EDITORIAL

Welcome to the 6th edition of the E4Water newsletter!

This newsletter keeps you up to date with issues and dates going on in the E4Water project.

Have a closer look into the actual work of several E4Water partners:

The Technical University of Denmark (DTU) is working together with other E4Water partners on an algal wastewater treatment concept for E4Water case study at the Kalundborg symbiosis. The selection of microalgal strains with optimal bioextraction characteristics is the basis for this concept.

Campden BRI Food and Drink Innovation is an RTD Center in the UK that includes the experience of the food industry in disinfection and sterilisation processes. Solutions are tested at the E4Water case study sites of Procter & Gamble where high loaded organic wastewaters are treated.

The Swedish Environmental Research Institute (IVL) and the Technical University Berlin (TUB) are working on an overall picture for the E4Water project. IVL is dealing with the assessment of the environmental and also economic benefits of improved water supply systems at the E4Water industrial sites compared to the present situation. TUB is developing a tool for the management of industrial water as well as related mass and heat flows.

Other interesting news in this edition includes the launch of the CEN workshop SustainWATER or the E4Water film is produced by Euronews TV (beside others).

We are very pleased to inform you about the upcoming E4Water workshop that will be held on November 5, 2015 in Brussels, Belgium and focuses on economic benefits of water innovation. Also we would like to draw your attention to the E4Water Final conference in April 2016. You are welcome to save the date for this event.

Please feel invited to visit our website (www.e4water.eu) which gives further details on the E4Water project and on upcoming events related to Industrial Water Management.

Your E4Water Team

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E4Water Consortium during the meeting in Paris.

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DTU – From Waste to Value: Microalgae Biorefinery

Our research group belongs to the Department of Environmental Engineering at the Technical University of Denmark (DTU). Our University is ranked as one of the foremost technical universities in Europe, persistently increasing and developing partnerships with industries.

DTU has international educational exchange programs with over 200 universities around the globe, and enjoys close research collaborations with its partners in addition to building research and educational programs.

The Department of Environmental Engineering (DTU Environment) is a DTU-institution at the highest international level. Its aim is to develop new environmentally friendly and sustainable technologies and disseminate this knowledge to society and new generations of engineers. Water supply, wastewater treatment and water handling in urban areas is a very important area for DTU Environment.

The staff members involved in the E4Water project are affiliated in the Bioenergy Group at the DTU Environment. The Bioenergy Group, headed by Prof. Irini Angelidaki, consists of approx. 25 scientific staff members with wide interdisciplinary expertise, ranging from fundamental research (microbiology, biochemistry, molecular biology) to more bioresource engineering approaches. It is one of the most internationally recognized in biological production of energy including biomethane, bioethanol, biodiesel and biohydrogen by biotechnological methods. The research experience spans from fundamental work on areas such as biochemistry and microbiology, to more applied issues, such as process monitoring and control. The scientific group staff consist of Professor Angelidaki, two senior researchers, seven postdoctoral associates, eight PhD students and number of guest researchers, master and bachelor students.

Department of Environmental Engineering DTU has state of the art lab facilities: fully equipped chemical (HPLC, GC, GC-MS) and microbiological (traditional and molecular biology tools including PCR, DGGE, FISH, clone libraries etc) laboratories required for successful implementation of the proposed project. Highly experienced technical staff (eight technicians) is available for running different analytical equipment. Access to basic and more applied software is possible via the IT service in the department.

In the recent years DTU Environment has developed a facility for the study of microalgae and their ability to grow in wastewaters. It includes a Synergy Mx reader® that, coupled with microplates, allows to measure the increase of optical density and/or of the in vivo fluorescence (IVF). In this way it is possible to simultaneously test the different dilutions and, possibly, combinations of specific wastewaters against different species of microalgae and the corresponding growth rate. Also, the facility is equipped with two types of photobioreactors: The Algaemist flat panel reactor (left) with short light-path (14 mm) and an ePBR (pond-simulating) reactor (right) with long light-path (250 mm). In the frame of E4Water, these photobioreactors are used to test a number of conditions, improve microalgal cultivation and define a number of parameters that can be useful for the pilot microalgae facility that has been built within Kalundborg wastewater treatment plant and that is the core of CS6. Using the species C. sorokiniana and the same anaerobic digestate that is used in Kalundborg, it was possible to provide information about the relationship between culture dilution rate and productivity of biomass or desired biochemicals. The effect of wastewater concentration and the capacity of the wastewater to support algae growth was initially tested in batch cultivation experiments. The effect of dilution rate on biomass productivity, photosynthetic yield and nutrient removal and utilization efficiency was investigated by deceleration-stat experiments in the flat panel reactors at both high (2100 μmol photons m⁻²s⁻¹) and low (200 μmol photons m⁻²s⁻¹) irradiances with 100% wastewater. A maximum volumetric productivity of 5 gL⁻¹day⁻¹ was achieved in the flat panel reactors at high light input during the deceleration-stat experiments, and is comparable to some of the highest values for land grown crops. At low light input, the maximum volumetric productivity was 1.6 gL⁻¹day⁻¹. The pond-simulating reactor demonstrated a maximum productivity of 0.2 gL⁻¹day⁻¹ during batch cultivation with a light input of 2000 μmol photons m⁻²s⁻¹. Photosynthetic yield was highest at low light intensities in the flat panel reactors with a maximum of 1.2 gmoles⁻¹. Results show that the tested wastewater containing 137±16 mgL⁻¹N and 9±0.5 mgL⁻¹P is well suited for algal cultivation. Nutrient removal at optimal dilution rates for biomass productivity, at both high and low light intensities was 28-55 % for N and 86-97 % for P.
Campden BRI – Technical Excellence for Industry

Campden BRI has been involved in CS4 of E4Water: Enhance in-process water loop closure by integrating biocidal with waste-water treatment technologies.

The objective of this study is use of waste water treatment and biocidal technologies to treat and recycle the highly concentrated wash water in a liquid detergent site.

The biocidal technology, previously used in food processing, was assessed for its use in the elimination of microbial contamination in cleaning and sanitisation wash-water, or to reduce microbial contamination to acceptable levels, without changing the physical and/or chemical characteristics of the wash water stream and without any significant impact on the final consumer product. In non-thermal pasteurization, ultraviolet and ultrasound technologies were investigated. Heat treatment – which is the most commonly used method of preserving foods – was also studied.

Promising results we obtained with rapid pasteurisation technology called Ohmic Heating (OH), where heat is generated volumetrically throughout a product. The results showed that OH has no significant impact on quality and stability of tested products. Quality parameters such as a viscosity, pH, stability were not affected. Micro sustainability tests MST test showed that antimicrobial compounds of the product formulation were not damaged after treatment. Finally, challenge test studies demonstrated that OH was an effective method to decontaminate products reducing all microorganisms below detection level.

Further studies with pilot plan equipment are planned.

Campden BRI

Practical application of technical excellence for the food and drink supply chain including production, manufacturing, retail and catering

Campden BRI provides practical scientific, technical, legislative and information support to the food and drink, brewing and alcoholic beverages, and allied industries. It is membership based and works closely with its members to ensure the industrial relevance of its services. These are underpinned by a strong programme of research and development, and include analysis and testing, product innovation, process validation, consultancy, auditing, and training. Many of its service activities are independently accredited and can be tailored to meet specific client needs. It also publishes leading industry guidance on best practice and legislation. Its areas of expertise cover:

- manufacturing technologies – food processing (heating, chilling, freezing), aseptic technology, microwave heating, malting and brewing, milling, baking and extrusion technology, and process control and instrumentation, packaging technology
- safety assurance – including hygiene and sanitation, microbiology and preservation, processing technologies, analysis and testing (microbiological, chemical), and quality and safety management,
- product development and quality, consumer studies, market insights, sensory science, authenticity testing, shelf-life evaluation, labelling and legislation
- agri-food production, ingredients, raw materials, raw material technology,
- underpinning science – cereal science, microbiology, chemistry and biochemistry, molecular biology

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IVL: Water innovation – from research to reality

The environmental technology group at IVL Swedish Environmental Research Institute helps companies to optimise processes from early development to full-scale implementation.

Using knowledge in separation technologies as well as in life-cycle assessment supports the development and assessment of technologies in order to find economic and environmentally beneficial solutions. Both industrial and municipal water is part of the working area, including the test and demonstration facility Hammarby Sjöstadsverk (www.sjostadsverket.se) in Stockholm, Sweden, for innovative water solutions.

Based on customer needs, we have developed and tested solutions for example in the area of:

- Recovery of metals and acids in stainless steel pickling, recovery of process chemicals in different industries.
- Treatment for water re-use, e.g. flue gas condensate
- Removal of priority pollutants and pharmaceuticals
- Treatment of chemical industry wastewater
- Life-cycle assessment of industrial water processes for process optimisation
- On-line implementation of life-cycle assessment for optimised process control

Within the projects we are using pilot equipment and knowledge for different separation technologies like: membrane filtration (micro-, ultra, nanofiltration, reverse osmosis), electrodialysis, membrane distillation, ion exchange, sorption, evaporation, biological treatment, and precipitation.

Optimised process and decision support

In E4Water, IVL is leading the work with environmental and economic assessment. With the input from other partners and using a life-cycle approach (LCA and LCC), the impacts and benefits of the treatment solutions developed in the project are assessed. Furthermore the water footprint for some solutions is calculated. With this work, the processes can be optimised and decision support for investments is provided.

About IVL

IVL Swedish Environmental Research Institute is an independent, non-profit organisation, owned by a foundation jointly established by the Swedish Government and Swedish industry. IVL was established in 1966 and has since then been involved in the development of solutions to environmental problems, both at national and international level. IVL is involved in numerous EU projects.

IVL works with applied research and contract assignments for an ecologically, economically, and socially sustainable growth within the business world and society at large. The institute comprises Sweden’s largest group of environmental experts and employs around 230 people, which makes IVL a leading institute for applied environmental research and consultancy services.

www.e4water.eu
TU Berlin – Towards an Integrated Water Management: Modeling and Simulation

The Chair of Environmental Process Engineering (EPE), is part of the Department of Environmental Technology of the Technische Universität Berlin (TUB), Germany. It is involved in education and research in environmental engineering, plant design and in wastewater treatment and reuse. EPE is also part of the Water Department of TUB in El Gouna, Egypt and currently active in the “IWRM Zyandeh Rud” Project in Esfahan (BMBF), Iran, the “E4Water” Project (EU), in the development of membrane contactors for ozonation (“ProTUTec”), the recovery of valuable materials from waste waters of food industry. EPE also gained expertise regarding the removal of trace pollutants in the aquatic environment (“TransRisk”, BMBF), wastewater treatment using membranes and modelling. The chair operates 250m² of pilot-plant stations and 280m² of laboratories.

EPE and E4WATER

EPE is responsible of the work package 12. The aim is to develop a model-based tool for the integrated management of industrial water, heat and related mass flows. The model is purposed to be structured in three levels to simulate single water treatment units, water, heat and related mass flows in production & water treatment processes and the integrated water cycle with interfaces between industry, urban areas, agriculture and natural water bodies. The simulation platform used is SIMBA, developed by the Institut fuer Automation und Kommunikation e.V (Ifak), Germany. Part of the work package is also a cooperation with the Svenska Miljoinstitutet AB (IVL) who are, within their own work package, responsible for the life cycle assessment (LCA) of the different case studies. The simulation results are transferred to the LCA software, GaBi for calculations of the environmental impact of the proposed treatment systems. Furthermore, lifecycle-costs are estimated.

The SolVin PVC production in Martorell, Spain has been selected as master site (introduced in the 3rd issue of this newsletter). An Integrated Water and Energy Management Model (IWEMM) comprised numerous mathematical models was developed in SIMBA. Additionally several process models have been implemented in SIMBA and will be combined with the integrated model to receive an overall model of the master site. As shown in the figure, it mainly consist three kinds of blocks. The yellow blocks are input blocks used to define different scenarios. Blue ones are models of the operating units, which are used to simulate the water and heat characteristics in the operating units.

The two green blocks are used for the transfer of the simulation results. IWEMM can be used to simulate the integrated water cycle and heat flows as well as to trace the related substances at SolVin. The model can be applied to define the optimum water treatment and recycling scheme as well as to train the personnel. It could be demonstrated that the demand for cooling water could be reduced by 40% and the heat saved by 32% if a recycling rate of 60% is applied as an example.
Background information

Europe is facing many challenges concerning water: adapting to climate change, including mitigation of floods and droughts risks, reaching good status of surface water, ensuring availability of water to deliver multiple benefits to nature and to the economy. At global level, the challenges are even greater with water crisis ranked very high in terms of impact and probability (The Global Risks Landscape 2015, World Economic Forum).

The water framework directive is the European masterpiece providing a common approach to these challenges, and the EU financing framework provides possible funding opportunities to create synergies with private sector on water innovation.

Concerning the chemical sector, our industry is placed at both sides of the equation of the water challenge, as a water users as well as a solution provider. Many of our industries are manufacturing critical products for water efficiency solutions (like membranes for water reuse) and they adopt innovative solutions at site level to ensure water is used in an efficient and sustainable way in chemical industries. An example is provided by the FP7 project E4Water, where 6 pilots are testing at industrial scale different technologies for water reuse in chemical plants.

With this workshop, we aim at supporting our members with a lively exchange on the factors determining a business case for water innovation and possible way to overcome factors undermining the success of a water-related innovative project. Insight will be provided by the public authorities, chemical companies and other partners of the chemical sector on water innovation.

Target audience

- Corporate managers, corporate environmental/water coordinators, sustainability and environmental managers
- European policy officers-EU Commission; EU Parliament representatives
- The workshop will give you the opportunity to
- Present the challenges the chemical sector is expected to face based on the European framework (water policy implementation, new approaches such as the economics of biodiversity and ecosystems)
- Present what are technologies available that present the chemical sector as a solution provider
- Have an overview of funding opportunities at European level to finance industrial projects (Horizon 2020, European Investment Banks, European Fund for strategic investment; European Innovation Partnership on water)
- Bring the experience of case studies on water innovative solution implementation

Confirmed speakers

Marianne Wenning EU Commission, Director Quality of Life, Water & Air Directorate
Panos Balabanis Deputy Head of Unit ‘Eco-innovation’, DG RTD
Edouard Perard European Investment Bank
Peter Cauwenberg Vito
Riikka Timonen Kemira
Alexandre Muller Total
Eddy Linclau P&G
Luc Brams Agfa

For registration and agenda information please use the following link: http://events-registration.cefic.org/Registration.aspx?eventld=73
ACHEMA – Industrial Water management was one of the FOCUS topics

ACHEMA 2015, the world’s largest trade fair for the process industry, opened the door to 166,444 trade visitors from around the world, on 15 – 19 June 2015 in Frankfurt, Germany.

Industrial Water Management was selected as one of three focal topics in the exhibition. Nearly one tenth out of 3810 exhibitors from 56 countries were related to this topic, including suppliers of materials (e.g. membranes, filters), equipment (e.g. pumps, analyzers), and services (e.g. R&D, software).

One of 3 plenary lectures was focused on water in industry, titled with “Integrated industrial water management – Efficiency in the process industries” given by N. Groot (Dow Benelux B.V.) and N. Swinnen (Solvay SA). The lecture took the chemical industry as an example to explain the methodology of efficient water use, based on the results of the ongoing EU project E4Water. Within the congress industrial water management was addressed for two days in a special session.

CEN Workshop Agreement (CWA): CEN workshop on “Sustainable Integrated Water Use & Treatment in Process Industries - SustainWATER”

The E4Water consortium has started to elaborate a framework on measures to achieve a sustainable integrated water use & treatment in chemical industry (and related process industry sectors). This is done in the format of a CEN workshop agreement to provide a practice oriented supportive/guidance document. The official kick-off meeting was held on April 22, 2015, in Paris (France) where the business plan was approved.


Kalundborg E4Water: Using microalgae to convert industrial wastewater into high value byproducts (published 14.05.2015)

The E4Water Project in Kalundborg has developed an efficient water treatment using microalgae for the cleaning of industrial residual streams. The microalgae clean the water and produce biomass which can be used for high value byproducts such as an alternative for fish food, proteins and lipids. This technology reduces costs and the use of water and adds more value to the production chain in Kalundborg.

More information under: www.youtube.com/watch?v=CH2ueh3_tIE.

E4Water at the Euronews TV channel FUTURIS: “Saving water from waste in chemical plants” – produced by Denis Loctier

This edition of Futuris explores how new technologies can help recycle the water used in chemical plants to make these more environmentally friendly. Producing chemicals and plastics indeed requires a lot of fresh water to cool down industrial processes, and this water is not always handy.


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ANNOUNCEMENT OF UPCOMING EVENTS -
Where you can meet E4Water

27 September – 1 October 2015
ECCE 10 – 10th European Congress of Chemical Engineering
NICE, France

3 – 6 November 2015
AQUATECH Amsterdam
Amsterdam, Netherlands

5 November 2015
Workshop: Economic Benefits of Water Innovation – Challenges and opportunities for the chemical sector
Brussels, Belgium
(more details see on page 6)

10 – 11 November 2015
Industrietage Wassertechnik
Frankfurt, Germany

10 February 2016
3rd EIP Water Conference
Leeuwarden, Netherlands

19 – 20 April 2016
E4Water Final Conference 2016
Brussels, Belgium
(Δ more information will follow soon)

Since the section of the website on upcoming events is regularly updated we invite you to visit our website for most recent changes.

Disclaimer

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