Technology Enabled Universal Access to Safe Water

Welcome to the second issue of the TECHNEAU Newsletter. The newsletter is designed to disseminate news, scientific results and developments to stakeholders. Newsletters are issued every six months, with Newsletter 3 scheduled for June 2007.

TECHNEAU challenges the ability of traditional drinking water supply systems to cope with present and future global threats and opportunities. TECHNEAU will rethink options for water supply and - through innovation, research and development – will provide and demonstrate new and improved technologies for the whole water supply chain.

Newsletter 2 highlights recent outputs and activities from TECHNEAU. The Newsletter can be downloaded from the TECHNEAU website (www.techneau.org / www.techneau.eu) where comments on the Newsletter or on any project-related issue are welcome.

RTP: Technology for Safe Drinking Water in the Baltic Region

Regional Technology Platforms (RTPs) are the main vehicle for consultation and dissemination in TECHNEAU. RTPs are held twice per year at locations across Europe to promote face-to-face consultation and knowledge transfer between local stakeholders and the TECHNEAU consortium.

Riga Technical University (RTU) hosted the first TECHNEAU RTP on 5 October 2006, near Riga, Latvia. The RTP focused on "Technology for Safe Drinking Water in the Baltic Region" and was attended by scientists, engineers, operators and regulators from Latvia, Estonia and Lithuania.

The RTP discussed the state of water supply in the Baltic Region - highlighting problems with water resources and with drinking water quality - and reviewed the TECHNEAU programme. Of particular relevance were the programmes and results of research from Work Areas 2 and 3 covering treatment, control and monitoring technologies for high quality water supply. The RTP promoted lively discussion and exchange of information between the local stakeholders and the TECHNEAU consortium.

An Integrated Project Funded by the European Commission under the Sustainable Development, Global Change and Ecosystems Thematic Priority Area.

Contract Number: 018320
Project Coordinator: Dr. Theo van den Hoven KIWA Water Research
Project Duration: 1st January 2006 to 31st December 2010

Delegates at the first RTP in Riga, Latvia

The RTP identified several challenges to the Baltic Region that will be addressed in the TECHNEAU programme, including:

- Increased effort to reduce water pollution - especially by industrial effluents - and to improve water quality.
- Cost-effective technologies to remove the high levels of NOM and iron in the Baltic States' resources. This, together with a drastic decrease in water consumption (up to 50%), has presented an enormous challenge to water companies, and has resulted in water price increases and in an increasing percentage of unpaid water.
- Deterioration of water quality in distribution due to non-stabilised water entering distribution, outdated distribution networks and long retention times.
- Improved management and operational practices and investment in staff training for the operation of modern, advanced treatment systems and distribution networks.

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As a result of the RTP, a network was established between local stakeholders and the TECHNEAU consortium that will be strengthened in follow-up meetings to be co-ordinated by RTU. Additionally, RTU will ensure that appropriate results from TECHNEAU are distributed among the regional stakeholders.

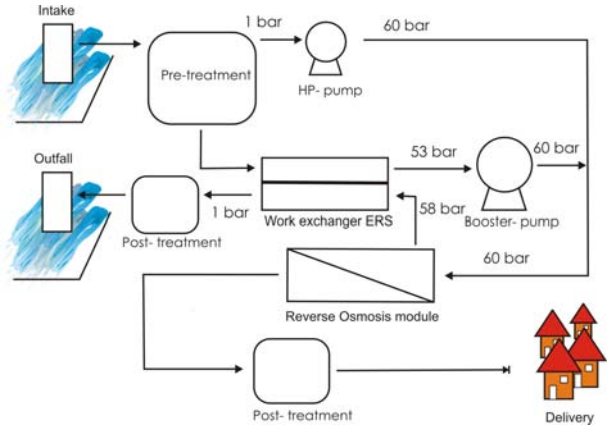
For further information, contact Toine Ramaker, WA8 Leader, or visit the TECHNEAU website (www.techneau.org).

Work Area Highlights

State-of-the-Art Review of Membrane-Based Desalination for Water-Stressed Regions (WA2)

Water shortage - or stress - is a problem facing many regions in the world. This situation is predicted to worsen as a result of global warming increasing demand for drinking water whilst perhaps adversely affecting the quality of raw water sources. Desalination - by reverse osmosis (RO) or thermal processes - is one option to overcome current or future water stress.

The Department of Chemical Engineering at RWTH Aachen University has conducted a state-of-the-art review of RO desalination for TECHNEAU. In Europe, RO desalination is the current state-of-the-art, displaying lower energy consumption and wider public acceptance than thermal desalination alternatives.



Desalination Flowsheet

This comprehensive study focused on the whole treatment process - from raw water intake to post treatment of product water - and included process fundamentals, developments in membrane technologies, operational issues (including pre-treatment of raw water, fouling and scaling, and post-treatment of product water), energy requirements and costs, waste management and disposal.

The study also outlines the role of RO in Europe, where desalination has seen intensive growth rates - especially in Mediterranean countries - and offers one viable option for mitigation of water stress.

The review is available on the TECHNEAU website.

Desalination Plant

For further information, contact Marie-Renée De-Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.org).

Research Investigates Treatment of Trace Organics in Membrane Concentrates (WA2)

Membrane systems, such as reverse osmosis (RO) or nanofiltration, are used increasingly for drinking water treatment to remove micropollutants and this trend is expected to continue. Although these technologies produce high quality water, 15-20% of the influent is discharged as wastewater, or concentrate. Concentrations of micropollutants in the concentrate, such as pesticides and endocrine disruptors, may be increased by a factor of 5 to 7 making disposal difficult.

Veolia Water Anjou Recherche is leading research to assess the performance of conventional technologies - such as oxidation, advanced oxidation or adsorption - as well as more advanced processes - such as oxidation/adsorption, adsorption/membrane separation, ultraviolet/hydrogen peroxide (UV/H_2O_2) - for removing micropollutants from membrane concentrates.

Ozonation and adsorption trials have been carried out on membrane concentrate spiked with nine common pesticides: atrazine, desethylatrazine, atrazine-2-hydroxy, glyphosate, AMPA, diuron, isoproturon, bentazone and aminotrol. Results of the trials (see Figure) show that ozonation is very efficient for removal of isoproturon, bentazone, aminotrol, diuron and glyphosate, but less efficient for removal of atrazine, AMPA and desethylatrazine.

Research is continuing and will investigate other conventional and advanced processes for the treatment of membrane concentrates.

For further information, contact Marie-Renée De-Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.org).

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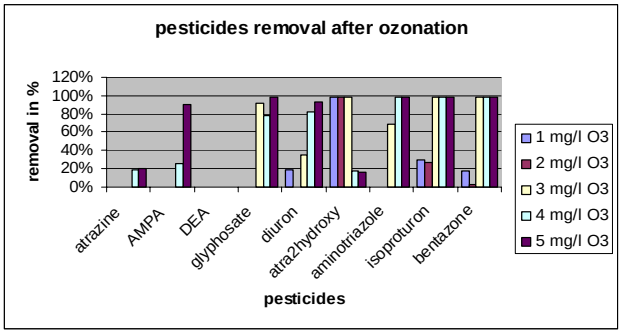


Pesticide removal from membrane concentrate by ozonation

Research Needs Identified for Point-of-Use Membrane Systems for Developing Countries (WA2)

Point-of-use (POU) technologies, including membrane-based systems, are widely and increasingly used in developed countries. POU membrane systems can also offer benefits for poor quality source waters in developing and transition countries. Such systems offer an alternative to centralized treatment, offer modular construction, operate with a range of energy sources and achieve a high retention of pathogens.

TECHNEAU Partner Eawag has conducted an extensive literature and state-of-the-art review of membrane-based POU systems to evaluate relevance, current usage and development needs in developing and transition countries.

POU technologies are used widely in industrialized countries for additional treatment of tap water or to produce safe and high quality drinking water in rural areas where access to a centralized supply is not available. However, the cost of such systems would be prohibitive in developing and transition countries. In addition, membrane-based POU systems may be unsuitable for high concentrations of organics and their requirements for maintenance and control may be inappropriate for developing countries.

Simple, low cost systems have been developed and applied in developing and transition countries. Case studies described in the literature show these systems to be appropriate short-term solutions for treating poor quality source waters. However, such systems typically supply only small amounts of water and fail to provide long-term sustainable solutions.

Based on this review, research needs for membrane-based POU systems were identified. It was concluded that systems should be developed that can be operated in a stable manner with a broad range of feedwater qualities. This will require the development of appropriate pre-treatment processes. Additionally, systems should be low cost, easily maintained and, as far as possible, be independent of chemicals and energy supply.

Research to meet these needs has started at Eawag and the first results will be published on the website shortly.

For further information, contact Marie-Renée De-Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.org).

Novel Oxidation-Biodegradation-Membrane Filtration (OBM) Process Under Development (WA2)

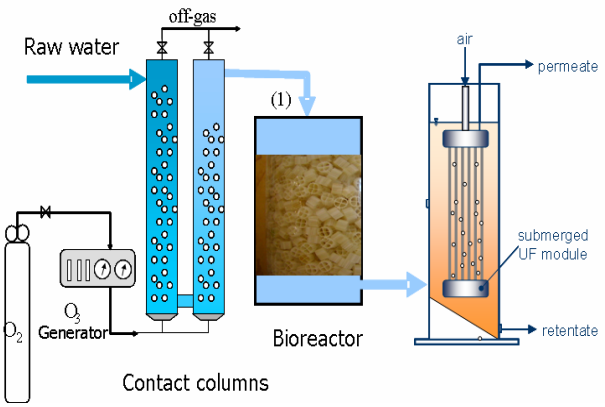
Modern drinking water treatment has to meet many requirements, including the efficient removal of pathogens, natural organic matter (NOM), iron, manganese, ammonia and various organic micropollutants. A treatment process is being developed combining oxidation, biodegradation and ultra- or microfiltration that offers a means to meet these requirements.

Numerous investigations have shown that ozonation of NOM-containing water efficiently removes colour and UV-absorbance but achieves only a small reduction in the dissolved organic carbon (DOC). There is, however, an increase in the formation of biodegradable by-products which can be removed by subsequent biological filtration, yielding an overall DOC removal of 10–50% . Ozonation/biofiltration may also efficiently remove (90%) many organic micropollutants. By applying other oxidation methods (e.g. UV/TiO_2), it may be possible to improve the overall removal of NOM and other organic compounds.

TECHNEAU Partner NTNU (Norwegian University of Science and Technology) is currently developing the novel Oxidation-Biodegradation-Membrane filtration (OBM) process. OBM potentially offers a compact, cost-effective process that could meet the above treatment requirements.

To date, trials have been carried out on a pilot plant comprised of two ozone columns, two biofilters and a submerged hollow fibre membrane filter (see Figure). There is additional equipment to investigate alternative oxidation methods (UV/TiO_2 and UV/H_2O_2) and ceramic membrane filtration.

Initial pilot trials have investigated the oxidation/degradation of NOM versus water quality and operational parameters (e.g. NOM concentration, hydraulic loads, etc.). Preliminary results from these trials are promising and will be published on the website shortly.



Schematic of the OBM pilot plant

For further information, contact Marie-Renée De-Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.org).

Chlorination Database Under Development (WA2)

Chemical oxidants used commonly in water treatment include ozone, chlorine and chlorine dioxide - used principally for disinfection but also for oxidation of anthropogenic organic trace pollutants. Under certain circumstances, however, chemical oxidants can induce formation of potentially harmful by-products. To ensure safe, high-quality drinking water, knowledge is required of the reactivity of oxidants towards micropollutants and pathogens present in raw water. Whilst kinetic and mechanistic data are available for ozone and hydroxyl radicals, less data are available for chlorine - probably the most widely used oxidant in water treatment.

TECHNEAU Partner Eawag has reviewed the scientific literature and developed a database for chlorine, including information on around 300 compounds (such as pharmaceuticals, endocrine disruptors, pesticides, disinfection by-products, natural compounds, As, Fe, NO_2^-, etc.). As well as kinetic and mechanistic information, the database includes general information on each compound (name, formula, chemical structure, CAS number, chemical functional groups, origin, physico-chemical properties, etc.) and appropriate references.

The database can be used to quickly find information relating to oxidation with chlorine, from specific information for a given compound to more general data for groups of similar compounds.

When completed, the database will be available on the TECHNEAU website.

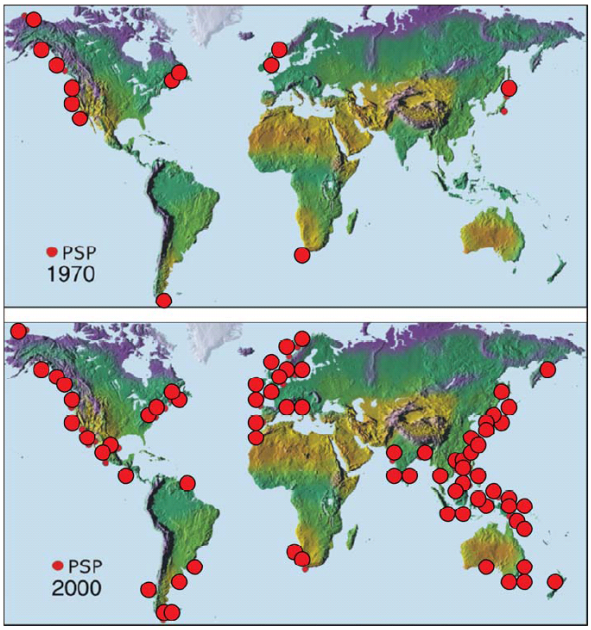
For further information, contact Marie-Renée De-Roubin, WA2 Leader, or visit the TECHNEAU website (www.techneau.org).

Analytical Methods Developed for 'New Algal Toxins' (WA3)

Coastal and fresh waters are increasingly affected by harmful algal blooms (HABs) and their release of toxins. Causative factors include the increased input of nutrients and wastewater into the oceans, the intensive use of coastal zones for sea food production and climate change. An example of the effects of HABs in sea water is illustrated which shows the worldwide increased incidence of Paralytic Shellfish Poisoning (PSP) due to HABs between 1970 and 2000.

This deterioration in quality is occurring at the very time sea and brackish waters are being used increasingly as sources for drinking water in many regions of the world. The control of HABs and algal toxins is thus essential for the production of safe drinking water from these sources. Unfortunately, the number of toxins produced during a HAB is high and up to now only a small number of these compounds have been clearly identified.

TECHNEAU is developing reliable and sensitive methods for the detection of algal toxins - in a continuation of work carried out under the previous EU-funded 'TOXIC' project. The development focuses on analysis in the water phase of trace amounts of the so called 'new toxins', such as saxitoxin, neosaxitoxin, gonyautoxin-1 to gonyautoxin-4, domoic and kainic acids, ß-N-methylamino-L-alanine (BMAA) and lyngbiatoxin.



Map of worldwide PSP events (Source: Glibert *et al.*, Oceanography, 18 (2), 2005)

Interim procedures for the pre-concentration and determination of domoic and kainic acids, BMAA and nodularin in the water phase will be soon available on the TECHNEAU website.

For further information, contact Frank Sacher, WA3 Leader, or visit the TECHNEAU website (www.techneau.org).

Main European Consumer Trends Identified (WA1)

Work Area 1 has identified trends with respect to all SEPTED (socio-cultural, economical, political, technological, ecological and demographical) dimensions. In 2007, adaptive strategies will be developed on the basis of these trends.

Socio-cultural factors and consumer demands, habits and preferences have the potential to affect the water sector and drive changes in an unplanned and potentially unpredictable manner.

The University of Surrey has guided an extensive literature review - complemented by interviews with selected researchers - focused on wide ranging socio-cultural trends and cross-cutting consumer issues. The results of this work identify many trends that pose significant challenges for the drinking water industry.

The trend report is available on the TECHNEAU website. The report provides a cross-cutting overview of consumer trends in the water sector across Europe. The evaluation leads to the identification of six important consumer trends and issues, namely bottled water use, greater consumer participation, consumer awareness of water issues, privatisation, willingness to pay and switching to water metering.

For further information, contact Wouter Pronk, WA1 Leader, or visit the TECHNEAU website (www.techneau.org).

Key Parameters for Water Quality Monitoring and Control (WA3)

Monitoring and control are indispensable for the production of safe drinking water and Work Area 3 is tasked with providing a set of analytical techniques and methods that ensure the provision of safe, high-quality drinking water that has the trust of the consumers.

A report is available on the TECHNEAU website which describes the selection of key parameters for monitoring and control of water quality. The report describes the requirements for monitoring and control technologies and lists the most essential biological and chemical water quality parameters.

Monitoring is required for catchment and source water characterisation, monitoring performance of treatment technologies, monitoring finished water quality and detection of quality changes during distribution, and monitoring of water quality at consumers' taps. For each of these requirements, a detailed set of parameters to be monitored - including criteria for their selection - is recommended.

Further work planned for 2007 will evaluate monitoring and control technologies for their suitability to provide the recommended analytical information.

For further information, contact Frank Sacher, WA3 Leader, or visit the TECHNEAU website (www.techneau.org).

Forthcoming Events

- **25-29 March 2007**

Chemistry for a Sustainable Water Supply Theme, 233rd ACS National Meeting, Chicago, USA.
Sponsor: ACS Division of Environmental Chemistry/AEESP/ NSF Science and Technology

- **5 June 2007**

TECHNEAU 2nd Regional Technology Platform, Lisbon, Portugal.
Organiser: LNEC
Host: Aguas de Portugal

- **14-16 June 2007**

First IWA Utilities Conference 'Customer Connection', Maastricht, The Netherlands.
Organiser: KVWN/NVA
Host: WML
Further information: www.moorga.com

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