on tree growth and mortality.

The study revealed that after two years from planting 40 % of larches and 60 % of spruces had survived. The larches had mean annual increment of 6 cm and spruces 3.5 cm. As the result of the study it appeared that main soil characteristics that have an effect on tree growth are possibly landfill gas, moisture content and pH. The study revealed that in addition initial height of planted trees and the optimum planting time, it is important to take notice of the soil characteristics. According to the results, the methane degradation layer which is made from excavated fine fraction serves an acceptable growing media. Tree spices, however, should be selected on different bases compared to regular forestation. A long-term research should be carried out, to study the methane oxidation layer as growing media for trees. Also, other tree species should be considered for research.

Keywords

Landfill; Methane degradation layer; Vegetation; Tree mortality; Spatial model

COLD (9-15° C) DEAMMONIFICATION BIOFILM ACHIEVMENT BY GRADUAL TEMPERATEURE DECREASE

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Abstract

For N-rich wastewater treatment the anaerobic ammonium oxidation (anammox) and nitritation-anammox (deammonification) processes are often used. Temperature gradual lowering by 0.5° C per week achieved a similar maximum total nitrogen removal (TNRR) of 1.5 g N m^{-2} at 15° C as at 20° C in a deammonification moving bed biofilm reactor (MBBR). Our experiments show that a biofilm of a deammonification reactor adapted to 15° C successfully tolerates short-term cold shocks down to 9° C retaining a high TNRR.

To study the short-term effect of temperature on the TNRR, a series of batch-scale experiments were performed which showed remarkable TNRRs even at 9-15° C (4.3-5.4 mg N L^{-1} h^{-1}, respectively). Anammox temperature constants (Q_{10}) ranged 1.3-1.6. After biomass was adapted to 15° C, the decrease in TNRR in batch tests at 9° C was lower (15-20%) than for biomass adapted to 17-18° C showing efficient biomass adaption to low temperature. qPCR analysis showed an increase in *Candidatus Brocadia* quantities from 5×10^3 to 1×10^7 anammox gene copies g^{-1} TSS despite temperature lowered to 15° C.

Keywords

Deammonification; Reject water; Nitrite inhibition

INFLUENCE OF INHERENT ALKALI CONTENT AND SURFACE AREA OF BIOMASS CHAR ON ITS CO_2 GASIFICATION REACTIVITY

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Abstract

The CO_2 gasification reactivity of oil palm shell (OPS) char and pistachio nut shell (PNS) char was studied under isothermal condition using Thermogravimetric analysis (TGA). The effects of temperature, inherent alkali content and surface area of each biomass char on promotion of CO_2 gasification reactivity were investigated. The achieved results revealed the profound catalytic effect of alkali, alkaline and transition metals including K, Na and Fe available in the ash of biomass on enhancing the gasification reactivity of the char at temperatures below 900 °C. However, at elevated temperatures the pore diffusion was dominant and controlled the gasification reactivity. It was found that at temperatures below 900 °C, PNS char demonstrated higher gasification reactivity because of its higher alkali index, while at temperature above 900 °C, conversion of OPS char was faster due to its higher porosity and larger surface area.

Keywords

CO_2 gasification; Palm shell char; Pistachio nut shell; Ash composition; Surface area.

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