The 15th IWA Leading Edge Conference on Water and Wastewater Technologies

the international water association

Technological Innovations for Improving Water Security

Conference Programme

27 – 31 MAY 2018
NANJING, CHINA

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Leading Edge Conference on Water and Wastewater Technologies

IWA the international water association

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INVITATION FROM THE IWA PRESIDENT

The IWA Leading Edge Conference on Water and Wastewater Technologies (LET) has built a world-class reputation as the forum for leading researchers to share and debate the pioneering science, technological innovation and leading practices that will provide solutions to water challenges, old and new. Those challenges are immense.

Fast growing cities, with rapidly expanding populations and industrial bases, are challenging the traditional model of large-scale centralised technology and infrastructure solutions; wastewater, the majority of which is discharged untreated into nature, presents a significant opportunity for building a circular, green economy; the increased presence of chemical micro-pollutants, including pharmaceuticals, pathogenic microorganisms and antibiotic resistant bacteria, threatens the quality of water around the globe.

This 15th LET, taking place in Nanjing, China, will be a window into the potential of the water sector to innovate for a sustainable, water-wise future. Nanjing's economy is mainly based on electronics, cars, petrochemicals, iron and steel, and power, the "five pillar industries". Coupled with Nanjing's commitment to the national Sponge City Initiative, it makes an ideal venue to discuss research for municipal and industrial applications.

Over recent years, China has invested significantly in the water sector, and delivered rapid technological innovation in advanced materials. Nanjing provide's the perfect backdrop for discussions on anticipating future developments for the water sector, fostering ground-breaking ideas, and enabling their rapid practical application.

LET is the place where individuals who share a passion and commitment to delivering technological innovation come to be inspired. I look forward to seeing you there.

Diane D'Arras
President, International Water Association

INVITATION FROM THE CHAIRMAN OF THE PROGRAMME COMMITTEE

No other resource is as important for life as is water, and the importance of clean water for global health and economic development cannot be overstated. For example, over 650 million people worldwide currently lack access to safe water, and water remains a major limiting factor for food and energy production in many parts of the world. Furthermore, frequent detection of priority pollutants and contaminants of emerging concern in drinking water sources, sewage treatment plant effluents and natural waters underscore the need to enhance water treatment infrastructure. Accordingly, technological innovation to economically treat and reuse water, recover resources from used water, and make clean water more accessible to more people is of the greatest challenges (and opportunities) of this century.

On behalf of the Programme Committee, I invite researchers and practitioners worldwide to join us for the 15th LET conference in the beautiful historic city of Nanjing, China. Your participation – as presenters and delegates – will ensure that LET maintains its hallmarks: the highest quality for a technical content that reflects scientific rigor and societal relevance (r2), and the greatest opportunity for networking. The programme will be organized by themes, which are described in this programme. Indeed, the programme features only the "best of the best." I encourage your participation and look forward to welcoming you to this beautiful center of culture, education, research, and tourism.

Pedro Álvarez
Rice Universtity, United States

INVITATION FROM THE CONFERENCE PRESIDENT

With 14 IWA LET Conferences successfully held worldwide since 2003, LET 2018 will represent a remarkable milestone that will come to Mainland China for the first time. As the Conference President, I would like to invite the experts from academia and water industry from all over the world to participate in the LET Conference 2018 in Nanjing, to exchange ideas on water technologies and inspire innovations and implementations.

China now is recognized as the most dynamic and largest market for water sector in the world. With the rapid economic growth in the past decades, water issues have presented critical challenges for the sustainable urban development in China, including drinking water supply, municipal wastewater treatment, industrial wastewater treatment and basin management. Opportunities, however, always coexist with challenges. The principle "lucid waters and lush mountains are invaluable assets" raised by Chinese President Xi Jinping, along with the eco-civilization construction, demonstrates the resolution from the central government to tackle water problems in China. Under such background, both public and private funded water projects are blooming and the demands on innovative technologies of water and wastewater treatment are experiencing unprecedented upsurge.

Nanjing is the capital city of Jiangsu Province. As a developed region rich in freshwater resources, Jiangsu Province, the home to over 2,000 environmental companies, is leading the technology innovations on water and wastewater treatment and, is proactive in developing novel water and wastewater technologies to achieve the goals and plays a leading role in water and wastewater technology innovation at the global level.

I am confident that the IWA LET Conference 2018 will offer all the delegates a unique opportunity to discover China's ideas and experiences in water management and to share knowledge on the development of cutting-edge water and wastewater technologies.

I look forward to meeting you in Nanjing, the historic and dynamic city in China!

Jiuhui Qu
Conference President

CONFERENCE TOPICS

Innovations in direct potable reuse.

Co-Chairs: Jonathan Clement and Chii Shang

With population expanding and increasing urbanisation, water scarcity strongly increases and the only option to alleviate the scarcity is often direct potable reuse. The treatment schemes are almost always driven by public perception and fear, rather than science. With increasing knowledge and detection of contaminants coupled with advanced technologies there is a movement towards a more scientifically credible treatment paradigm. This session will look at how technologies can be integrated together to achieve potable drinking water directly from wastewater.

Advances in energy efficiency and resource recovery in wastewater treatment.

Co-Chairs: Han Qing Yu and Mark van Loosdrecht

Wastewater can become a source of value and economic gain if its treatment is re-oriented to emphasize the recovery of water, energy, nutrients, and, in some cases, other materials. This session focuses on emerging processes and systems with a primary goal of recovering resources present in "used water". Examples include direct anaerobic treatment to give a net energy output; nitrogen and phosphorus separation and concentration to provide high value fertilizer feedstock; water reclamation for beneficial use; and recovery of other materials, such as metals and fiber.

Innovative decentralized technologies for urban/rural applications.

Co-Chairs: Doulaye Kone and Xiaochang Wang

Decentralization is an alternative to extend the coverage of existing urban water and wastewater systems, solve the problems of unsafe water supply and poor sanitation in rural regions, and facilitate onsite water and material recovery and reuse. The technologies widely applied for centralized systems may not always be suitable for smaller scale decentralized systems with more diverse system installation. This session will present research and practical application of leading-edge technologies for decentralized systems in urban/rural areas, with a focus on technologies for source separation, treatment, onsite reuse, risk control, and best operation/maintenance.

Emerging contaminants and antibiotic resistance – detection and control.

Co-Chairs: Amy Pruden and Bingcai Pan

Water quality is threatened by chemical micro-pollutants of emerging concern, such as pharmaceuticals, personal care products, or endocrine disruptors, and also emerging pathogenic microorganisms, including chlorine- and UV-resistant viruses and protozoa, and antibiotic resistant bacteria. Although there is still a lack of quantitative data on their effects on ecological and physiological processes, and especially on human health, the detection of these contaminants in natural waters and wastewater treatment plant effluents raises concerns about the efficiency of current treatment processes. This session focusses on innovative technologies for the control of emerging contaminants in water and wastewater.

Advanced oxidation processes for water and wastewater treatment.

Co-Chairs: Min Yang and Reynald Bonnard

We are facing challenges in removing micropollutants, such as pesticides, PPCPs and PFCs, in source water and bio-refractory compounds in industrial wastewater, including coking wastewater, pharmaceutical wastewater, fine chemistry wastewater. Recently, significant progress has been achieved in the AOP field, particularly in the development of plasma oxidation and catalytic oxidation. This session will provide a platform for exchanges on the progress of recent developments in these technologies, and the experiences of the application in water and wastewater treatment.

Advanced materials and membranes for water and wastewater treatment.

Co-Chairs: Xia Huang and Pedro Alvarez

Novel materials and multifunctional membranes are making significant improvements in the way we treat water and wastewater. Nanotechnology utilizes materials at the nanometer scale, whose unique properties enable novel functions, and is being actively pursued to enhance various treatment applications such as adsorption, catalysis, membrane separation and sensing. In addition, advances in membrane materials continue to innovate separation processes, whose application is becoming increasingly common in water and wastewater treatment systems of different scales. This session will address the development and application of advanced materials to enable a shift of treatment paradigm from the current chemical and energy intensive processes to high efficiency, physical and catalytic processes that minimize chemical and energy use as well as waste production.

Sustainable treatment of complex industrial wastewater streams.

Co-Chairs: Guanghao Chen and Bruce Rittmann

Wastewaters from many industries contain complex mixtures of organic and inorganic components, especially generated where centralized treatment of industrial wastewaters together with domestic wastewater is common, making treatment challenging. While biological treatment is generally the most cost-effective form of wastewater treatment, it's often compromised because some of those components are recalcitrant to biodegradation and even toxic to microorganisms. This session will present research and practical results for novel biological, chemical, physical, and combined means that overcome the roadblocks to successful treatment. Emphasis will be given to techniques that yield effective treatment that is energy ans financially sustainable.

Recent developments and applications of advanced molecular microbial tools in water and wastewater treatment.

Co-Chairs: Hongqiang Ren and Jurg Keller

Biological treatment systems are engineered to select for a few functional microbial groups that may be organized in spatial structures. Conventional microbial techniques can only show a relatively small proportion of the total diversity. Recently, molecular approaches have circumvented these limitations, allowing us to obtain a more detailed image of microbial communities, which may be useful for processes diagnosis/optimization. This session will document how the recent developments and applications of advanced molecular tools are providing deeper insight into the structure and function of microbial communities used to treat water and wastewater, as well as how those new insights lead to improvements in process performance.

LET2018CONFERENCE PROGRAMME

Sunday, 27 May 2018
Workshops

12:00	Registration Opens (Venue: Lobby, 1F)	
13:30-17:30	**Workshop 1 (Venue: 1F)** Changing with the times: what you need to know about publishing today	**Workshop 2 (Venue: 3F)** Performance Based Smart Water and Advanced Solutions
17:30-19:30	**Welcome Reception** **Venue: Dining Hall, B2**	

Workshops details:

Workshop 1: Changing with the times: what you need to know about publishing today

Organiser: **IWA Publishing**

Objective:

With the advent of digital publishing and a growing movement towards Open Access (OA), the publishing landscape is undergoing drastic changes. Researchers now have more options than ever when considering what, how and where to publish.
This workshop focuses on key aspects of the publishing process and aims to equip authors with the necessary tools to navigate the publishing landscape today. Topics will include manuscript preparation, publishing options, and a look at ways to maximize the impact of your paper post-publication. Special attention will be made to emerging platforms and technologies.

Topics

Part 1: Introduction to the publishing landscape today
- Recent innovations in publishing
- Open Access

Part 2: Manuscript preparation and publishing options (panel discussion with Editors)
- Publishing options
- Manuscript preparation
- How to make manuscript submissions standout
- Insight/tips on the peer-review process
- Changes in publishing

Part 3: Maximizing the Impact of your work
- Book/book chapters
- Databases, Indexing and citations
- Archiving code, data
- Marketing options for your paper

Programme

13:30-14:00 **Part 1: Introduction to the publishing landscape today**
Sara Bosshart, Open Access Publisher IWA Publishing

14:00-15:15 **Part 2: Manusctipt preparation and publishing options - panel presentation & discussion**
Guang-Hao Chen, Editor *Water Research*
Ana Deletic, Chief Editor *Blue Green Infrastructure & Systems* (new IWAP journal), Editor *Water Research*
Lutgarde Raskin, Associate Editor *Environmental Science and Technology*
Shane A Snyder, Chief Editor *Chemosphere*
Xiaochang Wang, Chief Editor *H2Open Journal*
Zhiguo Yuan, Editor *Water Science & Technology*

15:15-15:45 **Part 3: Maximizing the impact of your work**
Sara Bosshart, Open Access Publisher, IWA Publishing
Mark Hammond, Books Commissioning Editor, IWA Publishing

15:45-16:00 **Closing Remarks/Questions**

Workshop 2 : Performance Based Smart Water and Advanced Solutions

Organiser: SUEZ-NWS

Objective:

The purpose of this workshop is to expose the visionary attendees to IWA's LET conferences to get better known smart way of water system management and services. This workshop, aims to explore how performance-base smart water management and advanced technologies can reduce Capex and Opex, increase operation efficiency, promote sustainability of asset management and etc.

Topics

The workshop will mainly aim to share SUEZ's concept and experiences on smart and sustainable water management through presentation of SUEZ experts and communications between attendees and experts. The proposed activities of the workshop are summarized as follows:

1. introduce the notion of "Smart Water" and SUEZ advanced solution portfolio
2. introduce SUEZ sustainable asset management service model and showcase of performance based water network service around the world
3. share the experiences of Changshu Sino French Water Supply and Macau Water's smart water management, which include framework design of smart water, based on real-time online hydraulic model's smart network management system
4. share the advanced technology of ice pigging and Idroloc, which are SUEZ unique pipeline cleaning and helium leakage detection technology
5. discuss and highlight any other issues to be considered from the multi-disciplinary approach point of view

Programme

13:30-13:40	**Opening Speech.** Felix Fan, CEO of SUEZ NWS
13:40-14:00	**Big data and the future of environment protection.** Qing Hu, Professor South University of Science and Technology of China
14:00-14:20	**Smart water asset management --Introduce the advanced solutions of improving operation efficiency of water supply network.** Luis Garcia, Director of the Asset Performance Management Business Line of SUEZ Advanced Solutions.
14:20-14:40	**Macau smart water management and innovation.** Thurston Lou, Deputy General Manager of Macau Water.
14:40-15:00	**Rural residents drinking water safety solution - Jiangsu practice.** GuoFeng Lin, Doctor Jiangsu Water Supply Security Center.
15:00-15:30	**Panel Discussion**
15:30-15:50	**Coffee/Tea break**
15:50-16:10	**The effective application of Changshu Sino French smart water management.** Hao Zhang, Smart Water Director of Changshu Sinofrench.
16:10-16:30	**Case sharing of smart sponge city and AQDV urban drainage management.** Dawei Li, Senior Project Manager of SUEZ NWS.
16:30-16:50	**Case sharing of ice pigging – unique pipeline cleaning and leakage detection technology.** Cherry Huang, Project Manager of SUEZ NWS.
16:50-17:20	**Panel Discussion**
17:20-17:30	**Closing Speech.** Laurent Gestin, Executive Vice President of SUEZ NWS.

Monday, 28 May 2018
Plenary Session

Venue: Conference Room, 3F, Jiangdao Technology Innovation Center

08:00 — Registration opens (Venue: Lobby, 1F)

09:00-09:30 — Opening Ceremony
Venue: Conference Room, 3F

Morning Plenary Sessions
Chair: Pedro Alvarez

09:30-10:15

Evolution and Innovation of Water Purification Technologies: Return to Simplicity

Jiuhui Qu
Research Center for Eco-environmental Sciences, CAS & Tsinghua University, China

Dr. Qu is the former Director of the Research Center for Ecological and Environmental Sciences (RCEES) of the Chinese Academy of Sciences, China. He has been an Academician of the Chinese Academy of Engineering, China, since 2009. He serves/served as Vice President of the All-China Environment Federation, Vice Chairman of the Chinese Society for Environmental Sciences and the Chinese Society for Sustainable Development. His research expertise is mainly in water pollution control, particularly development of the theories, technologies, and engineering applications relating to drinking water quality and safety. He has achieved numerous innovations in water treatment, water quality risk assessment and water pollution control. He has authored three books and more than 400 journal papers and hold more than 80 Chinese and international patents. He was awarded the second prize of the National Science and Technology Progress Awards in 2004 and 2006 respectively, the Science and Technology Progress Award from The Ho Leung Ho Lee Foundation in 2009, and the Global and East Asia IWA Innovation Project Awards in 2010, the second prize of the National Technology Invention Awards in 2012. He was elected as the Distinguished Fellow of IWA.

10:15 - 10:45 — Morning Tea/Coffee

10:45 - 11:30

Could Blue Green Infrastructure Deliver on Robust Water Services?

Ana Deletic
University of New South Wales, Australia

Professor Ana Deletic is Pro Vice-Chancellor (Research) at the University of New South Wales, Sydney (UNSW). Until mid-2017 Ana was Associate Dean of Research Engineering Faculty and the Founding Director of Monash Infrastructure research institute at Monash University.
Ana leads a large research group that is working on multi-disciplinary urban water issue focusing on stormwater management and socio-technical modelling. Earlier she led the development of a number of green nature based water treatment systems which are now widely adopted in Australia and abroad.
Ana is a Fellow of Engineers Australia and the Australian Academy of Technological Sciences and Engineering (ATSE), and Editor of Water Research. In 2012, the Victorian State Government awarded Ana the Victoria Prize for Science and Innovation (Physical Sciences) for her lifelong achievements in stormwater research.

11:30 - 12:15

Creating Value from Data – a Digital (R)Evolution in Our Business

Herve Buisson
Veolia Water, France

Herve Buisson is currently, since 2005, the Vice-President of Process Engineering for Veolia Water – Solutions and Technologies, and a member of the Executive Committee of Veolia Water – Solutions and Technologies Americas
He is responsible for Technical Support and Coordination as well as the development of a portfolio of differentiated process solutions and products. He is a global expert in water and wastewater treatment and specialized expert in membrane filtration technologies. Frequent keynote speaker and lecturer on water issues and membrane based solutions.
Herve is also a long time NAMS, EMS, EDS, IWA member, he is acting as expert advisor for organizations such as Water Research Foundation, European Economic Commission – Research Directorate, Middle East Desalination Research Center, Canadian National Research Council.

12:15 - 13:15 — Lunch (Venue: Dining Hall, B2)

Afternoon Plenary Sessions
Chair: Guanghao Chen

13:15 - 14:00

Antibiotic Resistance Genes as Contaminants of Emerging Concern: Towards Actionable Policy and Practice in Risk Assessment, Monitoring, and Mitigation

Amy Pruden
Virginia Tech, USA

Amy Pruden is the W. Thomas Rice Professor of Civil and Environmental Engineering at Virginia Tech. Her research focuses on bringing a microbial ecological perspective to understanding and advancing design and management of environmental systems. Her current research, funded by The National Science Foundation, US Department of Agriculture, Water Environment & Reuse Foundation, and the Alfred P. Sloan Foundation, focuses on advancing practical means of antibiotic resistance monitoring, mitigation, and risk assessment in wastewater, recycled water, and other water systems. She has authored over 100 peer-reviewed scientific journal articles and currently serves as an Associate Editor of Environmental Science & Technology. Dr. Pruden is the recipient of the Presidential Early Career Award in Science and Engineering and the Paul L. Busch Award for innovation in water research. She holds a B.S. in biology and a Ph.D. in environmental science, both from the University of Cincinnati.

14:00 - 14:45

Managing the Drinking Water Microbiome

Lutgarde Raskin
University of Michigan, USA

Dr. Lut Raskin, the Altarum/ERIM Russell O'Neal Professor of Environmental Engineering at the University of Michigan, is a pioneer and internationally recognized scholar in molecular microbial ecology applied to water quality control. Most of her research focuses on various aspects of the engineered water cycle microbiome. Her laboratory especially focuses on drinking water systems including biofiltration, disinfection, distribution, and premise plumbing, and water and energy recovery from waste streams. She has published more than 130 peer-reviewed journal papers and over 300 conference proceedings papers and abstracts. Dr. Raskin has maintained a high level of professional service through several societies focusing on both microbiology and engineering and is an elected Fellow of the American Academy of Microbiology and the Water Environment Federation. Lut was the winner of 2016 IWA Bio Cluster Award. She has also received 2007 Association of Environmental Engineering and Science Professors (AEESP) Frontier Award in Research, the 2006 American Society of Civil Engineers Walter L. Huber Civil Engineering Research Prize, the 2002 Paul L. Busch Award (Water Environment Research Foundation Endowment for Innovation in Applied Water Quality Research), and a 1997 National Science Foundation CAREER Award.

14:45 - 15:15

Afternoon Tea/Coffee

15:15 - 16:00

Exploring New Opportunities for Resource Reuse in Wastewater Management

Zhiguo Yuan
The University of Queensland, Australia

Prof Zhiguo Yuan is the Director of the Advanced Water Management Centre at The University of Queensland, and a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) and an IWA Fellow. His research focuses on development of innovative solutions for urban water management through effective integration of fundamental science and applied engineering. His research achievements and leadership have been recognized through national and international awards including the 2015 ATSE Clunies Ross Award. He was named as one of Engineers Australia's Top 100 Most Influential Engineers for 2015. He was awarded the highly prestigious ARC Australian Laureate Fellowship in 2017. He is an Editor for Water Research.

16:00 - 16:45

R&D to Future-proof Singapore's Water System

Harry Seah
PUB, Singapore

Mr. Harry Seah holds the concurrent posts of Assistant Chief Executive (Future Systems & Technology) and Chief Engineering and Technology Officer at PUB, Singapore's national water agency. He leads PUB's efforts in the continuous exploration, research and development of water technology essential to future-proof PUB's water system. In his current role, Harry also integrates PUB's R&D efforts with the facilitation of water industry development and the commercialization of new water technology.

16:45 - 18:00

Poster Session
Venue: At the entrance of Jiangdao Technology Innovation Center, 1F

Tuesday, 29 May 2018
Technical Sessions

	Room 1 (Venue: 1F)	Room 2 (Venue: 3F)
	SESSION 1: INNOVATIONS IN DIRECT POTABLE REUSE **Co-Chairs:** Jonathan Clement, Chii Shang	**SESSION 2: SUSTAINABLE TREATMENT OF COMPLEX INDUSTRIAL WASTEWATER STREAMS** **Co-Chairs:** Guanghao Chen, Bruce Rittmann
08:30 - 09:00	**Keynote (1): Ensuring Water Safety Of Potable Water Reuse** Shane A Snyder, Nanyang Technological University (Singapore)	**Keynote (1): Novel Approaches For Treatment Of Heavy Metals In Wastewater** Liyuan Chai , Central South University (China)
09:00 - 09:15	**Potable Reuse Of Reclaimed Wastewater Using Ceramic Membrane Processes** Xihui Zhang, Tsinghua-Berkeley Shenzhen Institute (China)	**Evaluation Of Hybrid Systems For Treatment Of Effluents From The Pesticide Production Industry** Ana Soares, Cranfield University (United Kingdom)

09:15 - 09:30	**Ozonation Combined With Ceramic Membrane For Wastewater Re-use** Roberto Floris, PWNT (Netherlands)	**Realizing High-rate Sulfur Reduction Under Sulfate-rich Conditions In A Biological AMD Treatment System** Feng Jiang, South China Normal University (China)
09:30 - 10:00	**Discussions**	**Discussions**
10:00 - 10:30	Morning Tea/Coffee	
10:30 - 11:00	**Keynote (2): UV-Light Based Advanced Oxidation Processes For Direct Potable Reuse: From Science To Implementation** Mihaela Stefan, Trojan Technologies (Canada)	**Keynote (2): Evaluation Of Full Scale Ozonation Process With Massive O_3 Dosage As Tertiary Treatment Of Wastewater From Petroleum-Oil Chemical Industries: The SCIP Case** Daniel Qu, SCIP Sino French Water Development Co., Ltd. (China)
11:00 - 11:15	**Looking Toward Water Recycling Without RO** Ian Law, IBL Solutions (Australia)	**Options For Removing Refractory Organic Substances In Pre-treated Process Water From Hydrothermal Carbonization** Joachim Fettig, University of Applied Sciences Ostwestfalen-Lippe (Germany)
11:15 - 11:30	**Modelling The UV-LED Based Chlorine Photodecay And Radical Formation At Different Wavelengths And PHs** Ran Yin, Technological and Higher Education Institute of Hong Kong (Hong Kong, China)	**Zero-valent Iron Mediated Degradation Of Complex Organics In Hydraulic Fracturing Wastewater From Yanchang Shale, China** Olusegun Abass, Chinese Academy of Sciences (China)
11:30 - 12:00	**Discussions**	**Discussions**
12:00 - 12:15		**Poster Pitch** **Enhanced Treatment Of Industrial Wastewater Using AAO-MBR: Membrane Fouling Behavior And Microbial Community Succession** Lin Wang, Tongji University (China)
		Simultaneous Anaerobic And Aerobic Transformations Of Nitrobenzene Yongming Zhang, Shanghai Normal University (China)
		Treatment Of Medical Radioactive Wastewater By Forward Osmosis (FO) Membrane Process Seungkwan Hong, Korea University (Korea)
12:15 - 13:15	Lunch (Venue: Dining Hall, B2)	
	SESSION 3: INNOVATIVE DECENTRALIZED TECHNOLOGIES FOR URBAN/RURAL APPLICATIONS **Co-Chairs:** Doulaye Kone, Xiaochang Wang	**SESSION 4: ADVANCED OXIDATION PROCESSES FOR WATER AND WASTEWATER TREATMENT** **Co-Chairs:** Min Yang, Reynald Bonnard
13:15 - 13:45	**Keynote (1): A New Sewage Treatment System Using Anaerobic MBR And Anammox For Effective Energy Recovery And Low Carbon Design: Concept And Experimental Study** Yu-You Li , Tohoku University (Japan)	**Keynote (1): Highly Concentrated Organic Wastewater Treatment With CWAO Technique** Chenglin Sun , Dalian Institute of Chemical Physics (China)
13:45 - 14:00	**Re-Thinking The Sanitation Engineering Paradigm: A Strategic Approach Towards Off-the-Grid Solutions** Sudhir Pillay, Water Research Commission (South Africa)	**Degradation Of Polyacrylamide (PAM) By Plasma In Gas-liquid Multiphase Flow** Wenzhe song, Research Center for Eco-Environmental Sciences (China)
14:00 - 14:15	**The Nanomembrane Toilet: Enabling Non-sewered Sanitation At A Single Household Scale, Independent Of Grid Produced Power** Ewan McAdam, Cranfield University (United Kingdom)	**Removal Of Micropollutants In Wastewater Effluent During UV/H2O2 And UV/PDS** Jean-Philippe Croue, Curtin University (Australia)
14:15 - 14:45	**Discussions**	**Discussions**
14:45 - 15:15	Afternoon Tea/Coffee	
15:15 - 15:45	**Keynote (2): New Sanitation – Nucleus Of The Circular Economy Revolution** Dhesigen Naidoo, WRC South Africa (South Africa)	**Keynote (2): The Evolution of Leading Edge Advanced Oxidation Processes In Asia** Katia Wasiak, SUEZ Degremont Technologies AG (Switzerland)

15:45 - 16:00	**Performance And Mechanisms Of Ultrafiltration Membrane Fouling Mitigation In A Novel Electrochemical Membrane Reactor** Chengzhi Hu, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences (China)	**Mesoporous Ce-Ti-Zr Ternary Oxide Millispheres For Efficient Catalytic Ozonation In Bubble Column** Chao Shan, Nanjing University (China)
16:00 -16:15	**Combination Of Microfiltration Membrane With Microbial Desalination Cell For Advanced Wastewater Purification** Kuichang Zuo, Tsinghua University (China)	**Apply UV Absorbance And Fluorescence Indices For Assessing The Oxidation And Disinfection Efficiency Of Ozonation Process** Wentao Li, Nanjing University (China)
16:15 - 16:45	**Discussions**	**Discussions**
16:45 - 17:00	**Poster Pitch** **Pilot Demonstration Of Microalgae Cultivation Treating Source Separated Human Urine In Outdoor Raceway Ponds** Pritha Chatterjee, Tampere University of Technology (Finland)	**Poster Pitch** **Z-scheme WO3/CDots/CdS Heterostructure With Remarkable Photocatalytic Activity And Anti-photocorrosion Performance** Chaoqun Li, Jilin University (China)
	Cyclic Sequential Batch Reactor: Nitrogen And Phosphorus Removal From Domestic Sewage Rodrigo Bueno, Federal University of ABC (Brazil)	**Radical Mechanisms Of Micropollutants Degradation By The UV/Chlorine Process** Jingyun Fang, Sun Yat-Sen University (China)
		Porous FeCN Derived From MOF As An Efficient And Stable Heterogeneous Catalyst For Electro-Fenton Degradation Of BPA Lu Jiayuan, University of Science and Technology of China (China)
17:00	**End of Day**	

Wednesday, 30 May 2018
Technical Sessions

	Room 1 (Venue: 1F)	Room 2 (Venue: 3F)
	SESSION 5: EMERGING CONTAMINANTS AND ANTIBIOTIC RESISTANCE— DETECTION AND CONTROL **Co-Chairs:** Amy Pruden, Bingcai Pan	**SESSION 6: ADVANCES IN ENERGY EFFICIENCY AND RESOURCE RECOVERY IN WASTEWATER TREATMENT** **Co-Chairs:** Han Qing Yu, Zhiyong Jason Ren
08:30 - 09:00	**Keynote (1): Role/Application of Advanced Oxidation Technologies on the Treatment of Contaminants of Emerging Concern** Dionysios Dionysiou , University of Cincinnati (United States)	**Keynote (1): Wastewater Treatment for Energy Positive Carbon Valorization** Zhiyong Jason Ren, University of Colorado Boulder (United States)
09:00 - 09:15	**Bacteriophages To Sensitize A Pathogenic New Delhi Metallo <beta>-lactamase-positive Escherichia Coli To Solar Disinfection** PeiYing Hong, King Abdullah University of Science and Technology (Saudi Arabia)	**Role Of Calcium On Phosphate Deep Treatment And Recovery By Polymeric Ferric Nanocomposites** Yanyang Zhang, Nanjing University (China)
09:15 - 09:30	**Effects Of Polymer-supported Disinfectants On Antibiotic-resistant Pathogens And Genes In Drinking Water** Peng Shi, Nanjing University (China)	**Demonstration Of Dehydration And Dryer Technology For Biosolid Reuse As Fertilizer And Fuel In Small Or Medium Scale STP** Takatoshi Yamoto, National Institute for Land and Infrastructure Management (Japan)
09:30 - 10:00	**Discussions**	**Discussions**
10:00 - 10:30	**Morning Tea/Coffee**	
10:30 - 11:00	**Keynote (2): Contaminant Antibiotic Resistome In Wastewater: Evidence And Implications** Celia Manaia, Universidade Catolica Portuguesa Porto (Portugal)	**Keynote (2): Integration of MFC and MBR kills two birds with one stone** Satoshi Okabe, Hokkaido University , Sapporo Faculty of Engineering (Japan)

11:00 - 11:15	**How Do Online Parameters Relate To Elimination Of Micropollutants And Microorganisms During Ozonation Of Wastewater?** Kassandra Klaer, RWTH (Germany)	**Evaluation of HRAS/HiCS-DAF as an A-stage in Municipal Wastewater Treatment** Bart Saerens, Aquafin NV (Belgium)
11:15 - 11:30	**The Wastewater Antibiotic Resistome: A Global Survey** Peter Vikesland, Virginia Tech (United States)	**Pushing The FO And AnMBR Hybrid System Forward: Fouling Prevention Using Air-scouring And Saturated CO2 Solution** Sheng Li, Guangzhou Institute of Advance Technology (China)
11:30 - 12:00	**Discussions**	**Discussions**
12:00 - 12:15	**Poster Pitch** **Triclosan Induces Multiple Antibiotic Resistance And Promotes Conjugative Transfer Of Antibiotic Resistance Genes** Jianhua Guo, Advanced Water Management Centre/ UQ (Australia)	**Poster Pitch** **Coexistence Of Tetrasphaera And Accumulibacter In A High Temperature EBPR Process Fed With Alternating Carbon Sources** Rogelio Zuniga, SCLESE (Singapore)
	Spatial Distribution And Comprehensive Evaluation Of Emerging Pollutants In Effluents From WWTPs In Northern China Yuan Liu, Tianjin University, China (China)	**Complete Nitrogen Removal From Wastewater By Optimizing Nitrite-dependent Anaerobic Methane Oxidation** Jiaqi Wang, Zhejiang University (China)
	Chlorine Disinfection Increases Both Intracellular And Extracellular Antibiotic Resistance Genes In A Full- scale UWWTP Min Jin , Institute of Health and Environmental Medicine (China)	**Fe(III) Reduction And Vivianite Formation In Activated Sludge** Ru Wang, College of Environmental Sciences of Zhejiang University (China)
12:15 - 13:15	**Lunch (Venue: Dining Hall, B2)**	
	SESSION 7: ADVANCED MATERIALS AND MEMBRANES FOR WATER AND WASTEWATER TREATMENT **Co-Chairs:** Xia Huang, Pedro Alvarez	**SESSION 8: RECENT DEVELOPMENTS AND APPLICATIONS OF ADVANCED MOLECULAR MICROBIAL TOOLS IN WATER AND WASTEWATER TREATMENT** **Co-Chairs:** Hongqiang Ren, Jurg Keller
13:15 - 13:45	**Keynote (1): Artificial Tree for Solar-Powered Treatment of High-Salinity Waters (or 2D Nanomaterials for Novel Membrane Development)** Baoxia Mi, University of California, Berkeley (United States)	**Keynote (1): Applications Of Metagenomics And Metatranscriptomics In Water And Wastewater Treatment** Tong Zhang, the University of Hong Kong (Hong Kong, China)
13:45 - 14:00	**Membrane Bioreactor (MBR) Wastewater Technologies: Operator's Return Of Experience** Laurent Gestin, SUEZ-CDE (France)	**Elucidating The Long-Term Impact Of Disinfection Strategies On The Drinking Water Microbiome** Ameet Pinto, Northeastern University (United States)
14:00 - 14:15	**Ozone, O_3 +AOP, An Optimized Treatment Line For COD & TOC Removal. WanHua, From Lab Tests To Full Scale Plant** Laurent De Franceschi, SUEZ (Switzerland)	**Assessing The Impact Of Water Treatments On Microbial Ecology In Pilot Drinking Water Distribution Systems** Gang Liu, Delft University of Technology / Oasen Drink Water (Netherlands)
14:15 - 14:45	**Discussions**	**Discussions**
14:45 - 15:15	**Afternoon Tea/Coffee**	
15:15 - 15:45	**Keynote (2): Nanotechnology Enabled Water Quality Sensing** Peter Vikesland, Virginia Tech (United States)	**Keynote (2): Can Ecogenomics Be Used To Guide Water Processing Technologies?** Wen-Tso Liu, University of Illinois at Urbana- Champaign (United States)
15:45 - 16:00	**Recyclable Photothermal Materials For Full Utilization Of Solar Energy Towards Practical Water Evaporation And Treatment** Peng Wang, King Abdullah University of Science and Technology (Saudi Arabia)	**Using Proteomics For An Insight Into The Performance Of Activated Sludge: Are We There Yet?** Asma Azizan, University of Duisburg-Essen (Germany)

16:00 - 16:15	**Piezoelectric Nanofiber Membranes For Energy-Efficient Fouling Control In Anaerobic Membrane Bioreactors** Stephanie Gee, University of Southern California (United States)	**Early Biofouling Detection In Membrane Filtration Systems Using Fluorescently Measured Extracellular Enzyme Activity** Babar Khan, King Abdullah University of Science and Technology (Saudi Arabia)
16:15 - 16:45	**Discussions**	**Discussions**
16:45 - 17:00	**Poster Pitch** **A Revisit To The Mechanisms Of Membrane Cleaning Using NaOCl: Active Chlorine Species Diffusion And Its Implications** Wang Xueye, Tongji University (China)	**Poster Pitch** **Fouling Formation In A/O-MBR Under Low Organic Loading Rate Condition And Elucidation Of Biofilm Forming Bacteria** Takashi Yamaguchi, Nagaoka university of technology (Japan)
	Synthesis Of Covalent Organic Polymer On Granular Activated Carbon Surface To Immobilize Prussian Blue For Cs+ Removal Yuhoon Hwang, Seoul National University of Science and Technology (Korea)	**Water Purification And Biofouling Crisis Remedies** Yasin Orooji, Nanjing Tech University (China)
	Selective Removal Of Sulphate From Saltwater Using A Novel Composited Electrode In Capacitive Deionization Kuichang Zuo, Rice University (United States)	**Bacterial And Synthetic Biology Applications To FOGs In Wastewater** Elizabeth Court, University of Sheffield (United Kingdom)
17:00	**Closing Ceremony** **Venue: Conference Room, 3F**	
18:30	**Gala Dinner** **Venue: Baihua Hall, International Youth Convention Hotel** **No. 9 West Jinsha River Street, Nanjing**	

Thursday, 31 May 2018

Technical Visits

The transportation buses will depart at 8:00 at the entrance of Fairmont Hotel.

Venue of Fairmont Hotel: No. 333 Middle Jiangdong Road, Jianye District, Nanjing, 210019

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CONFERENCE VENUE

The 15th Leading Edge Conference on Water and Wastewater Technologies will be hosted at:

Singapore Nanjing Eco Hi-tech Island
No. 1 Xiankun Road, Jianye District, Nanjing
新加坡·南京生态科技岛 南京市建邺区贤坤路1号

ENQUIRIES

Conference Programme Secretariat
Please contact: let@iwahq.org

Please go to the registration desk or speakers preparation room for any on-site questions you may have.

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The 16th IWA Leading Edge Conference on Water and Wastewater Technologies

the international water association

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PLENARY SESSION PRESENTATIONS

Evolution and Innovation of Water Purification Technologies: Return to Simplicity

Jiuhui Qu, Research Center for Eco-environmental Sciences, CAS & Tsinghua University, China

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Could Blue Green Infrastructure Deliver on Robust Water Services?

Ana Deletic, University of New South Wales, Australia

Blue-Green Infrastructure and systems are emerging technologies that use nature-based processes to treat water, while delivering multiple benefits to our urban environments. They are known as Low Impact Development (LID) technologies in the USA, Nature Based Solutions (NBS) in Europe, Sponge City (SC) systems in China, and Water Sensitive Urban Design (WSUD) technologies in Australia. They range from well-known and widely used stormwater treatment systems (such as constructed wetlands, bioretentions or raingardens), to novel Blue-Green walls for treatment and management of not only stormwater but also low polluted urban wastewaters.
The talk will briefly discuss the well known LID technologies (wetlands and rain gardens), focusing on their multi-functionality. Green-Blue Walls, their design, benefits and implementation challenges, will be discussed in details. Blue-Green Walls are low-energy and low-cost water treatment technologies that are also urban green infrastructure systems that can reduce local temperatures, and increase biodiversity and amenity value of urban areas. They are designed to harness natural processes to reduce phosphorus concentrations from light greywater (discharge from baths, showers and washing basins) and stormwater (runoff from paved urbans surfaces). In essence, they are vegetated water filters, coming in two different shapes; (1) Living Walls (Figure 1: right and centre) - climbing plants and flowers are grown in a trench filled by filter media creating vertical green screens (a building wall could be used as a support, as well as stand-alone structures), or (2) Green Walls (Figure 1: left) - ornamentals are grown in boxes mounted onto the wall surfaces, creating living facades. As inflow water percolates via gravity through the engineered media and plant roots, phosphorus is retained within the system, and the treated water gets either discharged into receiving water bodies or re-used for irrigation of urban gardens or toilet flushing. In all cases the systems act to protect aquatic ecosystems, while the captured nutrients are taken up by the Green-Wall plants for their growth. In this way, the systems promote urban greening which provides multiple benefits to cities. Green-Blue Walls for greywater and stormwater treatment and management, are beautiful green infrastructure systems that increase urban amenity and biodiversity, cool nearby environment, while cleaning polluted urban discharges.

Creating Value from Data – a Digital (R)Evolution in our Business

Herve Buisson, V.P. Process Engineering, Veolia Water Technologies Americas, France

From data, to information, to performance indicators, to smart reporting, to advanced process control, to digital operator-assistants, and auto-diagnostic and auto-tuning smart water treatment processes and plants, the opportunities brought to our industry by the current digital revolution are many. Already our industry is adopting and creating new digital-based tools and practices, like Veolia Water Technologies new digital platform: AquavistaTM. The presentation will review some key elements of Digitalization and how they can apply to water and wastewater treatment plants. Some case studies and existing plants will also be used as examples of current implementation of digital tools and platforms.

Where the road will lead us from there is hard to predict.

Antibiotic Resistance Genes as Contaminants of Emerging Concern: Towards Actionable Policy and Practice in Risk Assessment, Monitoring, and Mitigation

Amy Pruden, Virginia Tech, USA

Rates of antibiotic resistance are continuing to increase globally among important pathogens, calling for comprehensive strategies to combat its spread. Wastewater treatment and water reuse are gaining attention as potentially key barriers to the spread of antibiotic resistance, however concerted effort is needed to inform intentional process configuration/operation and water distribution design that mitigates its spread. Major challenges include understanding the extent to which horizontal gene transfer occurs during biological treatment, leading to the development of new resistant strains, and optimizing disinfectant processes such that they reduce, rather than select for, proliferation of downstream resistant bacteria. In particular, metagenomic-enabled tools can serve to comprehensively profile antibiotic resistance genes (ARGs) and associated mobile genetic elements (MGEs), also known as the "resistome". Here we will provide examples of progress towards advancing monitoring and mitigation of antibiotic resistance in wastewater and water reuse systems through through the development and application of publicly-available bioinformatic tools and metrics for assessing and comparing the resistome in a range of wastewater treatment and reuse systems. This can aid in advancing, a "One Water" framework for comprehensive monitoring, mitigation, and control of antibiotic resistance via urban and environmental water cycles.

Managing the drinking water microbiome

Lutgarde Raskin, University of Michigan, USA

Biological treatment processes and particularly biofiltration have gained tremendous popularity in the drinking water field over the past decade. However, we do not yet understand how biofiltration, disinfection, and transport of treated water through distribution systems and building plumbing influence tap water and human microbiomes. Most microbes in biofilters mediate positive impacts through removal of contaminants, but others have the potential to cause disease. In high-income countries, the risk of waterborne infection is often due to exposure to opportunistic pathogens, such as Legionella pneumophila and nontuberculous mycobacteria. This presentation will show that these microbes, present in source water microbiomes, are only partially removed and sometimes are selected for by current treatment practices and therefore become integrated in the diverse microbial communities in drinking water. Waterborne infections by these microbes mainly affect immunocompromised individuals, a rapidly expanding subset of the population, and result primarily from inhalation of aerosols. These findings call for an increased understanding of how drinking water aerosols impact our respiratory tract microbiomes. We have begun to address this challenge by focusing on cystic fibrosis, a condition known to predispose individuals to polymicrobial respiratory tract infection. The presentation will conclude by discussing steps water quality engineers and drinking water utilities can take to reduce risk of opportunistic infections while maintaining drinking water treatment objectives.

Exploring new opportunities for resource reuse in wastewater management

Zhiguo Yuan, The University of Queensland, Australia

There is currently an on-going paradigm shift in wastewater management from pollutants removal to resource recovery. The primary resources in wastewater are water, energy and nutrients. The current research efforts focus on the recovery of these resources. The recovered products need to achieve a commodity quality to be competitive in the market, which typically add significantly to the capital and operational costs.

An additional/alternative option is to reuse various types of substances in wastewater for beneficial purposes. Such reuse options do not require the recovery of commodity-quality products, yet bringing about significant/substantial economic/environmental benefits as these substances could potentially replace the more costly commodity chemicals that would other be required.

A well-known example is the use of organic carbon in wastewater to support nitrogen and phosphorus removal through the incorporation of anoxic and anaerobic zones in a treatment process. This is already a common practice in contemporary wastewater treatment plants. In this presentation, it will be demonstrated that a wide range of opportunities can be created through a whole-of-system approach to wastewater management. Three recent examples will be discussed:

1.Multiple use of iron salts in wastewater management. Recent research has demonstrated that iron salts addition to sewers for sewer sulfide control can enhance phosphorus removal in the aerobic wastewater treatment reactor, and also control hydrogen sulfide in the anaerobic sludge digester. These results call for an integrated consideration of sewers and wastewater treatment plants beyond their hydraulic connections.

2.The use of anaerobic sludge digestion liquor to control the growth of nitrite oxidizing bacteria (NOB) in the mainstream treatment. Anaerobic sludge digestion liquor contains an elevated concentration of ammonium nitrogen (~1gN/L), which could be used to suppress the mainstream NOB growth through innovative process design, leading to the nitrite shunt or partial nitritation in the mainstream treatment.

The use of biogas as a supplementary carbon source to enhance nitrate/nitrite removal through the use of a membrane biofilm reactor, thus eliminating the need for imported carbon sources that are often required for enhanced nitrogen removal performance.

R&D to Future-proof Singapore's water system

Harry Seah, PUB, Singapore

PUB is the national water agency that manages Singapore's entire water loop to ensure an efficient, adequate and sustainable water supply. Though Singapore is a small city-state with only 719 square kilometres of highly urbanised land area, PUB has circumvented the physical constraints of limited catchment and storage and met the nation's water needs through an integrated water management system and by leveraging on innovative technologies. However, with the rapidly growing population and economy, demand for land and water is likely to surge in the next few decades. In 2015, World Resources Institute (WRI) ranked Singapore fifth amongst the 33 countries which face extremely high water stress by 2040.

Singapore's current water demand is about 430 million gallons a day. By 2060, this figure is expected to double, with the non-domestic sector accounting for about 70%. Unconventional sources such as NEWater and desalinated water are expected to meet up to 85% of this future demand. If current technologies are employed to meet this future need, energy consumption will quadruple to about 4,000 GWh/year and the amount of sludge will double to more than 600,000 tonnes/year. This sludge production rate is not sustainable due to shortage of landfill sites.

To future-proof Singapore's water system to meet the future water demand based on today's energy and waste footprint, or even better, PUB must continue to stay ahead of the curve and invest in the research and development of emerging innovative and sustainable technologies to treat, recycle and supply water. PUB's R&D programme was established in 2004 to support the translation of scientific principles into full scale implementation of improved processes. In this presentation, Mr. Harry Seah, Assistant Chief Executive (Future Systems and Technology) of PUB, will share on how R&D efforts have improved Singapore's water resilience with NEWater, PUB's R&D objectives and some of the current R&D projects which are directed towards an intelligent and sustainable water management system for Singapore.

SESSION 1: INNOVATIONS IN DIRECT POTABLE REUSE PRESENTATIONS

ISKN1 Ensuring Water Safety Of Potable Water Reuse

Shane A Snyder, Nanyang Technological University (Singapore)

Water scarcity along with rapid population and urbanization are overtaxing many already fragile water systems. Potable water reuse offers a sustainable resource for augmenting water resource portfolios. More recently, direct potable reuse (DPR) has gained mounting interests, as some geographies lack the land space or have inadequate geology for surface water blending and/or groundwater augmentation. The use of DPR is also scientifically sound, as the highly-purified water is not "recontaminated" by inferior quality surface or groundwaters, which may serve to create new challenges (such as arsenic leaching). While scientifically safe and resilient engineering solutions are available for DPR, public and regulatory concerns remain, especially considering the inarguable fact that DPR systems do not have long response times and thus a contamination breakthrough event could readily contaminate the distribution system. Much of the push-back against DPR comes from concerns over emerging contaminants. There are more than 65 million chemical available commercially with an innumerable amount of transformation products. In addition, natural chemical constituents such as arsenic, chromium, estrogen hormones, and other substances are all likely to be present in sewage.

In order to provide comprehensive evaluations of chemical constituents, a tiered approach of rapid measurements (surrogates), targeted known constituents (indicators), non-targeted analysis (NTA), and rapid biological screening (bioassays) are necessary. Chemical constituents will cover a gamut of physical chemical properties, from highly soluble salts to relatively insoluble large molecular weight organics. Thus, characterization tools must include measurement tools encompassing inorganics, volatiles, and semi/non-volatiles. This presentation will discuss the latest advances in rapid surrogate and indicator monitoring, as well as comprehensive evaluations using bioassays and high-resolution mass spectrometry.

Shane A Snyder, Nanyang Technological University (Singapore).

OP1 Potable Reuse Of Reclaimed Wastewater Using Ceramic Membrane Processes

X. Zhang, X. Fan, Z. Zhang, Y. Tao, Yi, Q. song (China)

Potable reuse of domestic wastewater after advanced treatment has drawn wide attention in recently years. However, degradation of newly emerged contaminants including odor matters, endocrine disrupting chemicals (EDCs) and pharmaceutical and personal care products (PPCPs) are hard in conventional processes. This paper tested the advanced oxidation process inside nano- porous channels of flat-sheet ceramic membrane for much higher efficiency. Thus, ozone/ceramic membrane coupled with biological carbon filtration were developed for potable reclamation of wastewater after advanced treatment. A demonstration project with a scale of 1000m^3/d showed that the effluent quality can meet the drinking water standard of China in terms of COD, ammonium, turbidity, bacteria, color, odor matters, etc. More than 95% of typical EDCs can be removed, and more than 97% of typical antibiotics can be removed. The working flux of flat-sheet ceramic membrane reached to 60～70L/m^2-h, in-situ and online chemical cleaning with ozonation last one time every 15 days.

Xihui Zhang, Tsinghua-Berkeley Shenzhen Institute, China.

OP2 Ozonation Combined With Ceramic Membrane For Wastewater Re-use

R. Floris, J. Zheng, G. Galjaard, J. Clement (Netherlands)

This paper summarizes the performance of the process ozonation - ceramic microfiltration for treating secondary wastewater effluent. The membrane performance was evaluated by trans-membrane pressure and permeate water quality. The impact of ozonation pre-treatment on the performance of ceramic microfiltration was evaluated at various pre-treatment scenario comparing: no-pre-treatment; ozone pre-treatment with no residual in front of the membrane and ozone pre-treatment with residual in front of the membrane. This is in an effort to better understand how the combination of ozone and ceramic microfiltration performs compared to the stage of the art RO based FAT process. These data will aid in the discussions about the viability of this alternative treatment trains for some re-use applications.

Roberto Floris, PWNT, Netherlands.

ISKN2 UV-Light Based Advanced Oxidation Processes For Direct Potable Reuse: From Science To Implementation

M. Stefan (Canada)

Full advanced treatment of secondary wastewater effluents in potable reuse projects typically includes microfiltration, reverse osmosis (RO) filtration, and the UV-Advanced Oxidation Process (UV/AOP). To increase the efficiency and lifetime of membranes by minimizing biological fouling, chlorine is injected upstream of the membranes into the secondary effluents containing various levels of free ammonia, which results in chloramine formation, mostly as monochloramine (NH_2Cl). NH_2Cl is an uncharged low-molecular weight compound which is not completely rejected by the RO membranes. Among other chemical species passing through RO are chloride and nitrate ions, and low-molecular weight organic pollutants such as 1,4-dioxane, N-nitrosodimethylamine (NDMA) and other nitrosamines, formaldehyde, acetone, chloroform, etc. Two UV/AOPs i.e. UV/H_2O_2 and UV/Chlorine are currently implemented at water reuse facilities to treat organic pollutants in RO permeate (ROP). The low ROP pH (~5 – 6) and low free ammonia levels favor NH_2Cl disproportionation to dichloramine ($NHCl_2$). $NHCl_2$ formation occurs particularly in the UV/Chlorine AOP due to breakpoint reactions. The two chloramines both absorb the UV (254nm) radiation and react with OH radicals, the highly oxidizing species generated through either H_2O_2 or free chlorine photolysis in the respective UV/AOP. Mono- and dichloramine photolyze with high quantum yields to reactive radical species and their degradation products compete effectively for the OH radicals with the target pollutant(s). Moreover, free chlorine chemistry and photochemistry are highly dependent on the ROP characteristics and composition. Therefore, understanding the science of such complex dynamics of UV/AOPs is paramount for accurate UV equipment sizing and UV/AOP performance prediction, as well as for cost-effective operation of the UV systems for organic contaminant treatment in water reuse projects.

Mihaela Stefan, Trojan Technologies, Canada.

OP3 Look toward water recycling without RO

I. Law (Australia)

The majority of advanced reclamation plants in Australia incorporate the dual membrane system – microfiltration (MF) or ultrafiltration (UF) - followed by reverse osmosis (RO). This process train appears to be the default process for many advanced reuse schemes not only in Australia but also in the US and parts of Europe. However, experience is showing that this train, while producing an exceptional product water quality, is not as cost effective or as sustainable as those trains that incorporate ozone and activated carbon in lieu of RO – examples of which are the UOSA plant in Virginia, US and the Goreangab Plant in Windhoek, Namibia. This paper will summarise early South African findings into the efficacy of the ozone/activated carbon combination before discussing the findings of investigative work carried out in Australia into the removal of Trace Organics (TrOCs) in three plants (two in Queensland and one in New South Wales) that incorporate the Ozone/BAC or GAC processes. The removal of both pathogens and TrOCs through the Ozone/GAC or Biological Media Filtration (BMF) trials at the large Eastern Treatment Plant in Melbourne will be incorporated into these findings and they will then be compared with actual operational results obtained from the Goreangab Water Reclamation Plant in Windhoek, Namibia – the world's first Direct Potable Reuse plant - the heart of which is the Ozone/BAC/GAC process. In addition, findings from recent pilot studies in Florida, US and on tertiary effluents in India will be incorporated. The paper will conclude that more serious consideration does need to be given to non-RO treatment trains for all forms of advanced reuse, if we are truly interested in fostering more sustainable solutions to our water management practices, particularly with the increased uptake of potable reuse.

Ian Law, IBL Solutions, Australia.

OP4 Modelling The UV-LED Based Chlorine Photodecay And Radical Formation At Different Wavelengths And PHs

R. Yin, L. Ling, C. Shang (China)

An empirical model that incorporates the chlorine photodecay rate constants, quantum yields, and molar absorption coefficients of hypochlorous acid (HOCl) and hypochlorite (OCl^-) was established and used to predict the chlorine photodecay rate at any wavelength (255–300 nm) and pH (5–10) in this study. The prediction of the chlorine photodecay rates at the four wavelengths (i.e., 255, 265, 285 and 300 nm) and two pHs (i.e., pHs 6 and 7) was well validated against the experimental results using UV-LEDs as light sources. The wavelength- and pH-dependency on the formation of reactive radical species from chlorine photolysis were also investigated in this study. We also provide implications of UV wavelength dependency on chlorine photodecay and its radical generation at different pHs in real-world applications.

Ran Yin, The Hong Kong University of Science and Technology, China.

SESSION 2: SUSTAINABLE TREATMENT OF COMPLEX INDUSTRIAL WASTEWATER STREAMS
PRESENTATIONS

ISKN3 Novel Approaches For Treatment Of Heavy Metals In Wastewater

L. Chai (China)

The presentation will introduce the novel in-suit mineralization method for high-rate treatment of wastewater containing As(III) or As(V), and the enhanced methods for the complex heavy metal wastewater based on group complex, which were developed in our group in recent years. Further, fluoride and chloride removal by sulfate exchange adsorption intensified by electrochemical field would be also introduced. The introduced combining technology has realized the deep purification and reuse of complicated wastewater containing multiple heavy metals, which has been applied in more than 200 full-scale plants and listed in the National Design Standards for Full-scale Heavy Metal Containing Wastewater Treatment.

Liyan Chai, Central South University, China.

OP5 Evaluation Of Hybrid Systems For Treatment Of Effluents From The Pesticide Production Industry

A. Soares (United Kingdom)

The pesticide production industry generates a high strength wastewater containing a range of toxic pollutants including phenoxy acids and dichloro acids. When evaluating different treatment options to design a hybrid system it was clear that a biological treatment process should be considered due to the high BOD and COD with concentrations that ranged from 5101-18000 mg/L and 18675-47763 mg/L, respectively. A number of hybrid systems (granular activated carbon, membrane bioreactor and ultraviolet photolysis) were investigated. The MBR-GAC pilot-plant was very effective especially after dosing of additional nutrients and alkalinity. After diluting the wastewater to 25%, to prevent toxicity to the MBR process, and GAC, the removals reached of 86-99% for pesticides. Photolysis with UV showed promising results to replace the GAC, as the MBR-UV system achieved a total pesticides removal of 99-100%. This latter is currently being considered for implementation on the industrial site.

Ana Soares, Cranfield University, United Kingdom.

OP6 Realizing High-rate Sulfur Reduction Under Sulfate-rich Conditions In A Biological AMD Treatment System

F. Jiang, R. Sun, L. Zhang, G. Chen (China)

Biological sulfur reduction can theoretically produce sufficient sulfide to effectively remove and recover heavy metals in the treatment of sulfate-rich acid mine drainage (AMD), using 75% less organics than biological sulfate reduction. The long-term feasibility of biological sulfur reduction under high sulfate conditions was investigated with a lab-scale AMD treatment system included a sulfidogenic reactor fed with sulfur. In the 169-day trial, an average sulfide production rate (SPR) as high as 47±9 mg S/L-h was achieved under sulfate-free condition, and it was 53±10 mg S/L-h when 1300 mg S/L sulfate were fed. Interestingly, sulfate was barely reduced even at such a high strength and contributed to only 1.5% of total sulfide production. With the produced sulfide, the metal ions excepted Mn(II) in the AMD were removed. In summary, sulfur reduction can be a promising and attractive technology to realize a high-rate and low-cost BSP process for treating sulfate-rich AMD

Feng Jiang, South China Normal University, China.

ISKN4 Evaluation Of Full Scale Ozonation Process With Massive O_3 Dosage As Tertiary Treatment Of Wastewater From Petroleum-Oil Chemical Industries: SCIP Case

D. Qu, J. Fettig, U. Austermann-Haun, J. Meier, A. Busch, E. Gilbert (China)

Wastewater produced by industries inside Shanghai Chemical Industry Park (SCIP), which are mainly from petroleum-oil chemistry and fine chemistry, is with the characteristics of deep brown colour and of high content of COD and phenyl organic pollutants. Furthermore, part of effluent from certain client has been confirmed to be toxic to biological nitrification and with high content of hard COD. To effectively remove biologically treated pollutants, to meet the more and more strengthened discharge limit required by local authorities, and to solve biological toxicity issue, ozonation process was introduced into wastewater treatment plant of SCIP (WWTP) firstly in 2011, served as tertiary treatment for colour removal with dosage of about 20 mg O_3/L wastewater, and later of about 130 mgO_3/L wastewater to meet the strengthened requirement of local discharge permit and standard especially on removal of COD/TOC and specific organic pollutants from beginning of 2016 and July 2017 respectively. Furthermore, combined hydrogen peroxide and ozone oxidation has been applied to optimize ozonation, and a biological filtration process is now attached after ozonation to enhance removal of ozonation-produced biologically-treatable residual organic pollutant. Recent performance of solo ozonation process showed a high efficiency of brightness and decreasing of COD or TOC and specific pollutants, and ozonation plus biological filtration has been confirmed to be a cost-effective measure especially for hard COD removal. However, there is still lack of information on the abatement of organic micropollutants and production of oxidation by-products in this process. Further investigation is needed for a better understanding of the environmental fate of the ozonated wastewater.

Feng Jiang, South China Normal University, China.

OP7 Options For Removing Refractory Organic Substances In Pre-treated Process Water From Hydrothermal Carbonization

J. Fettig, U. Austermann-Haun, J.F. Meier, A. Busch, E. Gilbert (Germany)

Granular activated carbon (GAC) adsorption as well as ozonation in combination with biodegradation was investigated in order to remove refractory organics from biologically pre-treated process waters (PW) produced by the hydrothermal carbonization (HTC) of spent grains and fine mulch. Kinetic tests revealed that the organics in spent grains PW had much lower molecular weights than organics in fine mulch PW, and overall isotherms showed that they were better adsorbable. This was confirmed in GAC column experiments where the breakthrough curves could be predicted fairly well by a dynamic adsorption model. On the other hand, ozonation had a stronger effect on fine mulch PW with respect to an enhancement of the aerobic degradability. Thus, the type of input material is crucial for selecting the most suitable post-treatment method for HTC process water.

Joachim Fettig, University of Applied Sciences Ostwestfalen-Lippe, Germany.

OP8 Zero-valent Iron Mediated Degradation Of Complex Organics In Hydraulic Fracturing Wastewater From Yanchang Shale, China

O. Abass, K. Zhang (China)

This work demonstrates the catalytic activity of zerovalent iron (n-ZVI) particles to effectively degrade/recover major organic/inorganic components of real hydraulic fracturing wastewater (HFW) from the shale play of Yanchang formation located in south-eastern Ordos Basin, China. Optimized concentration of nZVI (2 g/L) added to raw HFW led to COD reductions of 30% at pH 4, and 54% at pH 3 (with addition of H_2O_2) respectively within 120 min reaction time. The degradation kinetics of total petroleum hydrocarbon (TPH) by nZVI was over 6 times faster in acidic condition (Krc = 0.0029 min^{-1}), than at natural pH of the raw FW (Krc = 0.00046 min^{-1}). In addition, oxidant-assisted degradation of the HFW TPH showed better performance (C/C0 = 0.191) at half the time required for treatment without oxidant addition (C/C0 = 0.218). Besides, n-ZVI initiated oxidation led to rapid degradation of the HFW polyethylene glycols (93.7% PEGs removal). Therefore, pretreatment of HFW with n-ZVI represents a potential treatment option for the reuse of HF wastewaters.

Olusegun Abass, Chinese Academy of Sciences, China.

P707 Enhanced Treatment Of Industrial Wastewater Using AAO-MBR: Membrane Fouling Behavior And Microbial Community Succession

L.Wang, Y. Li (China)

The aim of this study to evaluate the removal of industrial wastewater using anaerobic-anoxic-oxic membrane (AAO-MBR) system. The results show that the optimal operational conditions were obtained as HRT of 73.6 h, SRT of 35 d, and mixed liquor return ratio of 300%. Gas chromatograph-mass spectrometer analysis indicated that organics in wastewater were significantly reduced after treatment. Among these organics, 2-hydroxydesmethylimipramine concentration was the highest both in the influent and effluent, implying its refractory characteristics. Scanning electron microscopy- energy dispersive X ray spectroscope analysis revealed that the membrane fouling was contributed to the combination effect of organic and inorganic compounds. Proteobacteria, Bacteroidetes, and Nitrospirae were dominant bacteria in the AAO-MBR system, which accounted for 86.9%, 74.1% and 69.4% of total bacteria in the anaerobic, anoxic and oxic reactors, respectively. The results will provide valuable information for optimizing the design and operation of industrial wastewater treatment system.

Lin Wang, Tongji University, China.

P704 Simultaneous Anaerobic And Aerobic Transformations Of Nitrobenzene

L. Cao, C. Zhang, S. Zou, Y. Zhang, B. Rittmannn (China)

Anaerobic biodegradation of nitrobenzene (NB) avoids generation of nitrophenol, which is more toxic than NB, but anaerobic transformation of nitrobenzene results in aniline accumulation, as its biodegradation must be aerobic. Simultaneous anaerobic and aerobic conditions, achieved in a vertical baffled bioreactor, removed nitrobenzene and aniline effectively.

Yongming Zhang, Shanghai Normal University, China.

P708 Treatment Of Medical Radioactive Wastewater By Forward Osmosis (FO) Membrane Process

S. Lee, Y. Kim, J. Park, S. Hong (Korea)

The use of forward osmosis (FO) for concentrating radioactive liquid waste from radiation therapy rooms in hospitals was investigated in this study. The removal of radioactive iodine using FO was investigated with varying conditions to identify the optimal conditions. FO had a rejection rate for radioactive iodine (125I) of up to 99.85%. The high rejection rate was achieved at high pH, due to electric repulsion between iodine and membrane. Furthermore, the radionuclides in the actual medical waste (131I) were also removed effectively, and hydraulic washing was applied to improve its sustainable operation. To our knowledge, this study is the first attempt to explore the potential of FO technology for treating radioactive waste, and thus could be expanded to the dewatering of the radioactive liquid wastes from a variety of sources, such as nuclear power plants.

Seungkwan Hong, Korea University, Korea.

SESSION 3: INNOVATIVE DECENTRALIZED TECHNOLOGIES FOR URBAN/RURAL APPLICATIONS

PRESENTATIONS

ISKN5 A New Sewage Treatment System Using Anaerobic Mbr And Anammox For Effective Energy Recovery And Low Carbon Design: Concept And Experimental Study

Y. Li (Japan)

Sewage is the most abundant type of wastewater and a valuable resource containing water, nutrients and energy. If recoverable, sewage has the potential to become a net supplier of renewable energy and reclaimed water. Consequently the selection of an appropriate technology that can convert sewage into high level renewable energy and high quality reclaimed water is very important.
This presentation gives an up-to-date review of application and research achievements in sewage treatment technologies in Japan for improving the efficiencies in term of low carbon, low cost and energy resource recovery. The effectiveness, environmental benefits and the current state of real application of each system are discussed, including centralized plant and decentralized system.The new challenge and technical issues encountered during development of sewage treatment system are discussed, and the future research needs in promoting energy resource recovery are proposed. A small-scale experimental plant consisting of an AnMBR with a working volume of 20 L and a 7-L, one-stage anammox reactor with suspended carriers will be introduced. This new concept plant was constructed in Senen Sewage Treatment Plant, Sendai, Japan and has been in operation for over 200 days. The HRT of AnMBR has been successfully shortened to 6 hrs and the HRT of a one-stage anammox reactor with suspended carriers has been successfully shortened to 2 hrs.

Yu-You Li, Tohoku University, Japan.

OP9 Re-Thinking The Sanitation Engineering Paradigm: A Strategic Approach Towards Off-the-Grid Solutions

S. Pillay, D. Kone (South Africa)

Engineering solutions applied in the developed world cannot be replicated at scale in the developing world for a number of reasons, including the rate of urbanisation, and limited resources (finance, revenue collection, infrastructure, water, energy and human capacity). For this reason, the majority of people in the developing world rely on on-site sanitation systems. While simpler to implement, these systems are associated with other challenges, including the emptying and safe disposal of faecal sludges and poor user experience. A new engineering paradigm for sanitation is proposed in this paper; one in which off-grid sanitation systems are used treat faecal sludge at point-of-use and without the need for sewers and a reliance for external water and energy sources. These innovations can be linked to water security and business opportunities. The opportunity allows for leapfrogging these solutions in growing urban cities of the developing world, reducing water consumption and eliminating pollutant pathways. In this strategic paper, the recent advances in demonstrating these technologies – developed through rigorous scientific evaluation by universities and other researchers – in South Africa will be presented.

Sudhir Pillay, Water Research Commission, South Africa.

OP10 The Nanomembrane Toilet: Enabling Non-sewered Sanitation At A Single Household Scale, Independent Of Grid Produced Power

F. Kamranvand, C. Davey, E. Mercer, A. Parker, L. Williams, A. Kolios, S. Tyrrel, E. McAdam (United Kingdom)

In this study, the Nanomembrane Toilet is introduced as a single household sanitation system that is independent of grid produced power. To address the paucity of information on faecal sludge characterisation, both the settling velocity and yield stress of faecal sludge have been evaluated and a two-stage post-flush source separation identified that can provide a consolidated faecal sludge phase together with partially contaminated urine for further processing. A small scale combustion chamber has been developed to operate on the faecal sludge phase, which has proven effective for chemical oxidation and the production of low grade heat, the latter being subsequently used to provide the vapour pressure gradient for thermally driven membrane separation of urine. Importantly, this study has demonstrated that through integration of this modularised componentry into the Nanomembrane Toilet, single household sanitation can be delivered, independent of external power sources.

Ewan McAdam, Cranfield University, United Kingdom.

ISKN6 New Sanitation – Nucleus Of The Circular Economy Revolution

D. Naidoo (South Africa)

Globally, the conversation of the need for a circular economy as the key to sustainable development has had as its exclamation mark the severe drought and flood episodes on the back of the most severe El Nino event in more that 20 years. In Southern Africa, parts of the region were affected to severely that four countries were facing the possibility of famine. Even economic powerhouses like South Africa had to deal with major state of emergency to deal with the devastation to people, agriculture and the economy.

A new impetus to quicker smarter solutions have emerged. A key stumbling block is the multiple strings of crises in many sectors leaving many government at a loss of where to start. This paper offers as a thesis the possibility of "new sanitation" being that key that unlocks the door to the pathway to a circular economy. New Sanitation is defined by new technologies and platforms that effect safe and dignified sanitation services with low or no water budgets on the one hand, and a waste beneficiation stream that has few parallels in other feedstock. The Gates "Reinvent the Toilet" campaign has been an important catalyst in this regard bringing together a global team of players that stand poised to redefine waste management. This paper will offer an analysis from a water-energy-food nexus perspective demonstrating that new sanitation is viable candidate to aggregate the core elements of a strategy to achieve a circular economy.

Dhesigen Naidoo, WRC South Africa, South Africa.

OP11 Performance And Mechanisms Of Ultrafiltration Membrane Fouling Mitigation In A Novel Electrochemical Membrane Reactor

J. Sun, C. Hu, K. Zhao, H. Liu, J. Qu (China)

A novel electrochemical membrane reactor (EMR), in which electrocoagulation (EC) and electrooxidation (EO) were integrated into one reactor with the ultrafiltration membrane module placed in the electric field zone between the electrodes, was designed to improve effluent water quality and reduce membrane fouling. EMR showed higher water flux than the conventional combination of EC and UF in separate units due to the formation of a polarized cake layer, which formed under higher electric field strengths showing higher porosity and hydrophilicity. EO modulated the morphology of the cake layer by breaking up humic acid (HA) molecules (i.e., carboxylic functional groups and aromatic structures), giving a more porous cake layer, while EC increased the hydrophilicity of the formed cake layer, leading to the alleviation of membrane fouling. Compared to EC-UF, EMR has a smaller footprint and could achieve energy savings due to improved fouling resistance and a more compact reactor design.

Chengzhi Hu, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China.

OP12 Combination Of Microfiltration Membrane With Microbial Desalination Cell For Advanced Wastewater Purification

K. zuo, F. Liu, X. Zhang, P. Liang, X. Huang (China)

In this study, a hollow fiber microfiltration membrane (HFM) coupled microbial desalination cell (HFM-MDC) was fabricated. During 105 days of operation with real domestic wastewater, the HFM-MDC produced 86.1v% of diluate, with the removal efficiencies of conductivity, chemical oxygen demand, total nitrogen, NH_4^+-N, and total phosphorus reaching 94.3 ± 2.6%, 84.1 ± 1.8%, 97.7 ± 1.2%, 98.9 ± 0.6%, and 97.8 ± 1.5%, respectively. The corresponding concentrate (13.9v%) recovered 6.7 times the initial conductivity and 98.7% of the phosphorous (40.9 ± 4.9 mg/L). In addition, trans membrane pressure of HFM was controlled at ⩽ 20 kPa through chemical on-line backwashing and aeration.

Kuichang Zuo, Tsinghua University, China.

P301 Pilot Demonstration Of Microalgae Cultivation Treating Source Separated Human Urine In Outdoor Raceway Ponds

P. Chatterjee, M. Grantenier, P. Ramasamy, M. Kokko, J. Rintala (Finland)

A freshwater green microalga, Scenedesmus acuminatus was grown in source separated human urine (15 – 20 times dilutions) in an outdoor raceway pond (RWP) of working volume 2000 L, located in Tampere, Finland, operated in a semi-continuous mode. Inoculum for the pilot RWP was developed using a 500 L RWP. A maximum biomass density of 2.3 g/L was obtained in 500 L RWP operated in batch mode with 1:20 times diluted urine. The algae growing in the pilot pond under semi-continuous mode could remove 91% Na, 94% K, 85% N and 63% P even at culture temperatures as low as 5°C. This is the first reported study of a pilot algal raceway pond growing microalgae in human urine.

Pritha Chatterjee, Tampere University of Technology, Finland

P306 Cyclic Sequential Batch Reactor: Nitrogen And Phosphorus Removal From Domestic Sewage

R. De Freitas Bueno, R. Passos Piveli, F. Campos (Brazil)

Treatment of domestic sewage by sequential batch processes has been shown to be quite attractive, mainly because it allows the maintenance of anaerobic, anoxic and aerobic conditions, necessary for the removal of nitrogen and phosphorus, in a single reactor. Therefore, the objective of this study was to evaluate the behavior of a new reactor design known as cyclic sequential batch reactor, applied to the removal of organic matter, nitrogen and phosphorus from domestic sewage in a tropical climate. The removal of organic matter, nitrogen and phosphorus were high, with values of 90.6%, 90.5% and 89.1%, respectively. Effluent quality of less than 8.3 mgN/L total nitrogen 4.6 mgN/L ammonia nitrogen and 0.8 mgP/L of total phosphorus was routinely obtained at and below 26°C, a solids retention time of around 12 days, hydraulic retention time of 4 h, organic loading rate (OLR) of 313.6 gCOD/L.d, nitrogen loading rate (NLR) of 36.9 gTKN/L.d, phosphorus loading rate (PLR) of 4.5 gP/L.d and food-to-mass ratios (F/M) of 0.76 gCOD/gMLVSS.d.

Rodrigo Bueno, Federal University of ABC, Brazil.

SESSION 4: ADVANCED OXIDATION PROCESSES FOR WATER AND WASTE-WATER TREATMENT PRESENTATIONS

ISKN7 Highly Concentrated Organic Wastewater Treatment With CWAO Technique

C. Sun (China)

The Catalytic Wet Air Oxidation (CWAO) system of Keduo Enviro. mainly consists of four operation units: storage and delivery unit, heat exchange unit, reaction unit and exhaust gas absorption unit. So far, the above technology has been successfully applied to the treatment of various high concentration organic wastewater in Wanhua Chemical Group Co., Ltd., Tianjin North Food Co., Ltd., Beijing Tiangang Auxiliary Co., Ltd. and Shenzhen Hazardous Waste Treatment Station Co., Ltd., etc.
CWAO, based on wet oxidation treatment, is an advanced environmental protection technology disposing of high concentration organic wastewater since the mid 1980s. In the presence of catalysts, organics and ammonia in the sewage are oxidized and thus decomposed into CO_2, H_2O, N_2 and other harmless substances at a certain temperature and pressure, achieving the purpose of water purification. High purification efficiency, simple process, small occupation area and so on are the advantages of CWAO.

Chenglin Sun, Dalian Institute of Chemical Physics, China.

OP13 Degradation Of Polyacrylamide (PAM) By Plasma In Gas-liquid Multiphase Flow

W. Song, Y. Zhang, Y. Gao, M. Yang (China)

PAM was frequently used as enhanced oil recovery and persisted for long periods of time due to be refractory to biodegradation in Underground wells. Pulsed corona discharge plasma was employed for the degradation of polyacrylamide (PAM) and the degradation process fitted the zero-order kinetic model. A possible pathway of PAM degradation in such a system was proposed. The results of this study demonstrated that the plasma treatment was effective in PAM degradation.

Wenzhe Song, Research Center for Eco-Environmental Sciences, China.

OP14 Removal Of Micropollutants In Wastewater Effluent During UV/H_2O_2 And UV/PDS

M. Nihemaiti, D. Miklos, J. Müller, U. Hübner, J. Drewes, K. Linden, J. Croué (Australia)

Degradation of micropollutants during UV-based advanced oxidation processes was studied. 12 micropollutants were selected based on their frequent detection in wastewater effluent and their diverse physicochemical characteristics. Experiments were conducted with solutions containing 1 µg/L of each selected micropollutant prepared in pure water (5 mM phosphate buffer) and wastewater effluent in order to investigate the effect of the water matrix. Results showed that UV/PDS was more efficient than UV/H_2O_2 in pure water due to the higher yield of $SO_4^{\cdot -}$ from UV irradiation of PDS than that of $OH^{\cdot}$ from H_2O_2. However, micropollutants were removed more selectively by $SO_4^{\cdot -}$ in wastewater effluent. Venlafaxine and metoprolol were found to react faster with $SO_4^{\cdot -}$, which might be related to their aromatic rings and secondary/tertiary amine groups. The influence of wastewater matrix can be overcome by increasing the UV fluence or oxidant concentration to generate more radicals.

Jean-Philippe Croue, Curtin University, Australia.

ISKN8 The Evolution of Leading Edge Advanced Oxidation Processes In Asia

K. Wasiak (Switzerland)

Advanced Oxidation Processes (AOP) are one of the most powerful tools available to the environmental industry. The most challenging effluents are treated using AOP technology to meet discharge regulations, and achieve ambitious water quality goals.
AOPs have several advantages over other technologies and provide benefits to water treatment process trains. AOPs provide powerful and fast oxidation of microorganisms, TOC, COD, and taste, odour and colour compounds. They also provide removal of trace organic compounds and other micro-pollutants such as PPCPs that most conventional technologies do not address. When conventional technologies fail, AOPs are used.
Since the definition of AOP as "…water treatment processes which involve the generation of hydroxyl radicals…" (Glaze et al. 1987), AOPs have been the focus of much research. AOPs are now broadly considered the combination of two or more oxidation technologies. While some AOPs have matured and are widely available in global markets, others remain in the early development stage.
This keynote addresses several important aspects of the evolution of AOP technology, both globally and with a specific focus on Asia:
- The first section of the paper provides a bibliographic review of AOP technologies; differentiating between established technologies such as UV-H_2O_2 and O_3-H_2O_2, and those still emerging such as catalyst based AOPs, electro-oxidation, and UV-Cl_2.
- The second section of the paper focuses on a data-science statistical analysis of literature sources. The literature analysis provides insight into the trends, frequency, geography, applications, and authorship of AOP publications.
- Finally, the last section of the paper illustrates the evolution of AOP technology over time using customer sentiment surveys. Surveys describe growth in laboratory & pilot scale studies, full-scale municipal and industrial installations, development of regulatory drivers, and improved customer sentiment.

Katia Wasiak, SUEZ Degremont Technologies AG, Switzerland.

OP15 Mesoporous Ce-Ti-Zr Ternary Oxide Millispheres For Efficient Catalytic Ozonation In Bubble Column

C. Shan, Y. Xu, P. Wang, Z. Lu, W. Zhang, B. Pan (China)

Mesoporous Ce-Ti-Zr ternary oxide (CTZO) millisphere of large size (0.8-1.0 mm in diameter) and high surface area (180 m^2 g^{-1}) was synthesized as ozonation catalyst for column operation in advanced water treatment. The fraction of Ce(III) is much higher on the surface of CTZO (49.2%) than CeO_2 (27.5%), resulting in its high catalytic activity in ozone decomposition and mineralization of oxalic acid (OA), an ozone-refractory probe compound. The oxidation of OA was mediated by the Ce(III)/Ce(IV) redox cycle, which continuously accepts the electron supply from OA ligand and meanwhile donates electron to activate O_3 into ·OH. The catalytic ozonation of OA by CTZO was enhanced in the presence of sulfate due to the generation of sulfate radical. Cyclic runs demonstrated that the CTZO millispheres exhibited high stability for sustainable catalytic ozonation of OA without noticeable release of Ce or change of Ce valence state.

Chao Shan, Nanjing University, China.

OP16 Apply UV Absorbance And Fluorescence Indices For Assessing The Oxidation And Disinfection Efficiency Of Ozonation Proces

W. Li, J. Wu, S. Cheng, Y. Wu, M. Cai, Y. Li, A. Li (China)

The UV absorbance (UVA254 & UVA280) and fluorescence indices (protein-like & humic-like fluorescence) were comprehensively studied as surrogate indicators for assessing the degradation of dissolved organic matter (DOM), the elimination of trace organic contaminants (TOrCs), the formation of bromate and biodegradable dissolved organic carbon (BDOC) and inactivation of Escherichia coli and autochthonous bacteria during the ozonation of surface water and wastewater effluent. The UVA280, protein-like fluorescence & humic-like fluorescence signals can be measured online by a miniaturized LED UV/fluorescence sensor. These relationships between spectral indices and the oxidation & disinfection efficiencies provide fundamental information for the design of smart automatic control system of ozonation process.

Wentao Li, Nanjing University, China.

P506 Z-scheme WO3/CDots/CdS Heterostructure With Remarkable Photocatalytic Activity And Anti-photocorrosion Performance

J. Zhang, Y. Guo, Y. Yuhan Xiong (China)

As a representative artificial photosynthetic system, the direct Z-scheme WO3/CdS is a promising photocatalyst system for water purification. However, this system is still limited due to the low electron transfer efficiency and serious photocorrosion. Herein, we designed and precisely fabricated a novel all-solid-state Z-scheme WO3/CDots/CdS system. The CDots, as a non-metallic electron mediator, could promote interfacial charge carrier separation and eliminate photocorrosion with enhanced photocatalytic activity. The phase, morphologies, microstructures, optical and electrical properties of as-obtained Z-scheme WO3/CDots/CdS heterojunction were investigated in detail. The photocatalytic performances of as-prepared catalysts were evaluated by the decomposition of 4-chlorophenol (4-CP), rhodamine B (RhB) and tetracycline hydrochloride (TCH), and the reduction of aqueous Cr (VI) in visible light, respectively. The results indicated that a thorough and complete Z-scheme charge carrier transfer route was achieved. The toxicity assessment authenticated good biocompatibility and low cytotoxicity of WO3/CDots/CdS

Chaoqun Li, Jilin University, China.

P512 Radical Mechanisms Of Micropollutants Degradation By The UV/Chlorine Process

K. Guo, Z. Wu, J. Fang (China)

The UV/chlorine process is an emerging advanced oxidation process (AOP) used for the degradation of micropollutants. The contributions of HO• and reactive chlorine species (RCS), including Cl•, Cl_2•− and ClO•, to the degradation of different PPCPs were compound specific. ClO• showed high reactivity with some PPCPs, such as carbamazepine, caffeine, and gemfibrozil. RCS showed considerable reactivity with olefins and benzene derivatives, such as phenols, anilines and alkyl-/alkoxybenzenes. The contribution of HO•, but not necessarily RCS, to PPCP removal decreased with increasing pH. Natural organic matter (NOM) induced significant scavenging of ClO• and greatly decreased the degradation of PPCPs that was attributable to ClO•. Alkalinity inhibited the degradation of PPCPs that was primarily attacked by HO• and Cl• but had negligible effects on the degradation of PPCPs by ClO•. This is the first study on the reactivity of RCS, particularly ClO•, with structurally diverse PPCPs.

Jingyun Fang, Sun Yat-Sen University, China.

P513 Porous FeCN Derived From MOF As An Efficient And Stable Heterogeneous Catalyst For Electro-Fenton Degradation Of BPA

Jiayuan, Lu; Xiao, Hu; Wenwei, Li (China)

In this work, we prepared, for the first time, a novel Fe3O4-containing N-doped porous carbon material (FeCN) from pyrolysis of Fe-based Metal-Organic Framework. The FeCN served as cathode catalysts to continuously generate H_2O_2 on site, meanwhile provided Fe^{2+} in electro-Fenton process. The FeCN as cathode catalysts exhibited an excellent performance in the electro-Fenton system on the degradation of bisphenol A (BPA). A brilliant removal efficiency (100%) of BPA was obtained in 120 min. The FeCN catalyst performs significantly remarkable reusability as the degradation in 120 min still above 80% in fifth cycle, indicating that the prepared FeCN is a promising cathode material in EF technology.

Lu Jiayuan, University of Science and Technology of China, China.

SESSION 5: EMERGING CONTAMINANTS AND ANTIBIOTIC RESISTANCE – DETECTION AND CONTROL PRESENTATIONS

ISKN9 Role/Application of Advanced Oxidation Technologies on the treatment of Contaminants of Emerging Concern

D. Dionysiou (United States)

Advanced oxidation processes (AOPs) based on the generation of reactive species (i.e., hydroxyl radicals, sulfate radicals, high valence iron) are gaining significant popularity for the treatment of contaminants of emerging concern in water. They have the potential to transform deleterious and recalcitrant contaminants in water to non-harmful products. Various AOPs are available for specific target applications. Examples include AOPs operating under ambient conditions in the dark (Fenton-like systems, persulfate, catalytic, ozone/high pH, catalytic ozonation), under UV radiation (i.e., UV/H_2O_2, UV/persulfate, UC/chlorine), under solar radiation (i.e., photocatalytic, photo-Fenton like), under thermal/steam/alkaline conditions (i.e., persulfate), using electric input (i.e., electrochemical, electrocatalytic), and other means. In water treatment, applications of AOPs include oxidation of organic and inorganic contaminants as well as killing of pathogenic microorganisms. In some cases, under certain conditions, AOPs can be modified to achieve reduction of some organic and inorganic contaminants. When necessary, AOPs can be applied as part of the overall process train for the treatment of surface water, groundwater, industrial wastewater, and other types of contaminated water. More recently, significant attention was given to the role of certain AOPs for water reuse applications (i.e., direct or indirect potable reuse). In this presentation, Prof. Dionysiou will provide examples of his work on the application of AOPs for the treatment of contaminants of emerging concern relevant to drinking water and water reuse applications. He will present details on the mechanism of transformation of cyanotoxins, pharmaceuticals, endocrine disruptors, pesticides, and other contaminants of concern using heterogeneous (i.e., photocatalytic and catalytic processes) and homogeneous (UV/H_2O_2, UV/persfulfate, UV/chlorine) AOPs. He will provide examples of the degradation pathways of selected contaminants and the role of water quality parameters in some of these processes. He will present details of the reactivity of species generated in AOPs with specific functional groups of contaminants of emerging concern and will elaborate on cases of structure-activity relationships.

Dionysios Dionysiou, University of Cincinnati, United States.

OP17 Bacteriophages To Sensitize A Pathogenic New Delhi Metallo <beta>-lactamase-positive Escherichia Coli To Solar Disinfection

N. Aljassim, P. Hong (Saudi Arabia)

Conventional wastewater treatment does not completely remove antibiotic-resistant and/or pathogenic bacteria, allowing their dissemination into the environment via reclaimed water. Our previous work identified a New Delhi metallo beta-lactamase-positive pathogenic E. coli strain PI-7 from wastewater, and found that solar irradiation can achieve up to 5-logs reduction for it in treated wastewater. But this strain showed a prolonged lag-phase before decay onset in response to solar irradiation. This paper explores the use of bacteriophages to increase the susceptibility of E. coli PI-7 to solar disinfection. Results showed that bacteriophages coupled with solar irradiation could successfully reduce the length of the lag-phase for E. coli PI-7, from 6.64 ± 0.63 h to 2.4 ± 0.89 h. Further work focusses on elucidating the gene expression response of E. coli PI-7 under solar irradiation in presence of bacteriophages to determine the molecular mechanisms behind the increased susceptibility.

PeiYing Hong, King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

OP18 Effects Of Polymer-supported Disinfectants On Antibiotic-resistant Pathogens And Genes In Drinking Water

F. Chang, P. Shi, S.Shen, H. Zhang, Q. Zhou, Y. Pan, C. Shuang, A. Li (China)

Extensive use of antibiotics stimulates the proliferation of antibiotic-resistant pathogens (ARP) and genes (ARGs) in natural waters, which aggravates the biological pollution of drinking water and thus threatens public health. The effective control of waterborne ARPs in drinking water calls for the development of new disinfection strategies, including multiple-barrier approaches that provide reliable physico-chemical removal. Polymer-supported disinfectants with quaternary-ammonium structure (PD-QAS) have potential advantages in ARP control because of the unique bactericidal mechanism (adsorption-dissociation). In this study, PDs-QAS disinfection showed good bacteria-eliminating performance on potential chlorine/UV-resistant pathogens in both stimulated and actual drinking water, and also effectively controlled the antibiotic resistance of residual bacteria when compared to other conventional disinfection strategies. The adsorption-dissociation effect of PDs-QAS was proven to be the underlying bactericidal mechanism, which determined their unique capabilities of ARPs and ARGs removal. This study proposes a complementary method to control ARPs and ARGs in drinking water.

Peng Shi, Nanjing University, China.

ISKN10 Contaminant Antibiotic Resistome In Wastewater: Evidence And Implications

C. Manaia (Portugal)

Antibiotic resistance is a major threat to human and animal health worldwide. Although it is at the clinical settings that antibiotic resistance shows the most threatening effects, antibiotic resistant bacteria and genes (ARB&ARG) colonizing humans and animals are continuously discharged to environment, where they become persistent contaminants. Water, simultaneously a major habitat for bacteria and routes of transport of environmental contaminants, has also a privileged role on ARB&ARG propagation.
Considered a relevant reservoir of ARB&ARG, domestic sewage, after conventional wastewater treatment or even after tertiary or advanced processes, may contain significant loads of ARB&ARG, although with distinct patterns across different regions. The growing body of knowledge about the profiles of ARB or ARG in different wastewater treatment plants may contribute to unveil some of the important drivers for antibiotic resistance persistence and spread. To reduce the risks associated with ARB&ARG wastewater discharges or reuse, further investigation, development of technical solutions and the improvement of policies are still needed.

Celia Manaia, Universidade Catolica Portuguesa Porto, Portugal.

OP19 How Do Online Parameters Relate To Elimination Of Micropollutants And Microorganisms During Ozonation Of Wastewater?

K. Klaer, I. Brückner, K. Kirchner, M. Agler-Rosenbaum, J. Pinnekamp (Germany)

An ozonation pilot plant was operated to receive basic information for designing a large-scale wastewater ozonation. Therefore, elimination of several pharmaceuticals was determined as well as reduction of E. coli and Intestinal Enterococci via microbial counts. I. a. UV254 and ozone concentration in water and off-gas were measured online to control ozone dosage. The relation of online parameters to reduction of micropollutants and microbial counts was investigated with the aim to derive a connection to performance of ozonation process. Results show a good correlation of specific ozone dosage and micropollutant elimination. Linking UV254 to micropollutant elimination allows process control based on the UV254 reduction. Correlations between ozone parameters and microbial count reduction is not as clear as it is for OMP removal, however, E. coli reduction displayed as log-counts increases with higher ozone dosages.

Kassandra Klaer, RWTH, Germany.

OP20 The Wastewater Antibiotic Resistome: A Global Survey

M. Riquelme Breazeal, J. Metch, E. Garner, N. Zhu, M. Blair, G. Arango-Argoty, M. Chan, A. Maile-Moskowitz, A. Li, D. Aga, I. Nambi, J. Larsson, H. Burgmann, T. Zhang, A. Pruden, P. Vikesland (United States)

Antibiotic resistance is a global public health concern that also threatens water sustainability. Wastewater treatment plants (WWTPs) provide an ideal environment for selection and interactions among pathogens and resistance carriers. Considering the global diversity of environments, the objective of this work was to characterize a cross-section of sewage samples and to investigate the effect of WWTPs on the removal of antibiotic resistance genes (ARGs). Metagenomics-based characterizations of WWTP influent and effluent samples collected from six countries revealed unique ARG profiles that clustered based on geographical location. Resistance in influent samples was dominated by multidrug, MLS, beta-lactam, and tetracycline ARGs; while trimethoprim ARGs were enriched in most effluents. qPCR-based quantification revealed sul1 gene log removals ranging from 0.5 to 2.8 in different WWTPs. A deeper understanding about ARGs in terms their relative risk is necessary to further guide effective mitigation.

Peter Vikesland, Virginia Tech, United States.

P419 Triclosan Induces Multiple Antibiotic Resistance And Promotes Conjugative Transfer Of Antibiotic Resistance Genes

J. Lu, M. Jin, Z. Yuan, J. Guo (Australia)

Antibiotic resistance (AR) has posed a major threat to public health globally. Overuse and misuse of antibiotics generally causes the acquisition and spread of antibiotic resistance. Here we report that, at a concentration of 0.2 mg/L, triclosan (TCS) as a biocide induces multi-drug resistance (MDR) in wide-type Escherichia coli after 30 days exposure. The oxidative stress induced by TCS caused genetic mutations in fabI, frdD, marR, acrR and soxR, and subsequently up-regulated the transcriptions of genes encoding beta-lactamase and multi-drug efflux pump as well as down-regulates genes related to membrane permeability. Moreover, exposure to TCS concentration from 0.02 µg/L to 0.2 mg/L could enhance the antibiotic resistance gene (ARG) transfer within and across bacteria genera. Our findings will enhance the understanding of potential roles of environmental chemicals in the global dissemination of AR in microbes.

Jianhua Guo, Advanced Water Management Centre/UQ, Australia.

P425 Spatial Distribution And Comprehensive Evaluation Of Emerging Pollutants In Effluents From WWTPs In Northern China

Liu, Yuan (China)

This study investigated physiochemical parameters, spatial distribution of 62 extensively used emerging organic pollutants (EOPs) in the effluents of 12 WWTPs in 11 northern cities of China. The investigated 62 EOPs included 42 pharmaceuticals and personal care products (PPCPs), 5 endocrine disrupting chemicals (EDCs), and 15 plasticizers. There were 49 species of EOPs were found in all the samples. 18 EOPs had high detection frequencies (over 90%) and PPCPs were the predominant EOP species. The top four EOPs in concentration were metoprolol (798.0 ng L^{-1}), carbamazepine (597.5 ng L^{-1}), sulpiride (543.5 ng L^{-1}) and dimethyl phthalate (502.6 ng L^{-1}). The pollution level of effluents was more affected by the presence of emerging and non-regulated priority pollutants due to a higher number of industrial wastewater discharges. Most contaminants detected showed significant positive correlations with total nitrogen. Roxithromycin, diclofenac, sulfamethoxazole, ofloxacin, clindamycin, sulpiride, ibuprofen, 17 α -ethynylestradiol, dimethyl phthalate in WWTP effluents exhibited a high or medium ecological risk and deserved special attention.

Yuan Liu, Tianjin University, China.

P414 Chlorine Disinfection Increases Both Intracellular And Extracellular Antibiotic Resistance Genes In A Full-scale UWWTP

S. Liu, H. Qu, D. Yang, H. Hu, W. Liu, Z. Qiu, J. Li, J. Guo, Z. Shen, M. Jin (China)

Disinfection play roles in global pathogens control. However, little effort is dedicated to revealing its potential impacts on transmission of antibiotic resistance genes (ARGs). Here, both extracellular ARGs (eARGs) and intracellular ARGs (iARGs) could be detected after the chlorine disinfection in the final effluent of a full-scale urban wastewater treatment plants (UWWTP) during a year. Worryingly, chlorination preferentially increased the abundances of eARGs against macrolide, tetracycline, sulfonamide, β -lactam, aminoglycosides, rifampicin and vancomycin up to 3 folds. Similar preferential promotion up to 7.8 folds was also found for iARGs abuandance after chlorination. E. coli abundance before chlorination showed strong positive correlation with the total eARGs, while iARGs was supposed to link with lower temperature and higher NH4+-N concentration.

Min Jin, Institute of Health and Environmental Medicine, China.

SESSION 6: ADVANCES IN ENERGY EFFICIENCY AND RESOURCE RECOVERY IN WASTEWATER TREATMENT PRESENTATIONS

ISKN11 Wastewater Treatment for Energy Positive Carbon and Nutrient Valorization

Z. Jason (United States)

Carbon-rich waste materials (liquid, solid, or gaseous) are largely considered to be a burden on society due to the large capital and energy costs for their treatment and disposal. There has been a paradigm shift towards developing a closed loop, biorefinery approach for the valorization of these wastes into value-added products, and such an approach enables a more carbon-efficient and circular economy. This presentation discusses the potential wastewater treatment pathways that are capable of simultaneously capturing and utilizing waste organic carbon and CO_2 and convert them into value-added products. It presents several recent developments on using electrochemical approach for carbon and nutrient valorization, and it provides preliminary quantitative analysis on the environmental and economic benefits of integrating microbial electrochemical and phototrophic processes for concurrent carbon removal, nitrogen, phosphorus, energy, and chemical recovery, as well as carbon capture and utilization.

Zhiyong Jason Ren, University of Colorado Boulder, United States.

OP21 Role Of Calcium On Phosphate Deep Treatment And Recovery By Polymeric Ferric Nanocomposites

Y. Zhang, X. She, B. Pan (China)

A polystyrene anion-exchanger based ferric nanocomposites (HFO-201) was employed to concentrate phosphate from WWTP secondary effluent while excluding Ca^{2+}. High purity struvite were successfully recovered from the desorption effluent of HFO-201. However, it was found that Ca^{2+} could enhance the phosphate removal by HFO-201 at the presence of abundant competitive anions ($SO4^{2-}$). As indicated by 20 adsorption-regeneration cycles, phosphate removal was constantly enhanced at the presence of Ca^{2+}. Fixed-bed runs showed that the working capacity of HFO-201 increased to 1200 BV with Ca^{2+}, almost 2 times as high as the control group. Both XRD and HR-TEM study revealed that repeated adsorption-regeneration caused the crystalline form shifted from ferrihydrite to hydroxyapatite. It was deferred based on XPS results that Ca^{2+} was captured by HFO-201 as CaHPO40 and through tertiary Fe-P-Ca complexes, then hydroxyapatite was gradually formed upon the release of OH-. Nevertheless, P bind with Ca could not be recovered through desorption.

Yanyang Zhang, Nanjing University, China.

OP22 Demonstration Of Dehydration And Dryer Technology For Biosolid Reuse As Fertiliser And Fuel In Small Or Medium Scale STP

T. Yamoto, T. Ota, H. Hiromasa, M. Yasuo, M. Matsuhashi, M. Itakura (Japan)

This study aims to evaluate the performance of two innovative technologies as energy saving biosolids reusable technology for both fertilizer and fuel use. The result of comparing innovative technology with conventional technology indicated that both of innovative technologies can reduce Life Cycle Cost (LCC) or the maintenance cost. In addition, it was suggested that the energy efficiency of both innovative technologies was obviously higher than that of conventional one. Furthermore, we conducted evaluation of the quality of the dried sludge by analysing its ingredient in order to confirm the compliance with the standard in the Fertilizer Regulation Act for fertilizer use and with the standard of JIS Z7312 BSF-15 for fuel use. As a result, both innovative technologies fulfilled these two standards for fertilizer and fuel.

Takatoshi Yamoto, National Institute for Land and Infrastructure Management, Japan.

ISKN12 Integration of MFC and MBR kills two birds with one stone

S. Okabe (Japan)

Microbial fuel cells (MFCs) have been considered as a promising wastewater treatment technology with renewable energy recovery. However, the MFC effluents usually need post-treatment to meet the effluent discharge standards due to poor effluent water quality. Furthermore, although membrane bioreactors (MBRs) have several advantages over conventional activated sludge system such as superior effluent water quality and small footprint, high energy requirement for aeration and membrane fouling are the remaining major challenges for wider practical application. In order to compensate the defects of both processes, MFCs could be integrated with MRB for wastewater treatment and energy recovery. A major issue of the integrated MFC and MBR is membrane fouling, because the integrated system does not aeration for air-scrubbing and biological oxidation. In this presentation, the impact of anodic respiration on membrane fouling and the feasibility of the MFC-MBR system as energy-saving or –generating wastewater treatment will be discussed.

Satoshi Okabe, Hokkaido University Sapporo Faculty of Engineering, Japan.

OP23 Evaluation of HRAS/HiCS-DAF as an A-stage in Municipal Wastewater Treatment

B. Saerens, C. Cagnetta, F. Meerburg, S. Decru, E. Broeders, W. Menkveld, T. Vandekerckhove, S. De Vlaeminck, J De Vrieze, A. Verliefde, B. De Gusseme, M. Weemaes, K. Rabaey. (Belgium)

High-rate activated sludge systems show great potential for the development of energy-neutral wastewater treatment, but often suffer from a sub-optimal solid/liquid separation. There is a need to improve the removal of suspended solids and increase sludge concentration of high-rate systems. In this study, a dissolved air flotation (DAF) unit was coupled to (a) a conventional high-rate activated sludge (HRAS) system and (b) a high-rate contact stabilization (HiCS) system, as an alternative to a settler. The HRAS-DAF system allowed removal of up to 78 % of the influent TSS; the HiCS-DAF 67 %, both higher than typical values for a conventional HRAS-settler system (48–68 %). The concentrated sludge had a concentration of up to 47.1 g COD/L, suppressing the need of further thickening before anaerobic digestion. DAF separation in combination with a HRAS or HiCS system could increase organics removal, increase sludge concentration, and contribute to energy-positive wastewater treatment.

Bart Saerens, Aquafin NV, Belgium.

OP24 Pushing The FO And AnMBR Hybrid System Forward: Fouling Prevention Using Air-scoouring And Saturated CO2 Solution

S. Li (China)

The hybrid forward osmosis (FO) and anaerobic MBR system was developed to concentrate municipal wastewater for a better methane production in AnMBR, and reuse municipal wastewater for direct irrigation. However, FO fouling prevention is a critical aspect for the success of this hybrid system. This study investigated the effectiveness of continuous air-scouring and saturated CO2 solution flushing on preventing FO membrane fouling. Three parallel experiments were conducted to compare the fouling development on FO membranes under the same conditions except for with/without air-scouring. The flux was online recorded, while the feed and draw solutions were sampled for COD, pH, conductivity, TN, TP, LC-OCD, and CLSM. Results showed air-scouring and saturated CO2 solution flushing can substantially prevent the serious fouling appear on the FO membranes by creating an intensive shearing force on the membrane surface, which not only reduce membrane fouling, but also concentrated the wastewater for the downstream AnMBR without loss of COD on the membrane fouling layer.

Sheng Li, Guangzhou Institute of Advance Technology, China.

P226 Coexistence Of Tetrasphaera And Accumulibacter In A High Temperature EBPR Process Fed With Alternating Carbon Sources

R. Zuniga-Montanez, G. Qiu, Y. Law, R. Williams, S. Wuertz (Singapore)

Enhanced biological phosphorus removal (EBPR) is a process that targets the removal of phosphorus from wastewater. Candidatus Accumulibacter phosphatis and Tetrasphaera spp. are two key polyphosphate accumulating organisms (PAOs) that have been linked to the utilization of specific carbon sources to carry out EBPR. In this study, glutamate and glucose were alternately fed to a sequencing batch reactor (SBR). Complete P removal was achieved, and the Tetrasphaera and Ca. Accumulibacter populations increased together with EBPR activity. EBPR is thought to depend on the availability of volatile fatty acids, whereas here we show that EBPR can also be achieved with other carbon sources, allowing the study of Tetrasphaera and Ca. Accumulibacter as coexisting organisms. These findings contribute to the understanding of the microbial diversity, metabolic potential and niche of PAOs.

Rogelio Zuniga, SCLESE, Singapore.

P241 Complete Nitrogen Removal From Wastewater By Optimizing Nitrite-dependent Anaerobic Methane Oxidation

J. Wang, M. Hua, Z. He, S. Geng, B. Hu (China)

Nitrite-dependent anaerobic methane oxidation (N-DAMO) is a newly discovered bioprocess that reduces nitrite to dinitrogen with methane as electron donor, which is mediated by Candidatus Methylomirabilis oxyfera (M. oxyfera) affiliated to NC10 phylum (Ettwig et al. 2009). This bioprocess plays an important role in the global carbon and nitrogen cycles and has promising potential to remove nitrogen from wastewater. N-DAMO bacteria grow incredibly slowly, and their doubling times are as long as weeks to months. It is hard to get enough N-DAMO culture, which limits the further scientific research and engineering application. Although N-DAMO bacteria distributes widely, their abundance in some ecosystems are very low (Hu et al. 2014). In this work, an anaerobic magnetically stirred gas lift reactor (MSGLR) was operated for over 600 days, and its performance was monitored. Growth factors and lycine were chosen to investigated their short- and long-term effects of different concentrations on N-DAMO bacteria.

Jiaqi Wang, Zhejiang University, China.

P231 Fe(III) Reduction And Vivianite Formation In Activated Sludge

P. Wilfert, M van Loosdrecht, R. Wang (China)

A novel technology to recovery P in wastewater was proposed. As iron is usually used as flocculant in sewage treatment plants (STPs), vivianite [(Fe2+)3[PO43-]2·8H2O] is detected in sewage activated sludge and it could be picked up and used as pigments and ornaments. To reveal the dynamic and mechanism of vivianite formation, the iron reduction rates and vivianite formation were measured and detected. Results showed that in the time scale in STPs, all dosed iron could be reduced to Fe(II) and vivianite was formed as soon as iron was reduced. Vivianite formation mechanism for EBPR process and CPR process is different. In EBPR activated sludge, PAOs release phosphate under anaerobic conditions and then the phosphate reacts with the Fe(II) reduced by IRB (iron reducing bacteria) to form vivianite. In CPR activated sludge, ferric iron (in FeP compounds) is reduced by IRB to release Fe(II) and dissolved phosphate, then Fe(II) reacts with phosphate to form vivianite.

Ru Wang, College of Environmental Sciences of Zhejiang University, China.

SESSION 7: ADVANCED MATERIALS AND MEMBRANES FOR WATER AND WASTEWATER TREATMENT PRESENTATIONS

ISKN13 Artificial Tree for Solar-Powered Treatment of High-Salinity Waters (or 2D Nanomaterials for Novel Membrane Development)

B. Mi (United States)

Recent advances in two-dimensional (2D) nanomaterials offer unprecedented opportunities to fabricate a new class of materials that can potentially revolutionize desalination technology. In this talk, I will first discuss the promise of using 2D nanomaterials (e.g., graphene oxide/GO and MoS2) as building blocks to make new nanostructured membranes with exceptional physical, chemical, and biological properties. The interlayer spacing of such 2D-stacked membranes plays a critical role in the water transport and membrane separation performance. Our recent efforts in characterization and control of membrane interlayer spacing and understanding of water structure and transport in the 2D nanochannels will be presented. Next, as a broadband solar light absorber, GO can be used to efficiently absorb solar light and localize the heat to enable fast water evaporation. I will introduce our recent study on developing a synthetic GO leaf and solar-powered artificial tree for desalination. The potential of the artificial tree for treating high salinity water will be discussed with a focus on achieving zero liquid discharge (ZLD).

Baoxia Mi, University of California, Berkeley, United States.

OP25 Membrane Bioreactor (MBR) Wastewater Technologies: Operator's Return Of Experience

F. Polizzi, L. Gestin (France)

MBR WWTP is the best wastewater technology known nowadays and from the last 10 years. It allows in achieving very high quality treated effluent with total nitrogen (NGL) and Biochemical Oxygen Demand (BOD5) below 5 ppm, Chemical Oxygen Demand (COD) below 15 ppm and Total Suspended Solid (TSS) below 2 ppm.
In this paper, our aim is to compare 2 technology of MBR, the hollow fiber versus the flat sheet, and get operator's return of experience on how to maintain them in "good health" and a guide of best practice.

Laurent Gestin, SUEZ-CDE, France.

OP26 Ozone, O3+AOP, An Optimized Treatment Line For COD & TOC Removal. WanHua, From Lab Tests To Full Scale Plant

M. Wang, S. Fouchet, C. Ji, L. Fan, J yu, K. Wasiak, B. Heiniger, L. De Franceschi (China)

An industrial project for the treatment of Wan Hua (Yantai) Reverse Osmosis concentrate is introduced in this presentation. It is including background of the project, trials at laboratory, demonstration trials on site, optimization and process design.

Cindy Ji, SOLVAY Research & Innovation, China.

ISKN14 Nanotechnology Enabled Water Quality Sensing

P. Vikesland (United States)

Nanoenabled sensors are being designed to provide high efficiency, multiplex functionality, and high flexibility sensing applications. Here we discuss how nanotechnology enabled sensors have great, but currently unmet, promise to provide widespread and potentially low-cost monitoring of chemicals, microbes, and other analytes in drinking water. We will highlight the development of gold enabled plasmonic platforms that facilitate detection of inorganic, organic, biologic, and nanoparticulate contaminants. As will be shown, both light spectroscopy and Raman spectroscopy can be used to detect and quantify waterborne analytes.

Peter Vikesland, Virginia Tech, United States.

OP27 Recyclable Photothermal Materials For Full Utilization Of Solar Energy Towards Practical Water Evaporation And Treatment

P. Wang (Saudi Arabia)

In this work, robust pigment/SiO_2 composite membrane with outstanding solar-driven water evaporation performance is rationally designed and synthesized using quartz glass fibrous membrane as supporting matrix and pigment particles as the active light absorber. The composite stays stable in air up to 900°, and it, when bio-fouled or contaminated, can be easily recovered by high temperature calcination in air and/or directly burning in fire. The composite is readily made into three-dimensional (3D) cylindrical cup structure whose water evaporation rate under one sun irradiation is increased to higher than 1.65 kg m^{-1} h^{-1}, representing a perfect 100% utilization of solar energy. The carbon/SiO_2 composite material is further fabricated with similar water evaporation performance. Our results show that the composites are promising photothermal materials towards practical applications in solar driven water desalination, wastewater treatment, and resource recovery.

Peng Wang, King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

OP28 Piezoelectric Nanofiber Membranes For Energy-Efficient Fouling Control In Anaerobic Membrane Bioreactors

S. Gee, A. Smith (United States)

Electrospinning was used to fabricate nanofiber membranes with piezoelectric potential as a novel fouling control approach for anaerobic membrane bioreactors (AnMBRs). Electrospinning parameters were optimized via systematic testing to determine their impact on membrane properties (i.e., piezoelectric characteristics, morphology, thickness). Preliminary testing was used to evaluate the filtration performance of the electrospun membranes compared to commercial membranes and the efficacy of piezoelectric fouling control with synthetic biofouling. Ongoing work is evaluating their performance in bench-scale AnMBRs.

Stephanie Gee, University of Southern California, United States.

P609 A Revisit To The Mechanisms Of Membrane Cleaning Using NaOCl: Active Chlorine Species Diffusion And Its Implications

Z. Wang, Wang. Han, H. Chen, Z. Wu (China)

Sodium hypochlorite (NaOCl) is a widely used cleaning reagent for membrane processes to recover membrane permeability; however, the competitive interactions of different chlorine species with fouling layers have not been adequately elucidated. In this work, we investigated the pH-dependent diffusion of the active chlorine species and reactions involved in the consequent dissociation and/or destruction of the fouling layers. The hypochlorite conductivity and dynamic diffusion tests showed that an increase in pH facilitated the uneven and fast diffusion of active chlorine via relaxing the matrix structure of the fouling layer. The enhanced diffusion resulted in an uneven but massive removal of the foulants rather than a layer-by-layer dissociation, leading to a higher membrane cleaning efficiency. Furthermore, the addition of sodium dodecyl sulfate led to a faster diffusion process and thus an enhanced cleaning efficiency. These findings provide new insight into the chemical cleaning mechanisms, which are of great importance to the optimisation of cleaning efficiency.

Wang Xueye, Tongji University, China.

P616 Synthesis Of Covalent Organic Polymer On Granular Activated Carbon Surface To Immobilize Prussian Blue For Cs+ Removal

Y. Seo, P. Mines (Korea)

Prussian blue (PB) is capable to selectively adsorb alkaline cations, especially, radioactive cesium from water. However, the small particle size cause difficulties to be used as water treatment option. In this study, immobilization of PB on granular activated carbon (GAC) modified by covalent organic polymer as binding matrix. Covalent organic polymer (COP) was successfully grafted on the GAC surface through acid oxidation, acyl chlorination, melamine attachment, and crosslinking process. COP-GAC was further used as supporting material for PB immobilization. PB was attached in the pore of COP network and PB content of the composite, COP-GAC-PB, was about 4.0%. The composite have higher affinity to adsorb Cs+, 3.03 mg Cs+/g composite or 75 mg Cs+/g PB. Moreover, the leaching of PB during Cs+ adsorption experiment was insignificant; only less than 0.13% of PB was leached to the aqueous phase. The surface modification of activated carbon using COP followed by PB immobilization could be successful option to treat Cs+ contaminated water.

Yuhoon Hwang, Seoul National University of Science and Technology, Korea.

P622 Selective Removal Of Sulphate From Saltwater Using A Novel Composited Electrode In Capacitive Deionization

K. Zuo, J. Kim, A. Jain, Q. Li, R. Verduzco (United States)

In this study, a capacitive deionization (CDI) cell was fabricated by flow coating resin slurry on an activated carbon electrode. With mixed solution working as saltwater influent, the resin coated CDI realized enhanced desalination efficiency, charge efficiency (63.3%), and SO42- selectivity (2.1) compared to blank CDI. The charge efficiency (>55%) and SO42- selectivity (>1.2) were kept at a high level even when Cl^-/SO_4^{2-} ratio increased from 5:5 mM to 100:5 mM, suggesting a promising technology of CDI in saltwater desalination.

Kuichang Zuo, Rice University, United States.

SESSION 8: RECENT DEVELOPMENTS AND APPLICATIONS OF ADVANCED MOLECULAR MICROBIAL TOOLS IN WATER AND WASTEWATER TREATMENT PRESENTATIONS

ISKN15 Applications Of Metagenomics And Metatranscriptomics In Water And Wastewater Treatment

T. Zhang (China)

Metagenomics and metatranscriptomics based on next generation sequencing have been widely used in studies of microbial ecology in the recent years. In this presentation, it applications in exploring bacterial diversity in water/wastewater treatment systems, revealing the metabolism features of key populations in the reactors, identifying pathogens in water/wastewater and detecting antibiotics resistance in various environmental samples will be demonstrated using a few case studies. We reported the first integrated metatranscriptomic and metagenomic analysis of enhanced biological phosphorus removal (EBPR) sludge. A draft genome of Candidatus Accumulibacter spp. strain HKU-1, a member of Clade IB, was retrieved. It was estimated to be ~90% complete. The preliminary metatranscriptomic results revealed that the most significantly up-regulated genes of CAP IB HKU-1 from the anaerobic to the aerobic phase were responsible for assimilatory sulfate reduction, genetic information processing and phosphorus absorption, while the down-regulated genes were related to N2O reduction, PHA synthesis and acetyl-CoA formation. This study yielded another important Accumulibacter genome, revealed the functional difference within the Accumulibacter Type I, and uncovered the genetic responses to EBPR stimuli at a higher resolution.Using both 16S profiling and metagenomic approach, pathogen-like species in the water and wastewater could be comprehensively identified, by similarity search against the reference sequence database, demonstrating the power of next generation sequencing in identification of pathogens compared with the conventional molecular methods.Metagenomic approach based on next generation sequencing also could be applied to reveal the antibiotics resistance gene in wastewater and effluent from wastewater treatment plants. It may give both qualitative and quantitative information about various ARGs in the environmental samples.

Tong Zhang, The University of Hong Kong, China.

OP29 Elucidating The Long-Term Impact Of Disinfection Strategies On The Drinking Water Microbiome

Z. Dai, M. Sevillano, S. Calus, Q. Bautista, U. Ijaz (United States)

Some countries require the presence of disinfectant residuals in drinking water to limit microbial regrowth. In contrast, countries in western Europe provide customers with drinking water free from disinfectant residual while focussing on substrate removal to minimize microbial regrowth. To investigate the impacts of these different microbial regrowth control strategies on the drinking water microbiome and regrowth potential, we employed metagenomics and obtained hundreds of metagenome assembled genomes (MAGs) from systems with and without a disinfectant residual. We are determining genome level selective pressures imposed by microbial regrowth control strategies and the correlation between the selective pressures using SAAV:SNV ratio and bacterial replication rates. Our goal is to determine the extent to which presence or absence of disinfectant impacts SAAV/SNV and whether bacteria subject to greater selective pressure are more likely to proliferate within drinking water systems.

Ameet Pinto, Northeastern University, United States.

OP30 Assessing The Impact Of Water Treatments On Microbial Ecology In Pilot Drinking Water Distribution Systems

G. Liu, Y. Zhang, H. Van der Laan, W. Liu, G. Medema, W. Van der Meer (Netherlands)

Although studies have focused on exploring the microbial ecology of DWDSs, knowledge about the effects of different water treatments on the microbial ecology in the distribution system is limited. This study assessed the impact of conventional treatment, RO treatment, remineralization, mixing water (70% RO permeate and 30% conventional water) on the microbial ecology in pilot distribution systems (PDSs). Results showed that remineralization has minor contribution to the biofilm formation with adding minerals into RO permeate, while mixing water only reduce slightly biofilm formation. The sequencing results showed that the bacterial community of biofilms formed in RO system stayed the same. Biofilm formed in mixing water PDS remained the bacterial community as feed water PDS. However, remineralization showed significant influence on the bacterial community. Additionally, we observed that RO permeate and remin water can limit the growth of both Mycobacterium spp. and Legionella spp.

Gang Liu, Delft University of Technology / Oasen Drink Water, Netherlands.

ISKN16 Can Ecogenomics be used to guide water processing technologies?

W. Liu (United States)

Significance advance in the development of molecular biological tools or ecological genomics (ecogenomics) tools has been made since the early 1990's. These tools have been used to improve the understanding of the biological fundamentals behind biological treatment processes. However, questions on whether these molecular tools can generate findings to improve performance and treatment/monitoring efficiency of water and wastewater processing technologies remain to be demonstrated. This further raises the debate whether the ecogenomics tools are almighty to address all questions related to water processing technologies or should be carefully used on specific questions. While this remains as an ongoing debate, my talk will provide studies exemplify the contribution of molecular tools in water processing technologies. The first case study is to show how ecogenomics tools can improve our understanding and monitoring of microbial regrowth in indoor plumbing systems in combining with engineering and ecological principles. The second case study is to show how ecogenomics tools can be combined with mass balance concept to evaluate the digestion efficiency of anaerobic digesters (AD), and better define core microbiome and discover the role of enigmatic microbes in AD. I will conclude with remarks on how researchers should use ecogenomics tools effectively in future studies of water processing technologies.

Wen-Tso Liu, University of Illinois at Urbana-Champaign, United States.

OP31 Using Proteomics For An Insight Into The Performance Of Activated Sludge: Are We There Yet?

A. Azizan, H. Barinas, F. Kaschani, S. Blaskowski, E. Alvarez, M. Denecke (Germany)

The performance of a lab-scale wastewater treatment plant during the start-up phase was investigated. A period of varying pH resulted in the loss of ammonium removal efficiency together with a corresponding decrease in the specific autotrophic oxygen uptake rate (OUR). From the OUR, it was inferred that the ammonium oxidizing bacteria (AOB) were inhibited by the changes in the pH values. However, the OUR alone could not provide the information as to how the AOB were affected at the molecular level. To gain a better insight, shotgun proteomic method was used in this work to quantify the total proteins in the system. Label-free quantification (LFQ) showed that during the time of poor ammonium removal, the enzyme hydroxylamine oxidase found in Nitrosomonas sp.was at the lowest LFQ intensity. Based on these results, proteomics has the potential to be used as a monitoring tool. Nonetheless, there are still some restrictions when measuring activated sludge using proteomic method. In this paper, we described the hurdles and the experiences we encountered.

Asma Azizan, University of Duisburg-Essen, Germany.

OP32 Early Biofouling Detection In Membrane Filtration Systems Using Fluorescently Measured Extracellular Enzyme Activity

B. Khan, L. Fortunato, T. Leiknes (Saudi Arabia)

Bacteria in aquatic environments produce extracellular enzymes catalyzing large molecules into assimilable molecules. Fluorogen bound bacterial substrates have been used to measure extracellular enzyme activity (EEA) (Overbeck, 1991). We propose that fluorescent measurements of fluorogen-substrate cleavage by extracellular enzymes can be used to monitor bacterial colonization proximal to the surface of membrane filtration systems both rapidly and non-invasively. This approach has been extensively tested in vitro and correlates with bacteria in aquatic systems. A prototype sensor for early biofouling detection was operated in a lab scale setup. In brief, we tracked bacteria from initiation of colonization to biofouling in a seawater matrix rapidly and sensitively using real-time measurements. This lays the foundation for early biofouling detection in membrane filtration using extracellular enzyme activity in an at-line sensor.

Babar Khan, King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

P803 Fouling Formation In A/O-MBR Under Low Organic Loading Rate Condition And Elucidation Of Biofilm Forming Bacteria

Y. Takimoto, T. Ishida, M. Hatamoto, T. Yamaguchi (Japan)

Two lab-scale anoxic/oxic membrane bioreactors (A/O-MBR) were operated at normal condition (0.42 kg-COD·m^{-3}·day^{-1}) and extremely low organic loading rate (0.002 kg-COD·m^{-3}·day^{-1}) to induce fouling development and estimate biofilm forming bacteria by comparing each reactor. The microbial community compositions in the activated sludge were similar between each reactor, however, in a low OLR condition reactor, TM6 was specifically detected as predominant bacteria, whereas OD1 bacteria was predominant in the normal condition reactor. Thus, uncultured bacterial phyla TM6 and OD1 were thought to important for biofilm formation on the membrane surface of A/O-MBR.

Takashi Yamaguchi, Nagaoka university of technology, Japan.

P802 Water Purification And Biofouling Crisis Remedies

Y. Orooji, W. Jin, A. Razmjou (China)

Flow cytometry analysis shows that the behaviors of Bacillus subtilis 168 as a gram-positive bacterium and Escherichia coli DH5 alpha as a gram-negative bacterium were different. Hence, cell property is a suspected contributory factor in biofilm formation. Accordingly, considering the local predominant bacterial strains, regionally customized membrane could scientifically be an expert solution for biofouling mitigation. Thermoexfoliated vermiculite (VMT) doped fabricated composite membranes have shown a higher flux compared to control PES membrane (476.4 L/m2h). The combination of and mesoporous carbon nanoparticles (MCN) into the membranes present an anti-adhesion and antimicrobial effects. According to flow cytometry results, enrichment of PES UF membrane matrix only by 0.2wt.% MCN- doped, induced obvious bacterial damage of Bacillus subtilis 168 (92.94%) and Escherichia coli DH5 alpha (93.21%).

Yasin Orooji, Nanjing Tech University, China.

P806 Bacterial And Synthetic Biology Applications To FOGs In Wastewater

G. Stafford, C. Biggs, E. Court (United Kingdom)

Fats, oils and grease (fogs) are a major problem for wastewater treatment. We are investigating the environment at "fatbergs" where fog accumulates to allow the design of a reliable fog treatment; this includes the microbiome, lipid degrading bacteria and the lipid content of the fatberg itself. Samples from a fatberg in London sewers were taken and enriched to select for lipid degrading organisms. We have isolated microbes that have shown positive for lipid degradation on Rhodamine B agar plates, we are currently characterising these isolates. The environment at the fatberg is also being investigated by 16S sequencing to determine the microbiome here. Constructs have been designed to express a thermostable and cold-adapted lipase under constitutive and lipid responsive promoters.

Elizabeth Court, University of Sheffield, United Kingdom.

TOPIC 1: INNOVATIONS IN DIRECT POTABLE REUSE

P101	**Biological IAsIII Oxidation Coupled With APPPS Using As A Combined Process For The Remediation Of As Polluted Groundwater** Y. Zhang, L. Cai, J. Wan (China)

TOPIC 2: ADVANCES IN ENERGY EFFICIENCY AND RESOURCE RECOVERY IN WASTEWATER TREATMENT

P201	**Energy And Carbon Footprints Differ Dramatically For Diverse Organic Substrates Fed In Wastewater Treatment Systems** X. Wang, D. Butler, Y. Li, J. Liu, J. Qu (China)
P202	**Improving The Efficiency Of An Anaerobic Sludge Digester Through Pre-treatment Of Waste Activated Sludge With FNA** L. Zhang, H. Duan, L. Ye, L. Liu, D. Batstone, Z. Yuan (China)
P203	**Aeration Energy Efficiency Improvement In A Wastewater Treatment Plant Using An On-line Respirometry System** X. Li, R. Taylor, J. Gomez, T. Rickett, D. Price, A. Brooking (United Kingdom)
P204	**Enhancement Of Magnetite On The Performance Of UASB Reactor With Stimulating Of Ethanol** L. Zhu, C. Wang (China)
P205	**Effect Of Short-term Alkaline Intervention On The Performance Of Buffer-free Single-chamber Microbial Fuel Cell** Y. Ren (China)
P206	**Microwave Digestion-assisted HFO/biochar Adsorption To Recover Phosphorus From Swine Manure Wastewater** T. Zhang (China)
P207	**Development Of A Novel Anaerobic Osmotic Membrane Bioreactor For Simultaneous Energy And Water Recovery From Wastewater** X. Wang, X. Li (China)
P208	**Effective Phosphorus Recycling From Iron-rich Sludge Liquor Via Adsorption By Layered Double Hydroxides** H. Yan, Q. Chen (China)
P209	**Inhibition Of Sludge Thermal Hydrolysis On Nitritation Process** Y. Li, Z. Gu, Y. Yang, S. Xia, S. Hermanowicz (United States)
P210	**Characteristics Of Dissolved Organic Matters During Anaerobic Digestion With Alkaline-ultrasonic Pretreatment** D. Lu, Y. Zhou (Singapore)
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As one of the earliest Chinese institutions dedicated to environmental higher education and research, the School of Environment (SOE) of Tsinghua University (THU) is pledged to the development of sustainable solutions that allows minimizing the impact of human activities on environment. Its commitment also includes educating people to embrace the idea of sustainability.

SOE conducts research in a wide arrange of fields, including water supply, wastewater treatment, air pollution control, solid wastes management, environmental chemistry, microbiology, hydrology, ecology, energy and resources, environmental simulation, and environmental management and policy. SOE has provided technical and theoretical support for China in solving big environmental problems and implementing sustainable development. After years of effort, SOE has established a scientific and comprehensive system of education, focusing on disciplines of Environmental Engineering, Environmental Science, Environmental Management, Municipal Engineering, Radioactive Protection and Environmental Protection. Each year hundreds of the most talented students were matriculated, many of them had become outstanding figures in the environmental field.

School of Environment, Nanjing University

As one of the earliest institutions dedicating to environmental education and research in China, the School of the Environment at Nanjing University is a leading player in environmental research in China. The school has 78 faculty members, including 39 professors and 39 associate professors. One professor is the member of Chinese Academy of Engineering and another professor was honored as the Most Famous Teacher for undergraduate teaching. In addition, many professors were awarded with various honors, including 5 Yangtze River Scholars, 2 NSF Distinguished Young Scholars, 4 National Thousand Talent Professors, 2 National Ten-Thousand Talent Professors, 6 NSF Excellent Young Scientists, and 11 MOE New Century Talent Professors. Additional honors include one principle investigator for 863 Program, two principle investigator for National Water Pollution Control and Treatment Project, two awardees of Distinguished PhD thesis, and awardees of Innovation Program by Ministry of Education, Ministry of Technology, and Jiangsu Province.

During the past 5 years, the school has been involved in over 500 projects from National Water Pollution Control and Treatment Major Project, national 863 Program, national 973 Program, and National Science Foundation of China, totaling more than ¥ 500 million. Researchers in the school published > 1000 SCI papers (150 in ES&T and other top journals) and obtained 285 national patents and 12 international patents. Over the past 10 years, the school received 6 honors from National Natural Science Awards, State Technological Invention Award, and National Science and Technology Progress Award, and more than 10 other awards from both national and local governments.

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Singapore Nanjing Eco Hi-tech Island Administrative Committee

Singapore Nanjing Eco Hi-tech Island, a flagship project under Singapore-Jiangsu Cooperation Council, is a partnership program co-sponsored by CPC Jiangsu Committee, the Provincial Government of Jiangsu, and the Ministry of Trade and Industry (MTI) of Singapore, and developed by Sembcorp Development Ltd, Yanlord Land Group and Nanjing Government. With ground-breaking ceremony held on 25 May 2009, the mission of the project is to transform a 15.21 km2 island along Yangtze River - Jiangxinzhou, in Nanjing into a min-Singapore style eco hi-tech island and low-carbon smart city. The island's industrial positioning focuses on "3+1" industries, forming four industry clusters: Information Communications Technology cluster, Ecology and Environmental Protection cluster, Cultural Tourism Industry cluster and Modern Urban Service cluster.

Eco Hi-Tech Island is located in the center of Nanjing. It is only 200 meters away from Hexi New Town and the National Jiangbei New Area stays on the North side. With only 6.5 kilometers from the traditional downtown Xinjiekou, it shares an excellent location and it's only 15 kilometers away from the two high-speed railway stations in Nanjing.

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The main body of Sino-Singapore Nanjing Eco Hi-Tech Island Development Company is set up by China and Singapore. Singaporean part includes Yanlord land group and Sembcorp Development Company by Temasek Holdings Limited. The Chinese part is the state assets management (holding) Co., Ltd. of Jianye District, Nanjing and the state assets holding of Hexi New Town of Nanjing limited company, the two sides set up development company in accordance with the shares of the 50% to 50% with a total registered capital of $300 million.

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State Key Laboratory of Pollution Control & Resource Reuce

STATE KEY LABORATORY OF POLLUTION CONTROL & RESOURCE REUSE

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The laboratory aims at developing and applying the advance technology on environmental pollution control and recycling to meet the major needs of China. By exploring the process and mechanism of environmental pollution, clarifying the environmental effects of pollutants, developing pollution control technologies with independent intellectual property rights centered on "resources recycling", practical application of pollution control and resource technologies of wastewater, solid waste, and other pollutions have been achieved. Through the efforts of outstanding domestic and foreign talents and innovation groups, training of innovative talents, international cooperation and exchanges, and etc., our laboratory has shown its leading roles in environmental intelligence development in China, and have become a state-level key national laboratory representing the nation.

The comprehensive advantages of the laboratory highlights in the aspects of water pollution control and resource recycling, solid waste treatment and disposal, resource utilization, and exploration of the frontiers of global environment disciplines and national strategic needs. The advanced treatment and recycling of wastewater, research and development of industrial waste water treatment and recycling, are the focus of the laboratory from the establishment, which mainly includes following aspects:

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SUEZ NWS Limited ("SUEZ NWS") is a joint venture between SUEZ and NWS Holdings Limited that encompasses four essential business segments– Water Management, Recycling and Waste Recovery, Water Infrastructure and Consultancy services in the Greater China region. With 8,000 employees and over 60 joint ventures with local partners, SUEZ NWS is helping authorities and industries develop innovative solutions to address climate change and sustainable resource management. It has built over 260 water and wastewater treatment plants in Greater China, supplying drinking water to 20 million people. It is a leading operator of waste management in Hong Kong and delivers its expertise in the management of environmental services to 11 industrial parks in Mainland China. It is a pioneer player of sustainable resource management in Greater China.

CSD Water Service Co., Ltd

CSD Water Service Co., Ltd is an innovative comprehensive environmental service provider who devotes to creating a safe, comfortable and sustainable environment. The company focuses on environmental service in small and medium-sized cities, and its business services include municipal wastewater treatment, treatment of industrial and industrial parks wastewater, residual sludge treatment and disposal, integrated environmental management, etc. The company is dedicated to both endogenous growth as well as extensive growth to constantly extend its business scope. CSD Water Service aims to construct an integrated urban-rural environmental value creating system and contribute to overall environmental development in small and medium-sized cities.

Gold Sponsor

BEWG

Beijing Enterprises Water Group Limited (BEWG) is a comprehensive and leading professional water services and environmental protection services provider covering industrial investment, design, construction, operation, technical service and capital operation in full industrial chain. Its scope of business covers many fields such as water services in cities and towns, water services in river basins, industrial water services, rural water services, seawater desalination services, environmental sanitation, solid waste treatment, scientific and technical services, financial services and clean energy. It is a company listed on the Main Board of The Stock Exchange of Hong Kong Limited (one of Red Chips, Stock Code: HK 00371), and has been selected in Hong Kong's Hang Seng Index of Chinese Stocks, in Hang Seng Main China 100 Index, in Hang Seng Composite Medium Index, and in Morgan Stanley Capital International Index. Meanwhile, it is one of the first batch of experimental companies of Shanghai-Hong Kong Stock Connect.

Silver Sponsor

IWH

The International Water Hub (IWH) is located on the Singapore Nanjing Eco Hi-tech Island (SNEI), which is jointly promoted by the CPC Jiangsu Provincial Committee, Jiangsu Provincial Government and Ministry of Trade and Industry, Singapore. The SNEI project is a cooperation effort between the Singapore government and Nanjing Municipal Government.

IWH is developed by Sembcorp Industries and will be the first commercial building for water-related industries on the island. IWH is committed to creating an eco-system for the international water industry players in sharing and promoting R&D, technology and innovation, and is set to become the hub for providing water solutions to global communities.


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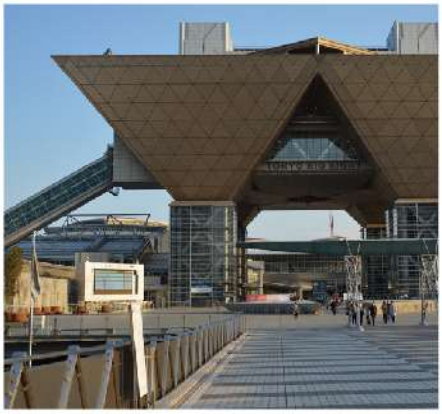

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Bureau of Sewerage Tokyo Metropolitan Government

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