

WEF/IWA Nutrient Removal and Recovery Conference 2013

Trends in Resource Recovery and Use

Vancouver, Canada
28 - 31 July 2013

ISBN: 978-1-5108-7151-9

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2013) by Water Environment Federation (WEF)
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact Water Environment Federation (WEF)
at the address below.

Water Environment Federation (WEF)
601 Wythe Street
Alexandria, Virginia 22314
USA

Phone: 1-800-666-0206
Fax: 1-703-684-1545

csc@wef.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Single-Stage Deammonification Process Performance - MBBR Versus IFAS Configurations	1
<i>Zhao, Hong; Lemaire, Romain; Christensson, Magnus; Thesing, Glenn; Veuillet, Frederic; Ochoa, Juan; Lamarre, Daniel; Gadbois, Alain</i>	
Segregation of Microbial Populations and Activities in the Biofilm and Suspended Phases of a Completely Autotrophic Nitrogen-Removal over Nitrite (CANON) Bioreactor	18
<i>Park, Hongkeun; Sundar, Suneethi; Ma, Yiwei; Chandran, Kartik</i>	
Impacts of Hydrazine on Nitrite Oxidizing Bacteria	26
<i>Kim, Young Mo; Chandran, Kartik</i>	
Startup and Process Performance Analysis of a Pilot Anammox MBBR Process at the 26th Ward WWTP in Brooklyn, New York using Microbial Techniques	31
<i>Mehrdad, M.; Park, H.; Ramalingam, K.; Fillos, J.; Beckmann, K.; Deur, A.; Chandran, K.</i>	
Real Time Monitoring of Process Dynamics in Anammox Reactors	47
<i>Kocanemi, Bilge Alpaslan; Dityapak, Duygu</i>	
Kinetics and Thermodynamics of Anaerobic Ammonium Oxidation Process using Brocadia Spp. Dominated Mixed Cultures	64
<i>Puyola, D.; Carvajala, J.M.; Garciaa, B.; Sierra-Alvarez, R.; Fielda, J.A.</i>	
Development of a Fully Automated Struvite Reactor to Recover Phosphorus from Source Separated Urine Collected at Urine Diversion Toilets in eThekweni	74
<i>Grau, Maximilian G.P.; Rhoton, Sara L.; Brouckaert, Chris J.; Buckley, Chris A.</i>	
Characterization of Mixed Liquor in a Pressurized Bioreactor for Nitrifying Urine for Insewer Denitrification	84
<i>Sun, Wei-Jun; Morito, Guillermo Rey; Mackey, Hamish; Chen, uang-Hao</i>	
Potential Evaluation of N, P and K Recovery from Urine: Based on a Combined Treatment Process	92
<i>Xu, Kangning; Zhang, Chi; Li, Jiyun; Zheng, Min; Wang, Chengwen</i>	
Ion Exchange Applications to Source Separated Urine: Pharmaceutical Separation and Phosphorus Recovery	99
<i>Landry, Kelly A.; Sendrowski, Alicia P.; Boyer, Treavor H.</i>	
Nutrient Recovery from Biodigestion Waste (Water) Streams and Reuse as Renewable Fertilizers: A Two-Year Field Experiment	113
<i>Vaneekhaute, Céline; Ghekiere, Greet; Michels, Evi; Vanrolleghem, Peter A.; Meers, Erik; Tack, Filip M.G.</i>	
Phosphorus Recovery from Source Separated Human Urine upon Processing with Clinoptilolite	117
<i>Allar, Ayse D.; Beler-Baykal, Bilsen</i>	
Nitrogen Removal and Recovery Using a Low Cost, Energy Efficient Technology	125
<i>Sutton, Paul M.; Bucher, Doug; Livingston, Dennis; Johnson, Tod</i>	
Enhancement of Tertiary Chemical P Removal by Precipitated Alum Solids Recycle in Full Scale Trials	136
<i>Maher, Chris; Neethling, JB; Pagilla, Krishna</i>	
Nutrient Species Implications for Technology Performance and Water Quality Impacts	152
<i>Neethling, J.B.; Stensel, H David</i>	
A Dynamic Physicochemical Model for Chemical Phosphorus Removal	172
<i>Hauduc, Hélène; Takács, Imre; Smith, Scott; Szabó, Anita; Murthy, Sudhir; Daigger, Glen T.; Sperandio, Mathieu</i>	
Hybrid Bardenpho/Step Feed Process to Achieve Low TN and TP in Cold Climate with Extreme Peak Flows	184
<i>Bassett, Britt D.; Balliet, James; Farrell, James; Marks, Glenn</i>	
BNR with Cloth Filters and Alum Achieve Total P 0.1 MG/L	211
<i>Stevens, Gerry</i>	
Meeting Ultra-Low Effluent Phosphorus in Small, Cold-Climate WWTFs	213
<i>Whalley, Michael; Laidlaw, Sarah; Steel, Paula; Shiskowski, Dean</i>	
Operation of Advanced Instrumentation to Support Enhanced Nutrient Removal: Sensor Selection, Validation, Maintenance, and Calibration	218
<i>Yi, P.; Khunjar, W.; Bilyk, K.; Latimer, R.; Pitt, P.; Bott, C.; O'Shaughnessy, M.</i>	
Factors for Successfully Reducing Effluent Total Nitrogen Below 2.5 mg/L using Conventional Nutrient Removal Strategies	235
<i>Rohrbacher, Joe; Bilyk, Katya; Matthews, Rosalyn; Pitt, Paul; Latimer, Ronald J.</i>	
Impact of Cr(VI) on Nitrification– Physiology, Microbial Ecology and Gene Expression	245
<i>Kim, Young Mo; Park, Hongkeun; Chandran, Kartik</i>	

Improving Simultaneous Nitrogen Removal Performance through Magnetite Addition	250
<i>Jimenez, Jose; Woodard, Steven; Vareika, Matthew; Parker, Denny</i>	
Impact of Chemical Addition and Biological Phosphorus Removal Operation on Phosphorus Recovery	264
<i>Schauer, Peter</i>	
Lessons Learned from Performance Testing of Seven Denitrification Filters under Varying Conditions	277
<i>Crosswell, Scott; Cannon, John; Drainville, Marc; Myers, Raymond; Young, Thor</i>	
Supporting Start-up of BNR Facilities: The Role of Dynamic Modeling	281
<i>Houweling, D.; Johnson, Bruce; Constantine, Tim</i>	
Pilot Study of Tertiary Denitrification Filtration at Extremely Low Temperatures Using Supplemental Carbon Sources	284
<i>Zhu, Ivan; Bates, Brian; Vegso, Gene; Getting, Tom</i>	
Where to Recover Phosphorus: From Source Separated Urine to Central Wastewater Plant	292
<i>Boyer, Treavor H.; O'Neal, Jeremy A.</i>	
Resource Recovery Potential from Side-Streams: An Australian Study	299
<i>Barber, Dr W. P. F.</i>	
Phospaq: Full Scale Experience with Phosphorus Recovery Via Controlled Struvite Precipitation	311
<i>Remy, Maxime; Kruit, Jans; Hendrickx, Tim; Haarhuis, Richard; van Loosdrecht, Mark</i>	
ANAMMOX Combined with Struvite Crystallization: A Sustainable Solution for Nitrogen and Phosphorus Removal and Recovery from Side Stream Processes	318
<i>Hassan, Parssa; Mavinic, Donald S.; Rezanian, Babak; Kelly, Harlan; Lo, Kwang V.</i>	
An Innovative Recovery Process of Phosphorus from Dairy Manure	328
<i>Zhang, Hui; Lo, Victor K.; Mavinic, Donald S.; Thompson, James R.; Atwater, James W.; Liao, Ping H.; Koch, Frederic A.; Lobanov, Sergey</i>	
Energy and Nutrient Recovery from Anaerobically Digested Swine Waste	337
<i>Kinyua, Alex Lin; Maureen; Peña, Oscar; Cunningham, Jeffery; Ergas, Sarina J.</i>	
Design Considerations for a Multiple-Reactor DEMON Process Treating Sludge Liquors from a Thermal Hydrolysis Anaerobic Digester	341
<i>Shaw, Andrew; Thomson, Peter; Stinson, Beverley; Kharkar, Salil; Murthy, Sudhir; deBarbaddillo, Chris; Passarelli, Nick; Wett, Bernhard; Nyhuis, Geert; Wisdom, Blair</i>	
Application of Lessons Learned During a Pilot Investigation to the Full Scale Design of a DEMON® System to Remove Nitrogen from Dewatering Centrate	350
<i>Klein, Adam; Williams, Lynn; Summers, Amanda; Johnson, Chandler; Melcer, Henryk</i>	
Sidestream Nitrogen Removal at the John E. Egan Water Reclamation Plant by Demon® Process	365
<i>Qin, Dongqi; Kozak, Joseph A.; Zhang, Heng; Granato, Thomas; Johnson, Chandler</i>	
Evaluation of the Anita-Mox Moving Bed Biofilm Reactor Process for Sidestream Deammonification at the Robert W. Hite Treatment Facility, Denver Colorado	389
<i>Hollowed, Meg; Stec-Uddin, Edyta; Zhao, Hong; McQuarrie, Jim</i>	
Utilizing Bioaugmentation to Minimize Capital Costs and Space Requirements	400
<i>Esping, Don; Parker, Denny; Jimenez, Jose; Kennedy, Robert; Elias, Dave</i>	
Use of Free Ammonia and Dissolved Oxygen for Process Control of a Sidestream Deammonification Sequential Batch Reactor	410
<i>Mehta, S.; Desmottes, C.; Khunjar, W. O.; Kaldate, A.</i>	
Energy Recovery from Wastewater: Life Cycle Comparison of Carbon Removal Technologies Upstream of Autotrophic Nitrogen Removal	416
<i>Stadlera, Lauren B.; Smitha, Adam L.; Caoa, Ling; Lovea, Nancy G.; Raskina, Lutgarde; Skerlos, Steven J.</i>	
Closing the loop - Strategies for Nutrient and Resource Management in Cities of the Future	422
<i>Jeyanayagam, Samuel; Latimer, Ronald; Khunjar, Wendell</i>	
The 30 Year Evolution of Phosphorus Removal from Tertiary Chemical Removal to Ultra Low Level Enhanced Biological Phosphorus Removal and its Impact on the Water Quality of Lake Mead	427
<i>Drury, Douglas D.; Rizzo, LeAnna</i>	
Designing to a Non-Defined Nutrient Regulation - Business Case Evaluation Applied to Mainstream and Side Stream Treatment Process Selection	438
<i>Melcer, Henryk; Klein, Adam; Ekstrom, Larry</i>	
Integrated Assessment of Phosphorus Recycling Technologies from Waste Water	457
<i>Egle, Lukas; Rechberger, Helmut; Zessner, Matthias</i>	
Program Review: A Multi-Tooled Approach for Nutrient Reduction	460
<i>McGettigan, John; Doyle, Matthew; McGrath, Michael; Mohsenin, Shahram; Motsch, Sarah; Gasparotto, Renzo; Wilber, Clyde; Wilson, Thomas E.; Xiao, Laurel</i>	
Planning Phosphorus Removal Upgrades through Water Quality Monitoring and Modeling	474
<i>Bicudo, José R.; Gorrie, Jack; Perrone, Jim; Summach, Dana; Fausto, Arnel; Anderson, Mark; Brown, Trevor</i>	

Process Control Strategies for Simultaneous Nitrogen Removal Systems	492
<i>Jimenez, Jose; Bott, Charles; Regmi, Pusker; Rieger, Leiv</i>	
Testing the Waters-Piloting High Rate Treatment Technologies for Secondary Treatment and Total Nitrogen Removal Process Selection	506
<i>Formica, Matthew T.; Desmarais, Terry L.; Rice, Peter H.; Anania, Paula; R. Pearson, Jon; Grotton, Erik. J.</i>	
BNR/ENR Model Calibration Experience Indicates Deviations in Key Modeling Parameters and Lessons Learned	536
<i>Latimer, Ron J.; Pitt, Paul A.; Rohrbacher, Joe; Bilyk, Katya</i>	
Maintenance and Use of Online Monitoring Data for Improved Process Control at Connecticut's BNR Treatment Plants	551
<i>Tsuchihashi, Ryujiro; Canterbury, Brian; Neethling, JB; Pramanik, Amit</i>	
All You Need is Air – Alternating Activated Sludge System BIOCOS Without Electro-mechanical Equipment	555
<i>Wett, Bernhard; Brückl, Annemarie; Reichenberger, Josef; Rauch, Wolfgang; Ingerle, Kurt</i>	
Short-Term Improvements with Long-Term Benefits for Phosphorus Removal and Recovery	563
<i>Sunderland, Perry; McCormick, Jeff; Conklin, Anne; Schauer, Paul</i>	
Nitrogen Behavior in the Advanced Sewage Treatment Process Combined Sludge Ozonation and Phosphorus Recovery	578
<i>Sui, Pengzhe; Nishimura, Fumitake; Tsuno, Hiroshi</i>	
Impact of Urine Source Separation on Wastewater Treatment and Sustainability Initiatives at Select U.S. Universities: A Triple Bottom Line Evaluation	588
<i>Ishii, Stephanie K. L.; Boyer, Treavor H.</i>	
Phosphorus Recovery and VFA Generation from Waste Activated Sludge Alone (WAS) and Co-thickened with Primary Sludge (PS)	597
<i>Zurzolo, Francesco; Kruk, Damian J; Oleszkiewicz, Jan A</i>	
Full-Scale Implementation of the WASSTRIP™ Process: Plant-wide Impact of Struvite Recovery	605
<i>Schauer, Peter; Laney, Brett</i>	
Assessing Extractive Nutrient Recovery as a Viable Nutrient Control Alternative	617
<i>Khunjar, Wendell. O.; Latimer, Ronald; Mehta, Chirag.; Batstone, Damien.; Jeyanayagam, Samuel</i>	
High-Frequency Field Measurement of Nitrous oxide (N₂O) Gas Emissions and Influencing Factors at WWTPs under Dry and Wet Weather Conditions	621
<i>Guo, Lisha; Lamaire-Chad, Coralie; Bellandi, Giacomo; Daelman, Matthijs; Amerlinck, Youri; Maere, Thomas; Nous, Jurgen; Flameling, Tony; Weijers, Stefan; van Loosdrecht, Mark C. M.; Volcke, Eveline I.P.; Nopens, Ingmar; Vanrolleghem, Peter A.</i>	
N₂O Emissions from Secondary Clarifiers and Their Contribution to the Total Emissions of the WWTP	630
<i>Mikola, Anna; Heinonen, Mari; Kosonen, Heta; Leppänen, Maarit; Rantanen, Pirjo; Vahala, Riku</i>	
Nitritation versus Full Nitrification of Ammonium-Rich Wastewater: Comparison in terms of Nitrous and Nitric Oxides Emissions	638
<i>Rodriguez-Caballero, Adrian; Ribera, Anna; Pijuan, Maite</i>	
Impact of Aeration Control on N₂O Emission in a Full-Scale Activated Sludge Wastewater Treatment Plant	642
<i>Filali, Ahlem; Fayolle, Yannick; Peu, Pascal; Philippe, Lydiane; Nauleau, Fabrice; Gillot, Sylvie</i>	
Production of Bio-Methanol by Ammonia Oxidizing Bacteria	647
<i>Taher, Edris; Chandran, Kartik</i>	
A Pilot Scale Investigation of Co-Fermentation of Primary Sludge and Grease Trap Waste for VFA Production	650
<i>Nicholson, Jeff; Latimer, Ronald; Long, Hunter; Hillard, Holy Anne; Balzer, Bill; Bott, Charles; Chiesa, Steven</i>	
Effect of Selective Organic Fractions on Denitrification Rates Using Salsnes Filter as a Primary Treatment	666
<i>Razafimanantsoa, V. A.; Ydstebø, L.; Bilstad, T.; Sahu, A. K.; Rusten, B.</i>	
Demonstration of Glycerol Fed Separate Centrate Treatment Process: Optimization, Performance and Impacts on Main Plant Plant Operations	674
<i>Sharp, Robert; Dailey, Sarah; Pitt, Paul; Motyl, Melissa; Deur, Allen; Beckmann, Keith</i>	
The Fate of Glycerin in BNR, A Closer Look at Nitrite Accumulation and Glycerin Specialists	682
<i>Ledwell, Samuel A.; Togna, Paul; Andalib, Mehran; Giovannone, Anthony; Rooney, Katie</i>	
The Impact of Cold Weather and Temperatures on the Design of Supplemental Carbon Facilities Using Glycerol as a Carbon Source for Biological Nitrogen Removal	686
<i>Gao, Amy; Supplee, Mark L.; Frost, Robert; Liu, Sue F.</i>	
Distillery Fusel Oil as an Alternative Carbon Source for Denitrification – from Laboratory Experiments to Full-Scale Applications	692
<i>Makinia, J.; Czerwionka, K.; Kaszubowska, M.; Majtacz, J.</i>	

Roadmap Toward Energy Neutrality & Chemical Optimization at Enhanced Nutrient Removal Facilities	702
<i>Stinson, Beverley; Murthy, Sudhir; Bott, Charles; Wett, Bernhard; Al-Omari, Ahmed; Bowden, Gregory; Mokhyerie, Yalda; De Clippeleir, Haydee</i>	
Effects of Organic Carbon Source, COD/N Ratio and Temperature on Anammox Organisms	732
<i>Guillén, J.A. Sánchez; Yimman, Y.; Vazquez, C.M. Lopez; Brdjanovic, D.; van Lier, J.B.</i>	
Simultaneous Chemical Precipitation of Phosphate and Shortcut Nitrogen Removal by Aerobic Granular Sludge	744
<i>Li, Yongmei</i>	
Measuring Nitrite - The Key to Controlling Deammonification Systems	748
<i>Melcer, Henryk; Bott, Charles B.; Regmi, Pusker; Rieger, Leiv; Wan, Jiang; Johnson, Chandler; Chandran, Kartik; Ma, Yiwei</i>	
Metabolisms of Acetate Transport in EBPR and Biokinetics for PAOs and Gaos	758
<i>Tu, Yunjie; Schuler, Andrew J.</i>	
Feeding Supplemental Carbon to Fermenters for Enhanced Biological Phosphorus Removal at Janesville WPCF	771
<i>Cassidy, Nathan; Zakovec, Joe; Paul, Greg; Stevens, Gerry</i>	
Running a Carbon Limited BNR Plant with In-Line Fermentation	776
<i>Kobylinski, Ed; Barnard, James; Shaw, Andrew; Phillips, Heather; Wirth, Michelle; Foster, Joe</i>	
Integration of Anammox Into the Aerobic Granular Sludge Process for the Conversion of BOD in Wastewater Treatment at Ambient Temperatures	786
<i>Winkler, Mari K.H.; Kleerebezem, Robbert; van Loosdrecht, Mark C.M.</i>	
WERF Nutrient Challenge: Challenges and Recommendations on Achieving Low Effluent Nutrient Concentrations with Membrane Bioreactors	788
<i>Pellegrin, Marie-Laure; Menniti, Adrienne; Stensel, David; Neethling, J.B.</i>	
Tertiary MBR for Nitrification and Low Level Phosphorus Removal	806
<i>Benisch, Mario; Neethling, JB; Clark, Dave; Fisher, Casey; Keil, Don</i>	
Pilot Trial Study of a Compact Macro-filtration Membrane Bioreactor Process for Saline Wastewater Treatment	824
<i>Guan, Dao; Fung, W. C.; Lau, Frankie; Deng, Chao; Leung, Anthony; Dai, Ji; Chen, G. H.</i>	
Cost-Effectiveness of MBR Treatment System for Low-Level Phosphorus Reduction from Municipal Wastewater	834
<i>Young, Thor; Smoot, Sebastian; Peeters, Jeff; Côté, Pierre</i>	
Dissolved and Colloidal Organic Nitrogen Removal from WWTP Effluents and Reject Waters Using Physical-Chemical Processes	838
<i>Czerwionka, K.; Makinia, J.</i>	
Author Index	