EcoTechnologies for Wastewater Treatment

Školení účastníků projektu
„Inovace a rozvoj výuky ekoinovací v bakalářských oborech akreditovaných na FTOP VŠCHT Praha“

Ing. Dana Pokorná, CSc.

Datum školení : 24.9.2012

ecoSTP

- Kdy : 25. – 27. 6. 2012
- Kde : Santiago de Compostela, Galicie, Španělsko

Universidade de Santiago de Compostela

- Konference byla organizována Univerzitou Santiago de Compostela (USC) s podporou IWA

- Univerzita je největší a nejstarší univerzitou v Galicii, založena v r. 1507 Alfonsem III. de Fonseca
- Má 2 kampusy v Santiagu a 1 kampus v Lugu
- 19 fakult
- 35 – 40 tisíc studentů

Místo konání konference
Rúa Lope Gómez de Marzoa s/n
Campus Vida
15782 Santiago de Compostela

Odborné zaměření akce

- Akce se zúčastnilo 120 odborníků z Evropy, Afriky, Asie, Severní a Jižní Ameriky
- Akce byla přínosná pro výzkumná pracoviště a univerzity zabývající se výzkumem v oblasti technologie vody a životního prostředí a provozovatele a pracovníky na čistírnách odpadních vod a úpravnách vod

Tematické zaměření akce

- Konference byla zaměřena na vývoj a aplikace nových technologií pro městské a průmyslové odpadní vody se zvláštním zaměřením na ochranu životního prostředí a ekonomickou udržitelnost. Významnou součástí programu byly příspěvky, které se zabývají integrací a hodnocením technologických, ekologických a ekonomických otázek souvisejících s provozem čistíren odpadních vod.

Z tohoto globálního pohledu byly hlavními tématy konference :

Inovativní technologie a procesy (odpadní vody, kaly)
Zdroje využití (živiny, energie, voda, bioplasty, atd.)
Procesní modelování, optimalizace a řízení
Systémová integrace
Odstraňování průmyslových škodlivin
Biopolutanty (viry, patogeny atd.)
Rozvíjející se znečišťující látky (léčiva, endokrinní disruptory, atd.)
Skleníkové plyny a emise
Ekonomické aspekty (provozní náklady, ekonomická efektivnost)
Energetická bilance a úspory energie
Nástroje pro správu (LCA, DSS, ekotoxikologie, atd.)

Tematické zaměření akce

Z pohledu naší účasti byly prioritní sekce

- *Inovativní technologie a procesy (odpadní vody, kaly)*
- *Zdroje využití (živiny, energie, voda, bioplasty, atd.)*
- *Odstraňování průmyslových škodlivin*
- *Biopolutanty (viry, patogeny atd.)*
- *Rozvíjející se znečišťující látky (léčiva, endokrinní disruptory, atd.)*

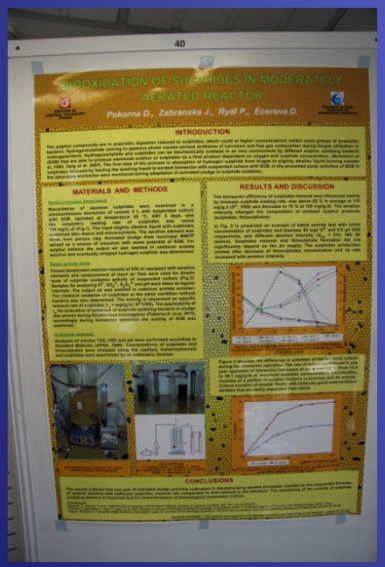
Program konference

Program konference zahrnoval

- 4 key-note přednášky
- 25 přednášek v 5 sekcích
- 39 krátkých sdělení ve 3 paralelních sekcích
- 146 posterů (u 3 posterů byly autoři či spoluautoři z VŠCHT Prahy, FTOP)

Program konference

- Posterové sekce se zúčastnili rovněž pracovníci FTOP VŠCHT jako autoři či spoluautoři 3 posterů :
- *Pokorná D., Zábranská J., Rýdl P., Ečerová D.: Biooxidation of sulphide in moderately aerated reactor*
- *Zábranská J., Pokorná D., Bartáček J., Máca J. : Industrial wastewater with high concentration of nitrates and sulphates – biological treatment*
- *Vergine P., Zábranská J., Canzabi R.: Rhermal pre-treatment to improve sludge anaerobic degradability: effects of microwave snd classical heating*



Program konference

Plenární přednášky byly rozděleny do 5 neparalelních sekcí :

1. **Inovativní technologie**
2. **Ekonomické a energetické aspekty**
3. **Emise skleníkových plynů**
4. **Nově vznikající polutanty**
5. Management

Výstupem z konference je tištěný sborník abstraktů a elektronická verze plných textů všech příspěvků, včetně krátkých sdělení a posterů.

Obojí je možno poskytnout – obraťte se na pokornd@vscht.cz

Program konference - **Key-note lectures**

Wastewater based biorefineries

M. C. M. van Loosdrecht and R. Kleerebezem

Department of Biotechnology Delft University of Technology, Delft, The Netherlands,m.c.m.vanloosdrecht@tudelft.nl

Wastewater treatment is slowly moving from being primarily a sanitation technology towards a resource recovery technology. Traditional energy recovery is well practised but recently chemicals recovery becomes more important. Not only nutrients (especially phosphate) but also chemicals like cellulose fibres, polyhydroxyalkanoates (PHA) or alginate can be recovered from wastewater. Cellulose fibres can, with simple sieving techniques, be recovered from wastewater. PHA already play an important role in the conversion processes of wastewater systems, and exploiting the ecological role of PHA will lead to systems with high PHA production. The recent developed aerobic granular sludge technology leads sludge with an amount of alginate content similar to that of algae biomass. It seems therefore to be a good Alginate resource. In the current drive to base the society on biobased products large amounts of agricultural waste will be produced. This gives new opportunities for wastewater technology. With the processes described above the wide array on chemical compounds in agrowaste can be converted in standard chemicals (like PHA) which can be further used in the industry.

Program konference - **Key-note lectures**

From wastewater to biofuel: innovations to recover resources and energy from municipal effluents

F. Rogalla[1], R. Fernandez[2], E. Lara[3] and P. Icaran[4]

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[3]Aqualia, C. San Francisco Javier, 15, E 41005 Sevilla, Andalucia, Spain (E-mail: elarac@fcc.es)
[4]Aqualia, C. Carnicería, 7; E 43700 El Vendrell, Catalunya, Spain (E-mail: picaranl@fcc.es)

Traditional wastewater treatment has as a priority to meet effluent quality discharge standards, mostly under considerable energy input around 0,5 kWh/m3 - and only in larger plants biogas is recovered from sludge digestion for co-generation, typically contributing about 50 % of the energy needs of a facility.

But a value orientated analysis shows that wastewater contains various resources:

- the raw energy content in wastewater can reach 1,5 kWh/m3 (for 500 mg COD/l),
- nitrogen needs about 15 kWh/kg N to be synthesized as artificial fertilizer from natural gas, while its oxidation to return it to the atmosphere can consume around 5 kWh/kg
- phosphorus is a limited mineral resource with only a handful of countries having significant reserves, and their lifetime being estimated in a few hundred years
- water for reuse, the value of which depends on the local water availability, but can be equivalent to at least 4 kWh/m3 if the supply relies on desalination

This contribution evaluated a few options for extracting these resources from wastewater, starting with anaerobic pretreatment for biomethane production, and subsequent nutrient recovery. Once the organic matter has been reduced, the nutrients can be used as fertilizer for algae cultures, which in turn are a valuable biomass for extracting subproducts for pharmaceutical, chemical or animal feed, such as oils, colorants or proteins. Leftover biomass can always be converted to biomethane.

The economics of the new pathways for the recovery of bioenergy and subproducts are compared to other alternatives such as MAP precipitation, and with alternative approaches such as separate source collection of urine, blackwater and grey-water (no-mix). Preliminary energy balances show that wastewater treatment can be autosufficient, and even generate excess energy usable as biomethane or electricity.

Innovative Technologies

V této sekci bylo prezentováno 5 plenárních přednášek, 13 krátkých sdělení a 62 posterů.

Sekce byla zaměřena na inovace stávajících technologií i na představení novinek, které byly spíše v oblasti laboratorního nebo poloprovozního výzkumu. Pro nás byly zajímavé příspěvky z oblasti membránových technologií, které zaznamenávají prudký rozvoj, z oblasti hodnocení nových produktů pro vodárenské účely (koagulanty,..), odstraňování nutrientů (nitrifikace, denitrifikace při sníženém obsahu organických látek, hodnocení zeolitů na odstraňování fosforu či jeho odstraňování pomocí kovů, kultivace řas na odstraňování nutrientů), inovativní technologie pro předúpravu kalů (např. ultrazvuk) s ohledem na omezení zápachu či zlepšení biologické rozložitelnosti odpadů. Minimalizace produkce kalu na ČOV pomocí Novinky se objevily i z oblasti analytické chemie – stanovení NMK nebo mikroskopické analýzy aktivovaného kalu (BIOFAC). Významnou inovativní technologií je izolace PHB produkované mikrobiálním konsorciem, ze které jsou následně vyráběny ekologické plasty, které jsou dobře biologicky rozložitelné.

Plenární přednášky – Innovative Technologies

Technical and economic analysis of real anaerobic digester centrate by means of partial nitrification and sustainable heterotrophic denitrification

A. Bartrolí*, C. Garcia**, J. M. Hidalgo***, P. Rougé***, C. Fàbregas****, M. Fortuny*, J. Lafuente*, Ó. J. Prado* (

** Aeris Environmental Technologies S.L. Edifici Eureka. Campus U.A.B., 08193 Bellaterra (Barcelona, Spain).*

*** CETaqua, Centro Tecnológico del Agua. Carretera d'Esplugues 75, 08940 Cornellà de Llobregat (Barcelona, Spain).*

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The reliability of partial nitrification coupled with heterotrophic denitrification for the treatment of real anaerobic digester centrate produced in a wastewater treatment plant was technically and economically assessed in two sequencing batch reactors. Removal efficiencies above 90 % were consistently achieved at N-ammonium loads above 1.2 g N L^{-1} d^{-1}. Ethanol, affluent from a waste water treatment plant and a zero-cost liquid residue from a chemical industry containing polyethylene glycol and sorbitol were employed as carbon source for denitrification. In this last case, a TOC requirement of 4.5 g TOC g^{-1} NO^{2-}-N was calculated. The denitrification rate was 0.26 g NO^{2-}-N g SSV^{-1} d^{-1}. These results show that a carbon-rich waste can serve as a no-cost feed for denitrifying bioreactors. An indepth economic analysis considering the main investment and operating costs of the process was developed, showing that it can suppose yearly savings above 50 % with respect to the most widely used alternative of returning anaerobic digester centrate untreated to the head of the facility.

Plenární přednášky - Innovative Technologies

The granule size distribution in an anammox-based granular sludge reactor affects the conversion

E. I. P. Volcke[1], C. Picioreanu[2], B. De Baets[3] and M. C. M. van Loosdrecht[2]

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[2] *Department of Biotechnology, Delft University of Technology, Julianalaan 67, 2628 BC Delft, The Netherlands (E-mail: C.Picioreanu@TUDelft.nl ; M.C.M.vanLoosdrecht@TUDelft.nl)*

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Granular sludge reactors are a type of biofilm reactors in which biomass is grown in the form of dense, fastsettling granules, resulting in compact systems which allow a high loading rate. These reactors are ideally suited for wastewater treatment and may be applied for e.g. (simultaneous) COD, nitrogen and phosphorus removal. Mathematical models are useful tools to gain process insight and to optimize the performance of granular sludge reactors . One of the aspects to be dealt with in these models concerns the granule size, more specifically the diameter in case a perfectly spherical shape is assumed, as is the case in one-dimensional models (only considering radial gradients). Typically a uniform granule size is assumed for the whole reactor, even though it is acknowledged that in reality the granules follow a size distribution. The granule size determines the granule surface to volume ratio, an important parameter for mass transport of solutes in the granular biofilm, and thereby affects reactor performance. Therefore, the choice of this parameter has clear implications on the reliability of the modelling results. Autotrophic nitrogen removal comprises partial nitritation and anaerobic ammonium oxidation (anammox) as onsecutive reactions. Ammonium is oxidized to nitrite (the so-called nitritation reaction) by ammonium oxidizing bacteria (AOB), while further oxidation to nitrate by nitrite oxidizing bacteria (NOB) is prevented.

During partial nitritation, only half of the ammonium is converted to nitrite. This reaction is typically followed by the combination of ammonium and nitrite to mainly nitrogen gas and little nitrate in a so-called anammox reaction. Combined partial nitritation-anammox processes result in substantial savings in aeration costs (up to 63 %) and external carbon addition costs (up to 100%) compared to conventional nitrificationdenitrification over nitrate, at the same time minimizing CO_2 emission and sludge production. A full-scale application of nitrogen removal from industrial wastewater through one-stage partial nitritation-anammox in a granular sludge reactor was described by. This process further fits in innovative process

schemes for energy-efficient treatment of municipal wastewater.

In this contribution, the effect of granule size and granule size distribution on autotrophic nitrogen removal in a granular sludge reactor has been assessed through numerical simulations. During the interpretation of the results, particular attention is devoted to the implications for modelling granular sludge reactor models.

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Plenární přednášky - Innovative Technologies

Combination of chemical biological flocculation and microalgae biofilm growth for decentralized sewage treatment

C. Zamalloa, N. Boon and W. Verstraete (carlos.zamalloa@ugent.be)

Laboratory of Microbial Ecology and Technology (LabMET), Ghent University, Coupure Links 653, B-9000 Gent, Belgium

Based on the ZeroWasteWater approach, a decentralized nutrient immobilization concept for the treatment of domestic wastewater is proposed (A/I process). In this lab-scale study, domestic wastewater was subjected to a chemically biological adsorption (A-stage), followed by treatment in a microalgae biofilm reactor for nutrient immobilization (I-stage). The A-stage process in which suspended solids are separated through chemical coagulation ($FeSO_4$) and biological flocculation was operated at a hydraulic retention time (HRT) of 2 hours and a solid retention time (SRT) of 1 day. The I-stage, which consequently received the effluent of the A-stage process, was operated at an HRT of 1 day. This reactor was exposed to natural light in a greenhouse for microalgae biofilm growth. The overall system removed on average 74 % of the total chemical oxygen demand, 82 % of the total suspended solids, 67 % of the total nitrogen and 96 % of the total phosphorous present in the wastewater. The design involves relatively low capital expenditures and operating cost so that the total cost per m^3 wastewater treated, even at small scale level, are considered to be comparable those of conventional treatment. These aspects suggest that this system can qualify for decentralized domestic wastewater treatment system.

Plenární přednášky - Innovative Technologies

A Full Scale Worm Reactor for Efficient Sludge Reduction by Predation in a Wastewater Treatment Plant

J. Tamis, G. van Schouwenburg, R. Kleerebezem and M.C.M. van Loosdrecht

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SR Technologie BV, Postbus 236, 8100 AE, Raalte

The activated sludge process is worldwide the most abundantly used process to treat wastewater. The principle of organic carbon removal with this process is based on partial aerobic respiration and partial conversion of organic matter to biomass that can be separated from the treated wastewater in a settling tank. Taken into account that 40-50% of all organic carbon removed is converted to biomass (i.e. sludge) this can be regarded as an unwanted side-product of the process. Produced sludge in many places has to be disposed by incineration or other costly techniques. Therefore sludge minimalisation techniques have become a major research topic in recent years. Most of the proposed strategies are not based on the basic cycling of organic carbon in natural systems. Complex organic carbon in nature is generally converted by benthic worms and it seems a logical route to incorporate them in a system for sludge minimisation. Implementation of this ecological principle for enhanced sludge degradation in WWTP was demonstrated on laboratory scale . However, a proper design for a full scale system has not been reported nor has the type of most beneficial type of benthic worm been investigated.

In this study the results of conversion of secondary sludge by the aquatic Oligochaete worm *Aulophorus furcatus in a 125 m^3 worm reactor and further degradation in an anaerobic tank* are presented. This system was operated over a period of more than 1434 days at WWTP Wolvega, the Netherlands

Plenární přednášky - Innovative Technologies

Performance evaluation of a low-cost microbial fuel cell

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A microbial fuel cell with baffles and brush-shaped anode was constructed with low-cost materials and operated in fed-batch mode using wastewater and acetate as substrate. The MFC was operated at room temperature. The external resistance was varied in order to determine the maximal power density produced by the cell. The operation of the MFC was divided in two phases; in phase one, the MFC had an external resistance of 1000 ; whereas on the second one it was 8200 ;. For those conditions, it was found that the average value of power density increased from 2.5±1.3 to 9.17±2.4 mW/m^2, respectively. However, no significant changes on coulombic efficiency and removed COD were observed. The low cost MFC produced higher power densities per dollar than other conventional systems.

Krátká sdělení - Innovative Technologies

Operational research of vertical and horizontal biofilters

F. Torres, J. Araña, J. A. Herrera

Alternating electric fields combined with activated carbon for disinfection of gram negative and gram positive bacteria

J. Racyte, S. Bernard, A. H. Paulitsch-Fuchs, D. R. Yntema, H. Bruning and H. H. M. Rijnaarts

Complete degradation of volatile acids in an anaerobic fluidized bed reactor treating low-strength wastewater

J. Bae, C. Shin and P. L. McCarty

Efficient total nitrogen removal in an ammonia gas biofilter through high rate OLAND

H. De Clippeleir, E. Courtens, S. E. Vlaeminck, N. Boon and W. Verstraete

Treatment of synthetic textile wastewater using a combined anaerobic/photo-Fenton process

M. Punzi, B. Mattiasson and M. Jonstrup

Effect of rotifers *Lecane inermis* on SVI (sludge volume index) and activated sludge biocenosis

W. Kocerba-Soroka, E. Fiałkowska, J. Fyda, A. Pajdak-Stós, M. Sobczyk and H. Salvadó

Performance of pure and waste-originated carbon sources within short-cut nitrogen bioremoval from anaerobic digestate

N. Frison, C. Cavinato, D. Bolzonella, P. Pavan and F. Fatone

Biofiltration of H_2S in biogas with *Thiobacillus denitrificans* under anoxic conditions

M. Fernández, M. Ramírez, R. M. Pérez, J. M. Gómez and D. Cantero

Study of the nitrification process of very low-strength water using aerobic granulation technology in a SBR

S. López-Palau, A. Mosquera-Corral, J. L. Campos, J. Dosta and J. MataÁlvarez

The Expanded Bed Biofilm Reactor (EBBR): innovative technology for sustainable wastewater treatment

M. J. Dempsey, C. McKeever and J. King

Environmental comparison of N and P removal technologies for the treatment of anaerobic digestion supernatant

G. Rodriguez-Garcia, N. Frison, J. R. Vázquez-Padín, A. Hospido, F. Fatone, D. Bolzonella, M. T. Moreira and G. Feijoo

Tertiary membrane filtration of municipal wastewater treated in a Moving Bed Bioreactor

A. Iglesias-Obelleiro, J. R. Vázquez-Padín, A. Silva-Teira, R. Fernández and J. M. Garrido

Postery– Innovative Technologies

Effect of the feeding strategy on a sequencing fed-batch biofilm reactor treating effluent from UASB reactor for nitrogen and sulfide removal

B. S. Moraes and E. Foresti

Monitoring anaerobic processes: measurement uncertainty evaluation and validation of a method for determination of volatile fatty acids in fermentation broths

A.Drolc, M. Cotman and A. Pintar

Treatment of synthetic wastewater and hog waste with reduced sludge generation by the multi-environment BioCAST technology

L. Yerushalmi, M. Alimahmoodi and C. N. Mulligan

Electroflox: a new technology for wastewater treatment

L. G. Zapata, R. Camargo-Amado, N. Marriaga-Cabrales and F. Machuca-Martínez

An integrated process MBR / solar photo-Fenton for wastewater reuse

A. Cabrera Reina, J. L. Casas López, I. Carra Ruiz and I. M. Román Sánchez

Algal-bacterial processes for the treatment of agroindustrial wastewaters: a preliminary screening

E. Posadas, R. Muñoz, M. Coca, M. C. García-González and P. A. García-Encina

Strategy for nitrite accumulation during oxidation at room temperature of ammonia from pig slurry

U. Durán, J. L. Campos, A. Mosquera-Corral and R. Méndez

Effect of conditioning on sulphur compounds emissions in low temperature drying of sewage sludge

E. Vega, R. González-Olmos, R. Lebrero, R. Muñoz and M. J. Martin

Sludge characteristics in stabilization ponds located at southern Spain after long operation period without sludge elimination

R. Bouza-Deaño and J. J. Salas-Rodríguez

The effect of pH and temperature in the generation of odor from swine slurry

G. Ortiz, C. A. Villamar and G. Vidal

Cultivation of microalgae for nutrient removal from the effluent of a submerged anaerobic membrane bioreactor (SAnMBR)

A.Ruiz-Martinez, N. Martí, J. Ferrer and A. Seco

Effect of different sludge pre-treatments on the potential odour footprint of secondary sewage sludge

M. Lira, J. Abelleira, R. Muñoz, A. Carvajal and R. Lebrero

Postery - Innovative Technologies

Ultrasonic pre-treatment effect on wastewater sludge

Y. Segura, F. Martinez, R. Molina and J. A. Melero

BIOFAC, self-microbiological tool for analysis of activated sludge

C. Ferrer, J. A. Llopis, J. Claramonte, S. Alonso and J. G. Berlanga

Coagulants/Flocculants recommended by the Council Directive 98/83/EC, on the quality of water intended for human consumption: analysis, application and new perspectives

R. Devesa-Rey, X. Vecino, J. M. Cruz and A. B Moldes

Denitrification system with adhered culture (SIDECA)

C. Ferrer, S. Alonso, D. Miguel, E. Tortajada, J. G. Berlanga, I. Sangüesa and J. Roger

Biooxidation of sulphide in moderately aerated reactor

D. Pokorna, J. Zábranská, P. Rydl and D. Ecerova

Elimination of odours by advanced oxidation and adsorption technologies

R. Portela, S. B. Rasmussen, R. F. Tessinari, S. Suárez, M. D. Hernández-Alonso, M. C. Canela, P. Ávila and B. Sánchez

Physicochemical and respirometric study of conventional activated sludge and nutrient removal (UCT) systems

N. Basset, C. Arnabat, O. Canals, J. Dosta, H. Salvadó and J. MataÁlvarez

A new configuration of algal-bacterial photobioreactors for wastewater treatment based on anoxic and aerobic conditions

I. de Godos, V. A. Vargas, H. O. Guzmán, R. Soto, P. A. García-Encina, B. García and R. Muñoz

Evaluation of natural zeolite (Mordenite) as medium in horizontal subsurface flow constructed wetland for phosphate removal from sewage wastewaters

I. Vera, F. Araya, E. Andrés and G. Vidal

Nitrogen removal from swine wastewater by partial nitrificationdenitrification at low C/N relationship

M. Belmonte, C.-H. Hsieh, J. L. Campos, A. Mosquera-Corral and G. Vidal

Advanced thermal hydrolysis as a pretreatment for conventional anaerobic digestion of sewage sludge: effect on methane production

J. Abelleira, S. I. Pérez-Elvira, J. Sánchez-Oneto, J. R. Portela and E. Nebot

Postery - Innovative Technologies

Sludge hydrolysis role in denitrification process in an activated sludge reactor after the sonication of a fraction of MLSS

A. Galí, L. Bouchy, J. Trillo, P. Rougé and C. Fàbregas

Effect of a methanogenic stage on membrane fouling in an aerobic membrane filtration chamber

D. Buntner, A. Sánchez, V. Pinto and J. M. Garrido

Investigation of a membrane aerated biofilm reactor for the treatment of landfill leachate

E. Syron, R. Heffernan and E. Casey

Dissolved oxygen monitoring for the optimization and control the photo-Fenton process

J. L. Casas López, L. Santos-Juanes, E. Ortega and A. Cabrera Reina

Heat effects of wet oxidation of activated sludge in sub-critical water

M. Imbierowicz and M. Troszkiewicz

Industrial herbal extraction wastewater treatment using an anaerobic membrane bioreactor

C. Brand, A. Sánchez, M. Chlaida and M. Kraume

Thermal pre-treatment to improve sludge anaerobic degradability : effects of microwave and classical heating

P. Vergine, J. Zabranska, R. Canziani

Denitrification of reclaimed wastewater during transportation with limited organic compounds

L.E. Rodriguez-Gómez, M.Álvarez, A. Hernández, J. Rodriguez and M.C. Marrero

Economic and Energetic Aspects

V této sekci bylo prezentováno 5 plenárních přednášek, 26 krátkých sdělení a 5 posterů.

Sekce byla zaměřena na hodnocení provozu ekologických zařízení z hlediska jejich energetické bilance a energetické soběstačnosti a náročnosti na jejich provoz. V tomto ohledu je znalost našich pracovníků na vysoké úrovni, nicméně za zmínku stojí prezentace některých matematických modelů, odvodňování kalů pomocí solární energie, nástroje pro úsporu energie na ČOV, simultánní využití elektrické energie a fosforu z prasečí kejdy, nové postupy při optimalizaci produkce metanu.

Resource Recovery

Tento okruh byl prezentován v rámci sekce Economic and Energetic Aspects v 21 posterech.

Byly zde prezentovány hlavně zkušenosti španělských provozovatelů s využitím některých zdrojů, jak energetických na ČOV, tak využití některých nutrientů. Pro naše podmínky byla většina příspěvků spíše zajímavostí (např. brakické vody, zpracování odpadů z výroby ryb,..), nicméně se objevilo i několik příspěvků, které mohou být inspirací a podkladem pro výuku v některých předmětech vyučovaných v bakalářském studiu na FTOP – Výroba energie z biomasy, Technologie výroby bioplynu a biovodíku, decentralizované zpracování odpadních vod

Plenární přednášky– Economic and Energetic Aspects

Energy self-sufficient wastewater treatment: a reality in the making

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The self-sufficient wastewater treatment works represent a visionary ambition to treat wastewater proficiently having in consideration current and future pressures that result from high energy costs, the need to reduce greenhouse gases emissions and to recover resources whilst not compromising the quality of the final effluent. Previous research has demonstrated that wastewater treatment utilising anaerobic processes at its core is an appropriate alternative towards sustainable wastewater treatment but the debate remains on how to operate the anaerobic reactor towards

achieving energy self-sufficiency and especially on the selection of the most suitable secondary treatment to enable polishing of the effluent and nutrient removal. Research completed at Cranfield University demonstrated the benefits of replacing the biological nutrient removal processes with adsorption based units as a prerequisite for achieving energy neutrality, high effluent quality and for recovery of the nutrient resource for reuse. Since both phosphate and ammonia exist principally as ions in wastewater, the alternative route to removal and recovery was the use of ion exchange (IEX) systems. Two pilot-plants have been commissioned and are currently being operated at a full scale wastewater treatment works: a granular sludge anaerobic membrane reactor – that enables COD and TSS removal by 85 – 95 % COD and 100 %, respectively (after membrane filtration); and a second pilot plant designed for nutrient removal that is composed of two main reaction vessels: the first contains a media that is a chemical modification of clay minerals and other aluminiumbearing materials creating an ion change material that captures ammonia and the second reaction vessel with media is based on embedded nanoparticles of transition metals very selective for phosphate.

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Working with energy and mass balances: A conceptual framework to understand the limits of wastewater treatment

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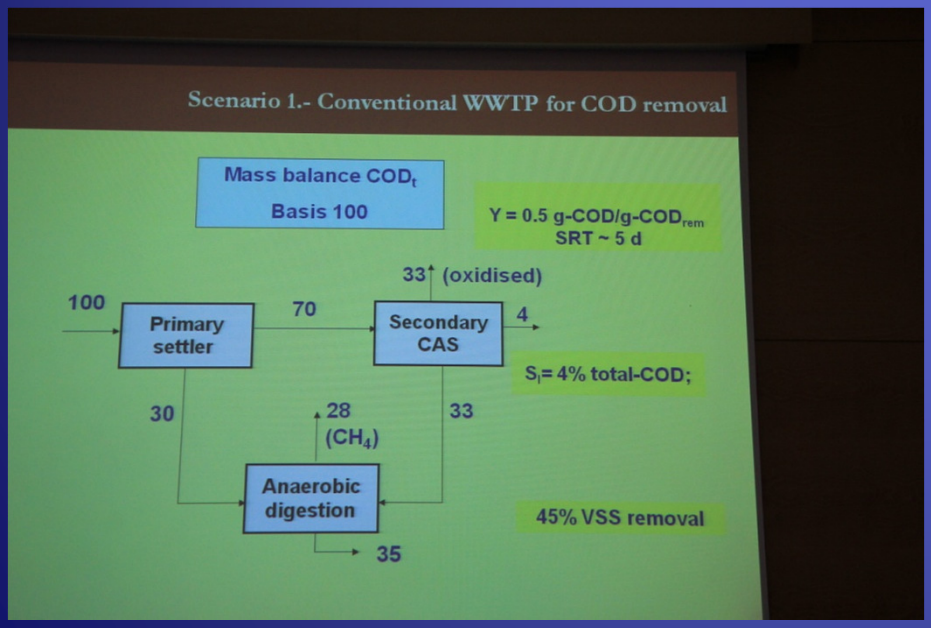
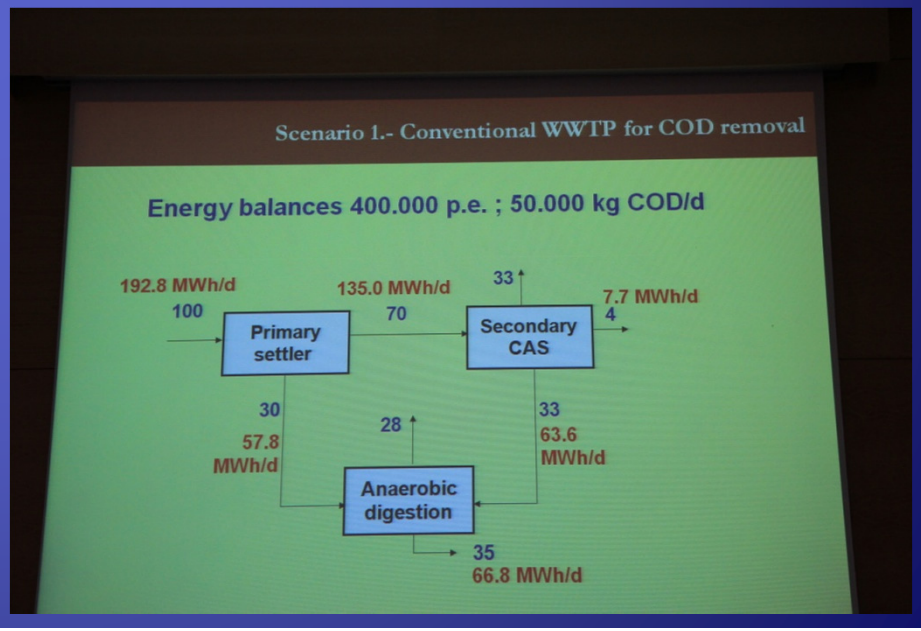
At present all municipal Waste Water Treatment Plants (WWTP) are energy consumers. Electrical energy requirements for oxygen transfer are large in secondary biological systems. Nevertheless, from a thermodynamic point of view COD is a energy source. Combustion of every gram of COD releases 4.07 Wh of energy. In this manuscript some measures are presented, from a conceptual point of view, in order to convert the actual concept of wastewater treatment as an « energy sink » to an « energy source » concept.





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Plenární přednášky– Economic and Energetic Aspects

Application of mathematical modelling to find energy saving operational methods to optimise a new variable energy tariff

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Activated sludge plants are energy intensive and aeration can account for over 60% of total energy consumption at the treatment plant. Optimum operation and control of these plants is therefore of utmost importance to owners in order to keep energy costs at a minimum. This paper summarises the results of the first stage of a two stage investigation to find energy saving operational methods to optimise a new variable energy tariff imposed on Yorkshire Water, a UK water company, in 2010.

The new Distribution Use of System (DUoS) tariff has three weekday charge periods viz: low, medium and high. Electricity costs 8 and 92 times more in the high DUoS period than in the medium and low DUoS periods respectively. Minimising energy consumption during the high DUoS period will therefore result in substantial savings in energy costs. The first part of the study applied whole plant modelling to initially evaluate feasible options before implementing them on site as the second part of the study. The modelling results predicted savings in aeration costs of up to 26 % through implementing optimised aeration control and up to 52 % through implementing both flow balancing and optimised aeration control. Initial application of desktop mathematical modelling allowed radical operational methods to be investigated, proving it to be a powerful and cost effective way of evaluating operation and control scenarios before site implementation.

Plenární přednášky– Economic and Energetic Aspects

A generic extension to a dynamic pumping energy model for wastewater applications

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Despite the increasing level of detail in wastewater treatment process models, oversimplified energy consumption models (i.e. constant “average” power consumption) are being used in optimization exercises. A new dynamic model for a more accurate prediction of pumping costs in wastewater treatment has been developed to overcome this unbalance in the coupled submodels. This model is calibrated on the municipal wastewater treatment plant of Mekolalde (Spain), showing good agreement between the modelling results and the plant data.

Plenární přednášky - Economic and Energetic Aspects

Oxygen transfer in activated sludge – a new paradigm

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Oxygen supply is still the largest energy consumer in activated sludge processes. The α-factor, the relationship of wastewater to clean water oxygen transfer coefficient, has the greatest impact on the calculation of the required standard oxygen transfer rate (SOTR). Knowing the dependencies of the α-factor leads to a better design of the aeration devices and, consequently, to a more efficient use of aeration energy. In contrast to the current opinion, the latest results demonstrate that neither dissolved surfactants nor the viscosity are the major driver for oxygen transfer depression in activated sludge plants treating municipal wastewater. Instead it seems that surfactants adsorbed to filterable solids or activated sludge and the overall floc volume of activated sludge have the biggest impact on oxygen transfer.

Krátká sdělení – Economic and Energetic Aspects/Resource Recovery

Optimization-based methodology for the synthesis of biorefinery treatment plants for energy and nutrient recovery

C. Gomez-Mont, C. Puchongkawarin, B. Chachuat and D. C. Stuckey

Upgrading sewage treatment works for water reuse: can vertical flow wetlands offer an alternative to conventional technologies?

A.Besancon, G. Dotro and B. Jefferson

Dewatering of sewage sludge assisted by solar energy

D. Giannelos and I.D. Manariotis

Comparative study of technologies to remove nitrogen in anaerobic digestion supernatants in WWTPs: pilot trials and assessment of scenarios

C. Garcia, L. Bouchy, J. M. Hidalgo, P. Rougé and C. Fàbregas

Sustainability of submerged anaerobic membrane bioreactors to treat domestic wastewater

J. B. Giménez, A. Robles, F. Durán, L. Carretero, M. V. Ruano, N. Martí, L. Borrás, F. García-Usach, J. Ribes, J. Ferrer and A. Seco

A decision support system to select WWTPs technologies for small populations: environmental and economic assessment

M. Molinos-Senante, M. Garrido, R. Reif, M. Poch and F. Hernández-Sancho

Techno-economical efficiency of wastewater treatment plants: a cost saving tool

R. Sala-Garrido, F. Hernández-Sancho and M. Molinos-Senante

Phosphate recovery from urine by MAP-precipitation

M. Röhricht, M. Hartmann, J. Heynemann, M. Winker and S. Paris

Simultaneous recovery of electrical power and phosphorus from swine wastewater by microbial fuel cell

O. Ichihashi and K. Hirooka

PHB production by a mixed photosynthetic consortium of bacteria and algae

J. C. Fradinho, J. M. B Domingos, A. Oehmen and M. A. M. Reis

Dissolved oxygen influence on the PHA content maximization step of a glycerol-based biopolymer production process

H. Moralejo-Gárate, A. Mosquera-Corral, R. Kleerebezem, M. C. M. van Loosdrecht

New strategies for optimal methane production from long chain fatty acids

A. J. Cavaleiro, A. F. Salvador, S. A. Silva, M. A. Pereira, D. Z. Sousa and M. M. Alves

Model-based control strategy for optimal mixed culture polyhydroxyalkanoate production

L. Montaño, R. E. Amaya and A. Vargas

Postery– Economic and Energetic Aspects

Economics of tertiary treatment wetlands at a UK water utility: balancing clogging management and whole life costs
G. Dotro, M. Jones, E. Butterworth and B. Jefferson

Preliminary assessment of AnMBR for winery wastewater
N. Basset, J. Dosta and J. Mata Álvarez

Fenton's process as an effective treatment for elderberry juice effluents: economical evaluation
N. Amaral-Silva, R. C. Martins, S. Castro-Silva and R. M. Quinta-Ferreira

Integrated design methodology for improving the economics and dynamical performance of the activated sludge process
S. Revollar, R. Lamanna, P. Vega, M. Francisco and A. Rodríguez

Productivity in wastewater treatment plants: benchmarking for improving the sustainability
F. Hernández-Sancho, R. Sala-Garrido and M. Molinos-Senante

Postery – Resource Recovery

Phosphorus release and metals separate from thickened sewage sludge with a combination of acidic hydrolysis and Donnan dialysis

A. Uysal, E. Sayilgan and E. Kir

Use of Box-Behnken design for MAP formation from potato processing industry wastewater

A. Uysal and B. Kuru

Further development of dry toilet sanitation through application of lactic acid fermentation process during human excreta collection

A. Yemaneh, M. Bulbo, H. Factura, C. Buzie and R. Otterpohl

The effect of carbon source on PAO-GAO competition in EBPR systems

M. Carvalheira, A. Oehmen, G. Carvalho and M. A. M. Reis

Mesophilic anaerobic co-digestion of a mixture consisting of dairy manure and cheese whey

J. L. Rico , C. Rico , N. Muñoz, J. Fernández and J. Renedo

Response of a sewage slugde mesophilic digester to short and long-term thermophilic temperature variation

M. Peces, S. Astals and J. MataÁlvarez

Struvite crystallization by using an industrial grade magnesium hydroxide suspension

D. Crutchik and J. M. Garrido

Anaerobic digestion of flocculent and granular sludge under brackish conditions

T. Palmeiro, A. Val del Río, A. Mosquera-Corral, J. L. Campos and R. Méndez

Green adsorbents for the recovery of surfactants from water X. Vecino, R. Devesa-Rey, A. B

Moldes and J. M. Cruz

Struvite recovery in a Spanish WWTP: pilot-scale results

C. Garcia, L. Bouchy, J. M. Hidalgo, P. Rougé and C. Fàbregas

Microbial fuel cell for perchlorate removal with municipal wastewater treatment: A model based study

J. Rodríguez, J. Bastidas and F. Ahmad

Postery – Resource Recovery

Evaluation of the performance of horizontal subsurface flow wetlands in the summer period
M. C. Mesquita, F. A Carreiro, M. Latado, A. Albuquerque, L. Amaral and R. Nogueira

Waste heat sources potential recovery on WWTP: assessment of Valladolid WWTP case study
E. Marzo, C. Labouré, E. Larrotcha, L. Bouchy and B. Rodríguez

Co-digestion of fish waste with gorse
M. Eiroa, M. Ben, J. C. Costa, M. M. Alves, C. Kennes and M. C. Veiga

Adsorption of Cr (VI) by spent foundry sands: effect of temperature in kinetic and equilibrium
I. Campos, J. A. Álvarez, P. Villar, A. Pascual and L. Herrero

Removal of Cr (VI) using compost derived from sewage treatment plant sludge
I. Campos, J. A. Álvarez, P. Villar, A. Pascual and L. Herrero

Application of reclaimed water with aerobic biofilm process and sand filtration to a channel for control of green algal growth potential
Y. Shibayama, N. Hisaoka, Y. Okayasu, Y. Suzuki and M. Minamiyama

Phosphorus recovery as struvite from synthetic wastewater by microbial fuel cell
K. Hirooka and O. Ichihashi

Choice of "the clean process" in the phosphate fertilizer industry
A. Mizane

Bioconversion of agro-industrial residues into biogas
I. Gonçalves, R. Oliveira, A. Mendonça, H. M. Pinheiro and M. I. Ferra

The long-term effect of carbon source on the microbial community in the ebpr system and stoichiometry
Z. J. Miao, Y. Z. Peng , G. S. Xue, S. Y. Wang and D. C. Weng

Greenhouse Gases Emission

V této sekci bylo prezentováno 5 plenárních přednášek, 6 krátkých sdělení a 2 postery.

Sekce byla zaměřena na hodnocení provozu ekologických zařízení z hlediska jejich energetické bilance a energetické soběstačnosti a náročnosti na jejich provoz. V tomto ohledu je znalost našich pracovníků na vysoké úrovni, nicméně za zmínku stojí prezentace některých matematických modelů, odvodňování kalů pomocí solární energie, nástroje pro úsporu energie na ČOV, simultánní využití elektrické energie a fosforu z prasečí kejdy, nové postupy při optimalizaci produkce metanu.

Plenární přednášky– Greenhouse Gases Emission

Microalgae bring an opportunity to reduce the CO_2 footprint of WWTPs by coupling biogas upgrading and nutrients removal from centrates.

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The performance of a 180 L high rate algal pond (HRAP) coupled with a 0.63 L external bubbled column for the simultaneous removal of H_2S and CO_2 from biogas was evaluated. Despite showing a comparable CO2 transfer capacity than that of a column packed with raschig rings at the pHs (7, 8, 9, 10) and flow rates (20, 40, 60, 80 ml/min) tested, the bubble column was preferred based on its ease of operation. When operated under continuous mode with mineral salt medium at 23 days of residence time, a biogas supply of 20 ml/min to the column and a recycling cultivation broth flow rate of 20 ml/min between the HRAP and the absorption column, the combined system was capable of removing 100 % of the H_2S supplied (up to 5000 ppmv) and 90 % of the CO_2. A switch in operation to diluted centrates resulted in a gradual decrease of the algal biomass concentration from 1.4 to 0. 6 g/l and steady CO_2 removals of 40 %, but H2S removal remained at 100 %. The anaerobic digestion of the algal-bacterial biomass produced during biogas upgrading resulted in CH_4 productivities of 0.21-0.27 L CH_4. The results here obtained confirm that microalgae can reduce the CO_2 footprint of the plant by removing CO_2 from biogas and by improving the energetic balance through the anaerobic digestion of the generated algal-bacterial biomass.

Plenární přednášky– Greenhouse Gases Emission

Interplay of intermediates in the formation of NO and N_2O during full-scale partial nitritation/anammox

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Next to energy- and cost-efficiency, sustainability is evolving as a benchmark for wastewater treatment. Taking into account the high global warming potential of nitrous oxide (N2O), minimization of its emission is gaining attention. As the formation of N_2O and nitric oxide (NO) is complex and relies on the interplay of different intermediates, such as nitrite (NO_2-) and hydroxylamine (NH_2OH), a detailed monitoring of all nitrogen species in both the gas and liquid phase was performed in this study. The aim was to find a link between measurable N components, operational conditions and the NO/N_2O emissions from a full-scale one-step partial nitritation/anammox reactor. High nitrogen loading rates, resulting in highly dynamic cycles with rapid on/off aeration regimes, resulted in higher NO and N_2O emissions, indicating that transient conditions favour both N_2O and NO emission. Therefore, the beginning of a cycle during which most changes in operational conditions occurred was studied in detail. At the beginning of the cycle a lag phase in N_2O and NO (30 and 15 min., respectively) emission was measured. Sudden peaks in ammonium oxidation rate up to 335 kg d^{-1} were accompanied with transient accumulations of NO_2 - (up to 0.2% of NH_4 + consumption) and/or NH_2OH (up to 0.001% of NH_4+consumption) and resulted in N_2O and NO emission peaks. Despite the complex interplay of many factors, this study showed that NH_2OH accumulation and NO/N_2O emission can be correlated positively. Therefore, a better understanding of the conditions leading to NH_2OH accumulation could help to find strategies to minimize N_2O and NO emission.

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Plenární přednášky– Greenhouse Gases Emission

Real-time monitoring of nitrous oxide emissions from a fullscale nitrifying activated sludge plant in the UK

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Nitrous oxide (N_2O) is a greenhouse gas about 310 times more potent than carbon dioxide produced and emitted during biological wastewater treatment. This study reports on the online, continuous quantification of N_2O fluxes in a full-scale nitrifying activated sludge plant under plug flow conditions. The study was performed over eight weeks and evaluated temporal as well as spatial profiles within a treatment lane. Nitrous oxide emissions were significantly correlated with diurnal flow patterns experiences in the plant, with higher emissions corresponding to peak load events. Spatially, the majority of the emissions were observed immediately after the anoxic zone, at the peak of the nitrification zone, and at the end of the lane. The overall emission factor for the plant during the eight week trial was 0.2 % N_2O-N/influent total nitrogen, which is in agreement with UK water industry estimates. The carbon footprint associated with process emissions corresponded to an additional 13 % of carbon equivalents needed for providing treatment with the activated sludge plant. Results are being used to inform investment and operational strategies decisions to balance energy use and process emissions in Severn Trent Water.

Postery - Greenhouse Gases Emission

Greenhouse emissions from CW treating municipal and industrial wastewater

D. de la Varga, T. Carballeira, I. Ruiz and M. Soto

Treatment of simulated biomass gasification wastewater using an algalbacterial system

H. Jeswani and S. Mukherji

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Emerging Contaminats

V této sekci bylo prezentováno 5 plenárních přednášek, 10 krátkých sdělení a 34 postery.

Sekce byla zaměřena na procesy likvidace nově se vyskytujících nebezpečných látek, převážně xenobiotik, jako jsou 3,4-dichloroanilin, benzotriazol a jeho deriváty, fenol, polychlorované bifenyly a DDT (adsorpce na aktivním uhlí), herbicidy.

Velice zajímavé a pro nás inspirativní příspěvky byly z oblasti výskytu a likvidace kosmetických přípravků, farmaceutických preparátů biomagnetickou technikou, likvidace veterinárních antibiotik dvoustupňovým nitrifikačním procesem a analytická technika na stanovení farmaceutických sloučenin v odpadních vodách z nemocnic. Likvidace těchto látek se v současné době dostává do popředí zájmu v souvislosti se stále zvyšující spotřebou léčiv a jejich rostoucím zastoupení v odpadních vodách. Jejich odstraňování z odpadních vod je velice složité a s ohledem na lidské zdraví nesmírně důležité. Je proto důležité nejen technologické řešení, ale i analytické, které dovoluje důsledně sledovat úspěšnost použité technologie.

Plenární přednášky– Emerging Contaminants

Removal of Micropollutants by Various Aerobic Energy-Free Treatment Processes

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The present work details the results of a comprehensive study dealing with 127 priority and emerging micropollutants. It focused on energy-free processes that are suitable for rural areas, as they involve passive aeration supply: stabilization pond, vertical and horizontal flow constructed wetlands, trickling filter, rotating biodiscs associated or not with reed-bed filters. The research work involved powerful and sensitive analytical techniques to measure micropollutants concentrations in wastewaters in order to calculate robust removals by the 6 types of treatment and evaluate released fluxes. This work also allowed to point out the micropollutants that would require further treatment.

Plenární přednášky– Emerging Contaminants

Persistent and emerging pollutants removal under anaerobic conditions: 15 years of experience

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Trace organic contaminants (TOCs) correspond to a broad range of molecules generated either directly or indirectly by human activity. Even though TOCs are found at low concentrations in the environment, they often accumulate by biomagnification into biological organisms and cause irreversible damages in biological systems through direct or indirect toxic effects, *e.g. endocrine disruption, carcinogenic* effect,.. Moreover, increasing amounts of industrial and urban TOCs are worldwide generated every year and effluent-collecting treatment plants are one of the most interesting spots for studying their fate in natural microbiological systems. The present manuscript reports the main findings of fifteen years of research based on the biological removal of various TOC found in sewage treatment plants. A specific focus is made on the anaerobic microbial processes in complex ecosystems. Four families of compounds mostly retrieved in urban plants were studied: the polycyclic aromatic hydrocarbons, the polychlorobiphenyls, the phthalic acid esters and the nonylphenol ethoxylates. It was observed that the microbial potentiality for removing low amounts of TOCs requires a long adaptation time and is often limited by the bioavailability of these compounds. Technological solutions for removing efficiently these compounds are presented. The overall biodegradation is resulting from the numerous interactions existing between the matrix (organic matter) and the microbial ecosystems according to the physico-chemical properties of sorption of these compounds. Mechanistic aspects were also tackled in depth, and specific models were developed for better understanding the network of interactions between TOC, microorganisms and the organic matter. Finally it was found that microbial cometabolism is essential for TOC removal, and the concept of bioavailability is not only dependent of the nature, the level and the sorption properties of TOC but it is also strongly dependent of the nature and the level of the sludge organic matter. Specific parameters are proposed for better evaluating the fate of TOC in microbial anaerobic processes.

Plenární přednášky– Emerging Contaminants

Trace organics removal by an IFAS-MBR system and comparison with MBR and conventional activated sludge technology

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A novel wastewater treatment process, the IFAS-MBR, was obtained from the combination of the integrated fixed-film activated sludge (IFAS) and membrane bioreactor (MBR) technology by introducing plastic carriers in the aerobic reactor of an MBR pilot plant. The plant had two lines in parallel, one working with hollow fibre and the other with flat sheet technology and it was operated during nine months. Additionally, a reverse osmosis (RO) unit treated the IFAS-MBR permeate. In order to evaluate the removal of trace organics by the new technology, 17 pharmaceutical active compounds (PhACs) and 22 other organic micropollutants were analysed regularly in the influent and permeate from the two lines of the IFAS-MBR and the RO. The elimination rates of the IFAS-MBR were higher to those of the previously existing MBR for the hormones. Compared to both the conventional activated sludge system and the MBR, the removal rates for the recalcitrant compound carbamazepine were significantly higher, achieving removal rates up to 55%. The increase in removal for the hormones and the carbamazepine was attributed to the presence of the biofilm that may lead to different conditions (aerobic-anoxic-anaerobic)

along its profile and also to a higher sludge age of the biofilm. The removal rates for the rest of compounds were quite similar for all processes studied. There were no big differences between the performance of the hollow fiber and the flat sheet line. The RO increased the elimination rates up to 85-100%. The IFAS-MBR achieves a high effluent quality for reuse in a very compact system.

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Plenární přednášky– Emerging Contaminants

The role of bioassays in the assessment of ozonation suitability for the removal of EDCs from wastewater

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WWTPs (WasteWater Treatment Plants) effluents are considered to be a major source for the release of EDCs (Endocrine Disrupting Compounds) in the aquatic environment. Though at very low concentrations, EDCs are able to interfere with regulation mechanisms controlled by estrogens, responsible for the maintenance of homeostasis, reproduction and development in vertebrates. Chemical analyses can successfully reveal the presence of EDCs, but only biological assays are able to measure the total estrogenic activity of a sample. In this work, the effluent of a Conventional Activated Sludge (CAS) system, treating a wastewater containing industrial (textile) inputs, and the performance of a tertiary ozonation were investigated. In particular, MCF-7 *in vitro* biological assay (E-SCREEN) was successfully applied for estrogenicity determination, displaying that the ozonation stage was only partially able to reduce it; then, a comparison between measured (by means of bioassay) and predicted (through chemical analysis) estrogenic activity was executed: experimental data highlighted a discrepancy between the two measurements (higher values for the former) and, as a consequence, the effective estrogenic abatement achieved by means of ozonation was significantly lower than the one predicted based on EDCs concentration.

Plenární přednášky– Emerging Contaminants

Improving removal of Pharmaceutical and Personal Care Products (PPCPs) in STPs

E. Fernandez-Fontaina, T. Alvarino, R. Reif, M. Carballa, S. Suárez, F. Omil and J.M. Lema

School of Engineering, University of Santiago de Compostela, Galicia, Spain.

Biodegradation kinetic constants (k_{biol}) and solid-liquid partitioning coefficients (K_d) of PPCPs have been determined for the main types of biological sludges present in sewage treatment plants (heterotrophic, nitrifying, anaerobic). This information is crucial to develop models for the prediction of the PPCPs fate, which can be used to optimise existing processes as well as to design innovative configurations to increase micropollutants removal. This work shows that these biodegradation and sorption coefficients depend on the type of biomass and on the performance of the primary metabolism (concerning nitrogen and COD) of the microorganisms present in the activated sludge. Therefore, the selection of a treatment strategy for improving the overall removal of these micropollutants should be based on models that incorporate accurate information about these coefficients.

Postery - Emerging Contaminants

Stimulating the Bioremediation of Propanil and its Metabolite 3,4-dichloroaniline
R. Marques, A. Oehmen, J. P. Noronha, G. Carvalho and M. A. M. Reis

Hexachlorobenzene dechlorination in constructed wetland mesocosms
Y. Q. Zhou, T. Tigane, X. Z Li, M. Truu, J. Truu and Ü. Mander

Enhanced TCE degradation by encapsulated *B. Cepacia* G4 under aerobic cometabolism using toluene as substrate
S. Hamid, W. Bae, M. T. Amin, A. A. Alazba and U. Manzoor

Benzotriazole and its derivatives: environmental occurrence andbiodegradation patterns with different activated sludge biocenoses
B. Herzog, H. Lemmer, H. Horn and E. Müller

Role of dissolved and colloidal matter on the distributionand the removal of PAHs in sewage sludge
G. Cea-Barcia, H. Carrère, H. Budzinski, K. Le Menach and D. Patureau

Catalytic hydrodechlorination of 2,4-D and MCPA herbicidesusing pillared clays
C. B. Molina, A. H. Pizarro, J. A. Casas and J. J. Rodríguez

The evaluations of antibiotic resistant plasmid transfers by various microcontaminant stressors
S. Kim, D. Kim, U. H. Ha, Y. Cho and Z. Yun

Adsorption of polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT) onto activated carbon in aqueous phase
V.-N. Tran and A. Perrard

Fate and behaviour of pharmaceuticals during hydrothermal carbonization
C. vom Eyser, K. Palmu, R. Otterpohl, T .C. Schmidt and J. Tuerk

Degradation and by-product formation of ofloxacin with ozonation, UV and UV/H_2O_2-treatment
C. vom Eyser, A. Börgers, J. Richard, E. Dopp, K. Bester and J. Tuerk

Efficient hydrogen peroxide usage in sulfamethazine remediation via advanced oxidation processes
M. Pérez-Moya, E. Yamal, L. Pérez-González, H. D. Mansilla and M. Graells

Quantum efficiencies of the photo-fenton mineralization of a commercial herbicide 2,4-D amine in water
L. O. Conte, E. D. Albizzati and O. M. Alfano

Postery - Emerging Contaminants

Ranking the impact on freshwater ecosystems of pharmaceuticals detected in biosolids applied to agricultural soils

S. Morais, C. Delerue-Matos, X. Gabarrell and P. Blánquez

Monitoring and risk assessment of pharmaceutical compounds in two WWTP effluents and their receiving rivers in the Po Valley, Italy

M. Al Aukidy , P. Verlicchi, A. Jelic and M. Petrovic

Fate of benzotriazole in wastewater treatment plants in Poland

E. Felis, J. Surmacz-Gorska, A. Ziembinska and A. Gnida

Study of the inhibition of biological treatment process for fungicide

J. G. Berlanga, E. J. Santateresa, L. Basiero, J. I. Briones, E. Olivas, B. Chiva, C. Ferrer, I. Bernacer, P. de Llago and J. Martí

Yeast residue from ethanol industry as biosorbent of 17-α-ethinyl estradiol: a chemometric approach

K. Debs, H. D. T. Silva, M. L. L. Moraes and G. Labuto

Phenol degradation by Fenton process in presence of EDTA at circumneutral pH

S. Ashagre, F. Stüber, C. Bengoa, A. Fortuny, A. Fabregat and J. Font

Removal of pharmaceuticals in wastewater treatment plant effluent using the microbial carrier process

K. Komori, Y. Okayasu, M. Minamiyama and Y. Suzuki

Coupling Fenton oxidation and biological treatment for the degradation of MCPA in water

S. Sanchis, A. M. Polo, A. F. Mohedano and J. J. Rodríguez

Degradation of pesticides in wastewaters of sugar cane crops using solar photocatalysis coupled to sub-surface flow constructed wetlands

T. Arriaga-Barrios, C. A. Madera-Parra, J. Colina-Márquez, F. Machuca-Martínez and M. Pinzón

Sequential process of anaerobic sequencing batch reactor/moving bed sequencing batch biofilm reactor as a promising technique for treatment of an azo dye-containing wastewater

E. Hosseini Koupaie, M. R. Alavi Moghaddam and S. H. Hashemi

Bio-Magnetic technique in treatment of pharmaceutical industry wastewater

S. A. Bash

Postery - Emerging Contaminants

UV/TiO_2 photocatalytic degradation of xanthene dyes solutions
L. Pereira, R. Pereira, C. S. Oliveira, L. Apostol, M. Gavrilescu and M. M. Alves

Bioindicative study in acetamiprid treatment with a SBR
M. F. López-Pérez, S. Palacios and A. M. Amat

Biodegradation of a persistent PhAC metabolite: clofibric acid
R. Salgado, A. Oehmen, G. Carvalho, J. P. Noronha and M. A. M. Reis

Fate of adsorbable micro-pollutants through sludge drying and composting processes
S. Besnault, S. Martin Ruel, J.-M. Choubert, H. Budzinski, C. Miège, M. Esperanza, N. Noyon, S. Garnaud and M. Coquery

Veterinary antibiotic removal in a two step nitrification process treating manure digestate
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Analysis of pharmaceutical compound in hospital wastewaters
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Colloids masking the detability of pharmaceuticals in wastewaters?
G. Kooijman, M. K. de Kreuk and J. B. van Lier

Matching micropollutant loads of influent and effluent for reliable mass balances in WWTPs
M. Majewsky, J. Farlin, T. Gallé and M. Bayerle

Towards overcoming TOC increase in wastewater treatment with Moringa oleifera seed extract
J. Beltrán-Heredia, J. Sánchez-Martín and A. Muñoz-Serrano

Emerging pollutants in water: the case of Methylparaben. Removal by UV radiation and study through Design of Experiments.
J. Beltrán-Heredia, J. Sánchez-Martín and J. R. Domínguez

Removal of linear alcohol ethoxylate (LAE) in anaerobic fluidized bed reactor
F. Moterani, J. K. Braga, E. L. Silva and M. B. A. Varesche

Management Tools

V této sekci bylo prezentováno 5 plenárních přednášek, 10 krátkých sdělení a 22 posterů.

Sekce byla zaměřena na prostředky vedoucí k důslednému řízení a kontrole technologií nejen na ČOV, ale např. na mokřadech, v oblasti mořské vody (inhibiční působení solí na mikrobiální konsorcium), modelování a simulace hybridního membránového reaktoru

Plenární přednášky - Management Tools

Development of Life Cycle Inventories of wastewater treatment systems: the case of activated sludge technology

F. Hernández-Padilla, A.J. Padilla-Rivera, L.P. Güereca, J. M. Morgan-Sagastume, A. Noyola

Engineering Institute (Instituto de Ingeniería), Universidad Nacional Autónoma de México, Ciudad Universitaria, Distrito Federal CP 04510, México (fhernandezp@iingen.unam.mx)

Life Cycle Inventory (LCI) of water treatment systems was developed for the activated sludge technology considering three flows: small, medium and large, focusing on evaluating the effect of each unit process within each size flow in regard mainly to energy. The input flow is based on data representative of the Latin America and the Caribbean (LAC) region, which were obtained by collecting data from six countries in to LAC. Similarly input and output of each unit process are based on real site data of 158 wastewater treatment plants within the region. The inventory results indicate that the aeration tank is the unitary process which presents the highest levels of organic matter removal and also is staged with higher consumption of electricity. As expected, sewage sludge and operational energy increase with increasing of flow. Nevertheless operational energy per m^3 decreases. The LCI obtained will be input for the evaluation of the life cycle impact.

Plenární přednášky - Management Tools

Comparative Life-Cycle Assessment of wastewater technologies - Constructed wetlands vs Activated sludge systems

E. Risch*, C.Boutin**, Sylvie Gillot***, Alain Héduit*** and Philippe Roux*

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Wetland ecosystems are known for their physical, chemical and biological microbial processes at play in pollutant breakdown and removal from water passing through these systems. Over the past decades in Europe, man-made ecosystems such as constructed wetland systems (CW) have been successfully harnessed to treat sewage and other pollutants in waste waters. Although there have been a few studies on CW systems, most of these assess alternative CW systems without comparing them to classic wastewater treatment technologies. This paper presents a comparative Life Cycle Assessment (LCA) (1) study between (i) a 2-stage vertical Reed Bed Filter (vRBF), and (ii) a conventional Activated Sludge (AS) system featuring an enhanced phosphate elimination involving precipitating agents and flocculants in the sludge conditioning process, both designed following usual French guidelines in domestic sewage treatment. The first LCA applicability challenge is to get an equilibrated mass balance between wastewater inputs in Nitrogen, Phosphorus, Carbon and systems outputs. This consists in conducting a complex inventory of all air emissions from the treatment units and of all substances retained in sludge, and in rhizomes, reeds (above-ground) and filter matrix for the vRBF. Then, to complete the LCA a further inventory is proposed following the end-of-life processes applied to the byproducts of the vRBF system, e.g. spreading, composting or land-filling of sludge; onsite burning of reeds and rhizomes. Indeed, most of the previous LCA studies on CW systems were focussed mainly on system construction and operation, choosing not to investigate in detail the end-of-life of these by-products. The second LCA challenge overcome in this work is to enable grounds for comparison in terms of treatment efficiency between the two types of systems. Although the choice of "functional unit" is critical in a comparative LCA study, it is of importance to include not only the resources used by each system but also to define effluent and sludge qualities since the systems' performances are different. The sewer network is excluded from the system boundaries since it is assumed that the collection and transportation of wastewater would be the same for the alternative wastewater treatment processes compared in this study. In this study, the chosen methods for Impact Assessment are ReCiPe with 16 midpoint categories and USEtox for 2 midpoint categories in Toxicity. Contribution diagrams over the whole life cycle stages of the wastewater treatment systems help understand the relative importance of each phase – construction, operation and maintenance, dismantling and final disposal. Results from the systems comparison using the same characterization method show that the vRBF outperforms the AS system in all impact categories with the exception of Eutrophication and Urban Land Occupation. In both systems, Eutrophication is caused by the water discharges, highlighting the weaker removal efficiency of the vRBF on nitrates, organic nitrogen and phosphates. Finally, the article analyses the applicability and limitations of LCA for wastewater treatment comparison in terms of water quality. Research perspectives to improve the method and enrich current databases are finally drawn from this study.

Plenární přednášky– Management Tools

Simulation based analysis of new layouts for eco-efficient Sewage Treatment Plants

T. Fernández [a], P. Grau [a], J. Abelleira [b], A. Donoso-Bravo [c], S. Pérez-Elvira [c], J.M. Lema [d], J.L. Campos [d], S. Suárez [d], A. Mosquera-Corral [d], and E. Ayesa[a]

[a] *CEIT and Tecnun (University of Navarra), 15 Paseo Manuel de Lardizabal, San Sebastián 20018, Spain (tfernandez@ceit.es)*

[b] *Department of Chemical Engineering and Food Technologies, University of Cádiz, C/República Saharaui, s/n, 11510 Puerto Real (Cádiz), Spain*

[c] *Department of Chemical Engineering and Environmental Technology, University of Valladolid, Prado de la Magdalena s/n, 47011, Valladolid, Spain;*

[d] *Department of Chemical Engineering, University of Santiago de Compostela, Santiago de Compostela, Spain*

This study presents and discusses the usefulness of mathematical models and simulation tools to describe the dynamic behaviour of advanced wastewater treatment plants taking into account technical, environmental, energetic and economical aspects. The main challenge of this work is to compare by simulation different conventional and advanced WWTPs configurations using the models library developed in the context of the NOVEDAR_Consolider project. Five different configurations are proposed for this study: a conventional wastewater treatment plant (BSM2 layout); the substitution of conventional activated sludge unit by an aerobic granular system; the combination of a high rate activated sludge system, operating at short retention, coupled with an autotrophic system for nitrogen removal; the use of a Thermal Hydrolysis (TH) reactor as sludge pretreatment; and a membrane anaerobic reactor in the water line coupled with an autotrophic unit.

Plenární přednášky - Management Tools

Carbon Footprints of Scandinavian Wastewater Treatment Plants

D. J. I. Gustavsson* and S. Tumlin**

** VA SYD, Box 191, S-201 21 Malmö, Sweden (david.gustavsson@vasyd.se)*

*** Gryaab, Box 8984, S-402 74 Gothenburg, Sweden*

This study estimates the carbon footprints of 15 municipal wastewater treatment plants (WWTPs), all situated in Scandinavian countries, by using a simple model. The carbon footprint calculations were based on operational data, literature emission factors and measurements of greenhouse gas emissions at some of the studied WWTPs. Generally, the major positive contributors to the carbon footprint were direct emissions of nitrous oxide and methane from wastewater treatment. No carbon neutral WWTPs were found. The choice of emission factors largely influenced the carbon footprint. High biogas generation and avoidance of addition of external fossil carbon source for denitrification are important factors to minimize the carbon footprint at a WWTP.

Plenární přednášky - Management Tools

Development of mass flow-based Life Cycle Assessment tool for sewage sludge treatment and disposal

H. Yoshida, J. Clavreul, C. Scheutz, T.H. Christensen

Department of Environmental Engineering, Denmark Technical University, Building 113 Milijøvej, Kgs. Lyngby 2800, Denmark (*hyos@env.dtu.dk;julc@env.dtu.dk; chas@env.dtu.dk;thhc@env.dtu.dk)*

Management of sewage sludge have to take wide range of sustainable imperatives in consideration and Life Cycle Assessment (LCA) is gaining its ground to provide quantitative information of environmental performance. Nonetheless, baseline data and user-friendly accessible LCA tool are still scarce in water/wastewater industry. Taking this challenge, substance flow analysis of operating wastewater treatment plant was conducted. The result was used to expand the existing mass flow based LCA tool,EASEWASTE to sewage sludge management. The study concluded that process based approach is well applicable to sewage sludge treatment processes.

Poznatky z konference se hodí zařadit jako ekoinovace do následujících předmětů fakulty

- *Alternativní zdroje energie I –předúprava a odvodnění kalů*
- *Alternativní zdroje energie II - monitorování anaerobního procesu*
- *Výroba energie z biomasy – zlepšení procesu a zvýšení produkce metanu vhodnou předúpravou, předcházení pachových problémů, odsiřování bioplynu*
- *Ekologie – výroba ekoplastů, výskyt a likvidace xenobiotik v životním prostředí*
- *Základy toxikologie a ekologie - výroba ekoplastů, výskyt a likvidace xenobiotik v životním prostředí*
- *Základy čištění odpadních vod – biologické odstraňování nutrientů z OV – fosfor, denitrifikace (heterotrofní x autotrofní)*
- *Technologie výroby bioplynu a biovodíku – zlepšení procesu a zvýšení produkce metanu vhodnou předúpravou, předcházení pachových problémů, odsiřování bioplynu oxidací a autotrofní denitrifikací- spojené odstraňování dusíku a sulfanu z bioplynu*
- *Chemie ovzduší – emise skleníkových plynů, emise sirných sloučenin*
- *Kvalita ovzduší a její kontrola - emise skleníkových plynů, emise sirných sloučenin, pachové problémy kalů a zemědělských vstupů do anaerobních technologií*
- *Úprava vody – nové perspektivy v oblasti koagulantů s ohledem na lidské zdraví*
- *Analytika vody - léčiva a veterinární antibiotika a kosmetické přípravky - riziko pro odpadní vody a životní prostředí, analytické stanovení těchto látek ve vodách*
- *Hydrochemie - léčiva a veterinární antibiotika a kosmetické přípravky - riziko pro odpadní vody a životní prostředí, analytické stanovení těchto látek ve vodách*
- *Ochrana čistoty vod - Výskyt a odstraňování xenobiotik ze životního prostředí*

Ekoinovace pro předmět

Alternativní zdroje energie I a II

Název ekoinovace pro daný předmět

- monitorování anaerobního procesu,
- termická předúprava vstupu do anaerobního procesu a její vliv na produkci metanu,
- biologické odsiřování bioplynu (s dusičnany)
- odvodňování kalů pomocí solární energie
- předúprava kalů ultrazvukem

Ultrasonic pre-treatment effect on wastewater sludge

Y. Segura, F. Martinez, R. Molina and J. A. Melero

Monitoring anaerobic processes: measurement uncertainty evaluation and validation of a method for determination of volatile fatty acids in fermentation broths

A.Drolc, M. Cotman and A. Pintar

Thermal pre-treatment to improve sludge anaerobic degradability : effects of microwave and classical heating

P. Vergine, J. Zabranska, R. Canziani

Advanced thermal hydrolysis as a pretreatment for conventional anaerobic digestion of sewage sludge: effect on methane production

J. Abelleira, S. I. Pérez-Elvira, J. Sánchez-Oneto, J. R. Portela and E. Nebot

Anaerobic digestion of flocculent and granular sludge under brackish conditions

T. Palmeiro, A. Val del Río, A. Mosquera-Corral, J. L. Campos and R. Méndez

Denitrification of reclaimed wastewater during transportation with limited organic compounds

L.E. Rodriguez-Gómez, M.Álvarez, A. Hernández, J. Rodriguez and M.C. Marrero

Dewatering of sewage sludge assisted by solar energy

D. Giannelos and I.D. Manariotis

Biofiltration of H_2S in biogas with *Thiobacillus denitrificans* under anoxic conditions

M. Fernández, M. Ramírez, R. M. Pérez, J. M. Gómez and D. Cantero

Ekoinovace pro předmět

Výroba energie z biomasy

Název ekoinovace pro daný předmět

- monitorování anaerobního procesu,
- termická předúprava vstupu do anaerobního procesu a její vliv na produkci metanu,
- biologické odsiřování bioplynu (s dusičnany)
- odvodňování kalů pomocí solární energie

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Ekoinovace pro předmět

Ekologie

Velká část příspěvků byla věnována likvidaci ekologicky závadných látek převážně xenobiotik, jako jsou 3,4-dichloroanilin, benzotriazol a jeho deriváty, fenol, polychlorované bifenyly a DDT (adsorpce na aktivním uhlí), herbicidy, farmaceutické přípravky a veterinární léčiva.

Zajímavým problémem je izolace PHB a PHA, zásobních látek bacteriálního konsorcia během biologického zpracovávání odpadů, a její následné využití pro výrobu snadno biologicky rozložitelných plastů (**Wastewater based biorefineries,** *M. C. M. van Loosdrecht and R. Kleerebezem)*

Přínosem pro tento předmět je prakticky celá sekce věnovaná Emerging Contaminats

Ekoinovace pro předmět

Základy toxikologie a ekologie

Velká část příspěvků byla věnována likvidaci ekologicky závadných látek převážně xenobiotik, jako jsou 3,4-dichloroanilin, benzotriazol a jeho deriváty, fenol, polychlorované bifenyly a DDT (adsorpce na aktivním uhlí), herbicidy, farmaceutické přípravky a veterinární léčiva.

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OPPA PRAHA PRAGUE PRAGA PRAG EVROPSKÁ UNIE
Evropský sociální fond
Praha & EU: Investujeme do vaší budoucnosti
VŠCHT PRAHA

Ekoinovace pro předmět

Základy čištění odpadních vod

Významným přínosem pro tento předmět je řešení problematiky farmaceutických odpadních vod a odpadních vod z oblasti výrob kosmetických přípravků a veterinárních léčiv. Tyto látky jsou ze životního prostředí velice těžko odbouratelné a jejich hromadění významně ovlivňuje lidské zdraví. Řešení této problematiky by mělo mít velký prostor jak ve výzkumu, tak ve výuce, což by mělo mít za následek využití získaných poznatků v následné praxi absolventů. Spolu s řešením problematiky odstraňování těchto látek je velice důležitá rozvíjející se oblast analytického stanovení těchto látek, která je nedílnou součástí vyvíjených technologií odstraňování daných xenobiotik. Objevily se i nové technologie – Electroflox, membránové technologie (zde má FTOP velké zkušenosti a poznatky),..

Monitoring and risk assessment of pharmaceutical compounds in two WWTP effluents and their receiving rivers in the Po Valley, Italy

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Electroflox : a new technology for wastewater treatment

L.G.Zapata, R. Camargo-Amado, N.Marriaga-Cabrales, F. Machuca-Martinéz

An integrated process MBR / solar photo-Fenton for wastewater reuse

A. Cabrera Reina, J. L. Casas López, I. Carra Ruiz and I. M. Román Sánchez

Cultivation of microalgae for nutrient removal from the effluent of a submerged anaerobic membrane bioreactor (SAnMBR)

A. Ruiz-Martinez, N. Martí, J. Ferrer and A. Seco

Investigation of a membrane aerated biofilm reactor for the treatment of landfill leachate

E. Syron, R. Heffernan and E. Casey

Industrial herbal extraction wastewater treatment using an anaerobic membrane bioreactor

C. Brand, A. Sánchez, M. Chlaida and M. Kraume

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Evropský sociální fond
Praha & EU: Investujeme do vaší budoucnosti

VŠCHT PRAHA

Ekoinovace pro předmět

Technologie výroby bioplynu a biovodíku

Název ekoinovace pro daný předmět

- monitorování anaerobního procesu,
- termická předúprava vstupu do anaerobního procesu a její vliv na produkci metanu,
- biologické odsiřování bioplynu (s dusičnany)
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- kofermentace některých druhů odpadů

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T. Palmeiro, A. Val del Río, A. Mosquera-Corral, J. L. Campos and R. Méndez
Denitrification of reclaimed wastewater during transportation with limited organic compounds
L.E. Rodriguez-Gómez, M.Álvarez, A. Hernández, J. Rodriguez and M.C. Marrero
Dewatering of sewage sludge assisted by solar energy
D. Giannelos and I.D. Manariotis
Biofiltration of H_2S in biogas with *Thiobacillus denitrificans* under anoxic conditions
M. Fernández, M. Ramírez, R. M. Pérez, J. M. Gómez and D. Cantero

Ekoinovace pro předmět

Chemie ovzduší

Problematika spojená
- s produkcí a monitorováním skleníkových plynů
- zápachy spojenými s produkcí bioplynu,
- vliv různých druhů předúpravy kalů na jejich další možný zápach,
- vliv pH a teploty na generaci zápachu z prasečí kejdy,
- odstraňování sulfanu z bioplynu

Effect of different sludge pre-treatments on the potential odour footprint of secondary sewage sludge
M. Lira, J. Abelleira, R. Muñoz, A. Carvajal and R. Lebrero
The effect of pH and temperature in the generation of odor from swine slurry
G. Ortiz, C. A. Villamar and G. Vidal
Greenhouse emissions from CW treating municipal and industrial wastewater
D. de la Varga, T. Carballeira, I. Ruiz and M. Soto
Treatment of simulated biomass gasification wastewater using an algalbacterial system
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Biofiltration of H_2S in biogas with *Thiobacillus denitrificans* under anoxic conditions
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Biooxidation of sulphide in moderately aerated reactor
D. Pokorná, J. Zábranská, P. Rýdl and D. Ečerová

Ekoinovace pro předmět

Kvalita ovzduší a její kontrola

Problematika spojená
- s produkcí a monitorováním skleníkových plynů
- zápachy spojenými s produkcí bioplynu,
- vliv různých druhů předúpravy kalů na jejich další možný zápach,
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Ekoinovace pro předmět

Úprava vody

Použití nových koagulantů/flokulantů s ohledem na lidské zdraví

Coagulants/Flocculants recommended by the Council Directive 98/83/EC, on the quality of water intended for human consumption: analysis, application and new perspectives

R. Devesa-Rey, X. Vecino, J. M. Cruz and A. B. Moldes

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Ekoinovace pro předmět

Analytika vody a Hydrochemie

Léčiva a veterinární antibiotika a kosmetické přípravky

- riziko pro odpadní vody a životní prostředí
- analytické stanovení těchto látek ve vodách, monitoring anaerobního procesu (NMK)

Yeast residue from ethanol industry as biosorbent of 17-α-ethinyl estradiol: a chemometric approach

K. Debs, H. D. T. Silva, M. L. L. Moraes and G. Labuto

Analysis of pharmaceutical compound in hospital wastewaters

M. Gómez, M. J. Vázquez, F. Omil and S. Suárez

Monitoring and risk assessment of pharmaceutical compounds in two WWTP effluents and their receiving rivers in the Po Valley, Italy

M. Al Aukidy , P. Verlicchi, A. Jelic and M. Petrovic

Colloids masking the detability of pharmaceuticals in wastewaters?

G. Kooijman, M. K. de Kreuk and J. B. van Lier

Monitoring anaerobic processes: measurement uncertainty evaluation and validation of a method for determination of volatile fatty acids in fermentation broths

A.Drolc, M. Cotman and A. Pintar

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Ekoinovace pro předmět

Ochrana čistoty vod

Výskyt a odstraňování xenobiotik ze životního prostředí - 3,4-dichloroanilin, benzotriazol a jeho deriváty, fenol, polychlorované bifenyly a DDT (adsorpce na aktivním uhlí), herbicidy, farmaceutické přípravky a veterinární léčiva, kosmetické přípravky,....

Monitoring and risk assessment of pharmaceutical compounds in two WWTP effluents and their receiving rivers in the Po Valley, Italy
M. Al Aukidy , P. Verlicchi, A. Jelic and M. Petrovic
Removal of pharmaceuticals in wastewater treatment plant effluent using the microbial carrier process
K. Komori, Y. Okayasu, M. Minamiyama and Y. Suzuki
Veterinary antibiotic removal in a two step nitrification process treating manure digestate
S. Di Fabio, S. Suárez, F. Fatone and F. Omil
Analysis of pharmaceutical compound in hospital wastewaters
M. Gómez, M. J. Vázquez, F. Omil and S. Suárez
Colloids masking the detability of pharmaceuticals in wastewaters?
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Monitoring and risk assessment of pharmaceutical compounds in two WWTP effluents and their receiving rivers in the Po Valley, Italy
M. Al Aukidy , P. Verlicchi, A. Jelic and M. Petrovic
Fate of benzotriazole in wastewater treatment plants in Poland
E. Felis, J. Surmacz-Gorska, A. Ziembinska and A. Gnida
Study of the inhibition of biological treatment process for fungicide
J. G. Berlanga, E. J. Santateresa, L. Basiero, J. I. Briones, E. Olivas, B. Chiva, C. Ferrer, I. Bernacer, P. de Llago and J. Martí
Hexachlorobenzene dechlorination in constructed wetland mesocosms
Y. Q. Zhou, T. Tigane, X. Z Li, M. Truu, J. Truu and Ü. Mander
The evaluations of antibiotic resistant plasmid transfers by various microcontaminant stressors
S. Kim, D. Kim, U. H. Ha, Y. Cho and Z. Yun
Enhanced TCE degradation by encapsulated *B. Cepacia* G4 under aerobic cometabolism using toluene as substrate
S. Hamid, W. Bae, M. T. Amin, A. A. Alazba and U. Manzoor
Emerging pollutants in water: the case of Methylparaben. Removal by UV radiation and study through Design of Experiments.
J. Beltrán-Heredia, J. Sánchez-Martín and J. R. Domínguez
Phenol degradation by Fenton process in presence of EDTA at circumneutral pH
S. Ashagre, F. Stüber, C. Bengoa, A. Fortuny, A. Fabregat and J. Font

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Celkové shrnutí konference/školení

Konference byla profesně zajímavá a velice inspirativně vzhledem k tomu, že byla tematicky poměrně široká a bylo možno vzhledem k tomu, že sekce neprobíhaly paralelně, sledovat více trendů. Přínosné bylo vzhledem k účasti velkého počtu účastníků nejen z různých částí světa, ale i z různých oblastí ekologické problematiky vzájemné setkávání a vyměňování si zkušeností s odborníky z oblasti základního i aplikovaného výzkumu – inovativní technologie z oblasti čištění i úpravy vod, emise skleníkových plynů, technologie v oblasti odstraňování nutrientů a odstraňování nových polutantů – léčiva, veterinární antibiotika,.. Patří tedy mezi akce, kde si novinky ze svého oboru vyberou nejen pracovníci z oblasti čištění odpadních vod, ale i z oblasti anaerobních technologií ve smyslu likvidace kalů a produkce bioplynu z biomasy, úpravy vody, mikrobiologie a analytické chemie.

Plenární přednášky přinesly souhrnný pohled na řešenou problematiku s konkrétními výstupy, krátká sdělení a postery potom podrobněji popisovaly konkrétní řešený problém, se kterým se mohli účastníci konference seznámit v diskusi s autory.

Akci pro její různorodost a dobrou úroveň jak po stránce odbornosti příspěvků, možnosti setkání se stejně zaměřenými kolegy s celého světa i vynikající organizaci mohu doporučit.