TECHNEAU

Workshop "Decentralised Water Supply and Membrane Processes"

Minutes from the first Workshop of Techneau 3S Task Force "Small Scale Systems"

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Report within WP2.5: Compact Units for Decentralised Water Supply.

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Title
Workshop on "Decentralised water supply and membrane processes"
Minutes from the first Workshop of Techneau 3S Task Force "Small Scale Systems"

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1 Introduction

Within the framework of Techneau WP2.5 “Compact units for decentralised water supply”, the Berlin Center of Competence for Water (KWB) organised the 1st workshop of the Techneau 3S “Small Scale Systems” Task Force[1] on 7th September, 2007. KWB created this group in order to enhance an effective integration and planning of the activities related to small-scale systems and decentralised water supply and to foster the positioning of Techneau within the global picture. It currently involves more than 60 members, including, among others, representatives from Techneau, WHO or the IWA group “Small-scale water and wastewater treatment”. Around 30 scientists and professionals from Europe and South Africa attended this event dedicated to the topic “Decentralised Water Supply and Membrane Processes”.

Workshop objectives and program

The workshop was composed of two successive presentation sessions and two parallel discussions:

1. Presentation Session 1: “Global and European picture of decentralised water supply”

2. Presentation Session 2: “Membrane-based technologies as viable solutions for small-scale systems ?”

3. Discussion 1: “Other (Techneau) activities and issues in the world of small-scale system and needs of demonstration”

4. Discussion 2: “Promises and bottlenecks of membrane-based technologies for decentralised water supply”

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2 Participants

Name	Institute	Country
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Bengu Bozkaya	Anjou Recherche	France
Marc Caligaris	Anjou Recherche	France
Laurent Pred'homme	Opalium	France
Marie-Renée de Roubin	Anjou Recherche	France
Uwe Mueller	TZW	Germany
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Eric Hoa	KWB	Germany
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Susanne Herbst	Bonn University	Germany
Clemens Fritzmann	RWTH	Germany
Georg Staaks	IGB	Germany
Roger Aertgeerts	DHE-WSN WHO	Italy
Torove Leiknes	NTNU	Norway
Stein Wold Osterhus	NTNU	Norway
Chris Swarz	CS	South Africa
Thomas Petterson	Chalmers University	Sweden
Anna Norström	CIT Urban Water	Sweden
Maryna Varbanets	EAWAG	Switzerland
Adriana Hulsmann	KIWA	The Netherlands
Peer Kamp	PWN	The Netherlands
Wim Bruggink	Philips	The Netherlands
Bas Heijman	KIWA	The Netherlands
Jim Wright	University of Southampton	UK

3 Minutes

3.1 Presentation Session 1: "Global and European picture of decentralised water supply"

A. Hulsmann (KIWA, Adriana.Hulsmann@kiwa.nl): "Small systems / large problems: a European inventory of small water systems and associated problems"

Within the framework of WEKNOW, a survey on (very) small water supplies in Europe was completed in 2003. Regarding the situation for 21 countries, at least 10% of population is provided by small water supplies. However, little information about the number of small supplies (especially private wells) and their users is available as very small supplies are not covered by national legislation and are not monitored. A better water safety approach is then to be established.

R. Aertgeerts (DHE-WSN, WHO representative, rae@ecr.euro.who.int): "Reaching the Development Millennium Goal with small-scale systems"

Along with the MDG, WHO aims at reducing by 20% the water and sanitation coverage disparities between the richest and the poorest populations. In Europe, rural water supply is a major issue with water quality concerns related to nitrates and metals. Adaptation to climate change and emergency supply are other important topics. WHO has established Networks to create a coordinated global cooperation: Household Water Network and Small Community Water Supply Management Network.

S. Herbst (University of Bonn, Susanne.Herbst@ukb.uni-bonn.de):"Health Risks from small water supplies"

Case Studies in Vietnam (Mekong Delta), Uzbekistan (Aral Sea) and Germany (Rengsdorf) were presented with epidemiologic data support. Cultural background and human behavior were highlighted as key criteria regarding health risks from small water supplies.

J. Wright (University of Southampton, J.A.Wright@soton.ac.uk) "New initiatives for small-scale systems in developing countries: low-cost water testing and home water treatment"

The Aquapol project (2000-2005) studied the water contamination between source and point-of-use and tested ceramic filters as home water treatment in Zimbabwe and South Africa. Current activities consist in developing a low-cost and simple water test that can diagnose the water quality using E. Coli as an contamination indicator (Aquatest project).

3.2 Presentation Session 2: "Membrane-based technologies as viable solutions for small-scale systems ?"

E. Hoa (KWB, eric.hoa@kompetenz-wasser.de): "International Market Survey on Membrane-based Products for Decentralised Water Supply"

Since June 2007, membrane companies were surveyed in order to characterize their membrane-based products for decentralised applications. Out of 202 companies, 15% have replied by August 2007 and main categories of products were identified (ceramic POU, organic POU, emergency systems, compact units). Further detailed results will be available at the end of 2007 (Techneau project).

P. Kamp (PWN, Peer.Kamp@pwn.nl): "Perfector E: development and possible application for decentralised water supply "

PWN and Norit designed the Perfector-E as a quick response to the Asian Tsunami in December 2004. Using a small generator, this UF system can treat up to 2,000L/h in a 1x1m skid, is user-friendly (no use of chemicals, maintenance every 3 months) and it provides safe drinking water (20,000€ per unit). The system is delivered with a UV post-treatment unit as secondary disinfection barrier.

Dr. U. Müller (TZW, mueller@tzw.de): "Application of COP-membranes for particle removal in small systems"

Different cleaning-out of place (COP) systems, using spring water sources, were investigated in Germany and compared according to their flushing modes (media and direction). Those small UF systems (0.1 to 10 m3/h) operated without chemicals. Filterability was monitored in order to assess applications intervals regarding feed turbidity. Cost considerations were also presented.

M. Peter (EAWAG, Maryna.Peter@eawag.ch): "Point-of-use membrane systems: Alternative concept of operation and pre-treatment "

The operation of a simple POU-UF system with substantial NOM- or/and Bio- fouling layer under low flux was studied. Although no crossflow, backflush or cleaning occurs, the flux seems to stabilize at 7-10 $L.h.m^2$ over several weeks. Biological pre-treatment options will be investigated in order to get biostable treated water. A demonstration of this concept will be carried out within the Techneau project.

Prof. Frechen (University of Kassel, frechen@uni-kassel.de): "A Gravity-driven MF-systems for water production in emergency cases"

The University of Kassel designed an emergency system that is based on a simple process: dead-end MF filtration driven by gravity. Moreover, the product is robust, chemical-free and easy to transport (<25kg) and to set up. It can provide water for small communities of 200-500 people in emergency at least 3 days.

B.Heijman (KIWA, Bas.heijman@kiwa.nl): "Desalination with wind energy: The perfect combination for the small scale"

Prototypes of a desalination unit, which is combined with a windmill, are to be run in small communities in Cabo Verde and Aruba. Based on mechanical control, the system converts wind energy to supply the high-pressure pump of the desalination unit with a minimum 30%-recovery. A standard windmill (12 000€) could provide water to 500 people (10L/pers/day).

3.3 Discussion 1: "Other (Techneau) activities and issues in the world of small-scale system and needs of demonstration"

Participants: R. Aertgeerts, S. Herbst, J. Greskowiak, A. Hulsmann (reporter), T. Leiknes, B. Lesjean (moderator), A. Norström, P. Ockier, T. Petterson, M.-R. de Roubin (moderator), G. Staak, C. Swarz, J. Wright

The discussion was led according to the Work Area structure of the Techneau project, with the perspective of decentralized water supply.

3.3.1 WA1: Place of PoU /SSS in present and future of water supply

R. Aertgeerts (WHO) and A. Hulsmann (KIWA) kindly gave a summary statement of their presentations:

- SSS technology is important as a potential contributor to the fulfillment of the basic human right to safe water, particularly in rural areas where the MDGs are not being met.
- SSS technology is also important as a climate adaptation and mitigation tool especially is areas with reduced or deteriorating water resources.
- Applications are not only outside the EU. SSS technology can help matching the development goals in the EU Member States.
- Applications need to be placed in the overall framework of IWRM and not be stand-alone.

3.3.2 WA2: Technologies

Focus of this workshop was on membrane based solutions (as focus in Techneau project), but keep in mind other conventional or innovative technologies (for example evaporation and condensation, water harvesting from the air …) Within Techneau, P. Ockier will highlight innovative technologies relevant for SSS in the technology scan. Also think of cases with no need for technology (education etc).

WA3: Monitoring tools requirements.

Clear overlap with Aquatest. Techneau and Aquatest teams will meet in the next weeks for exchange on low-cost / fast monitoring technologies (which parameter is relevant in SSS applications ?) and to consider demonstration of Aquatest monitoring kits with Techneau Case Studies. Within Techneau, a

KIWA report is due early next year on monitoring tools: it will include the SSS issue (summary of exchanges with Aquatest). An issue related to SSS monitoring tools concern their commercialization and distribution. They will be cheap if produced in large quantity (outside the scope of R&D project).

3.3.3 WA4: Risk Assessment / Risk Management strategy and needs

Techneau includes RA / RM study to evaluate the risk that people of one catchment are not getting safe water at all. This is a generic framework based on WHO Water Safety Plan, from very small to very large systems, with several case studies. Case study on-going on small community in South Africa (3000 people with river abstraction source "from source to tap" study, report due by end of 2007) and in Czech Republic (3500 people with groundwater). RA studies can be useful as decision tool of management / improvement solutions in decentralized supply system. (quality + quantity of water), and should identify whether or not technological intervention is necessary, or other solutions (incl. level and risk of sanitation and Hydro-climatic events). Technical demonstration could be considered with those communities should the RA study conclude on needs of technological intervention (project continuity).

3.3.4 WA5: Operational and maintenance issues

In Techneau, not much attention of operational issues related to medium-sized or small scale systems. It was precised, in echo of the morning presentations that the approach is very different between systems constructed for long-term supply and emergency systems. This is a topic within the IWA Specialist Group "Small Scale Water and Wastewater Treatment Systems", as the management issue was identified as a key issue of decentralized systems, even for most robust processes. Solutions exist or have been developed such as central management of satellite small units, whereby attention should be paid to resources (time, staff, costs). Cooperation and feedback will be welcome

3.3.5 WA6: Customer acceptance and preference

Valid issues for decentralized supply: cultural acceptance in some countries (crucial for risk assessment) or economical preference (how willing are consumers to pay?). The prize to pay for safety and no interruption of water supply should be balanced against the economical benefit due to the absence of illness.
Do not forget the European dimension, European side. There is interest in e.g. some new Member States for social case studies, consumer awareness and communication strategy (see example of San Franciso's major officially forbidding bottle water in council meetings). There is said to be willingness to pay. WHO can help to select sites with respect to commitment and highest need.
Investigate customer expectations for small PoU device, including the impact of aggressive publicity from retailers / manufacturers. The Techneau Case

Studies in Lisbon on customer acceptance should include the aspect of PoU systems (drivers for customers to acquire PoU devices).

3.3.6 *WA7: Needs of demonstration*

Two countries considered so far for Case Studies in Techneau: India and South Africa. Decentralised water supply being also a key issue in Europe, a demonstration action in Europe is also recommended. The Lithuanian government is supporting such initiatives towards the rural area. Demonstration projects should include monitoring issue and epidemiological aspects (targeting school children for example), as impact study. WHO Euro would be interested in the framework in the Childrens Environment and Health Action Plan for Europe, (CEHAPE), to explore cooperation during the demonstration in Eastern Europe. Other ways to find additional funding might be available by contact with.

3.3.7 *Final "Take-home" messages of participants*

In some cases, small supplies have both microbiological and chemical contaminations. Need for technical solutions that address and solve both.
As the program and budget of the Techneau projects are not unlimited, all ideas will not be able to be concretized within the project. The Task Force should identify opportunities of partnering and other sources of funding (future EU projects?).
Such meetings are very valuable to make sure everyone goes home with new enthusiasm, focus and ideas, and to foster the integration within Techneau and coordination with extern activities.

3.4 Discussion 2: "Promises and bottlenecks of membrane-based technologies for decentralised water supply"

Participants: B. Bozkaya, M. Calligaris, W. Bruggink, F. B. Frechen, C. Fritzmann, E. Hoa (moderator), P. Kamp, U. Mueller, S. W. Osterhus, M. Peter (moderator), L. Pred'Homme (reporter)

The discussion was led according to the following issues:
- Why membrane processes for decentralized water supply systems
- Limitations of membrane processes
- Envisaged applications fields
- Final "Take Home Messages" of participants

3.4.1 *Why membrane processes for decentralized water supply systems*

General statements: a membrane is an absolute barrier which can guarantee the elimination of many components. This is a physical elimination. The production cost of membrane elements decreases significantly year after year: China now produced membranes at 10 USD/m2. In addition to these elements, the process appears simple, as it only consists in one step of treatment.

3.4.2 *Limitations of membrane processes*

The membrane remains a barrier as long as the integrity is warranty (no leak or breakage). For long term supply of drinking water (not necessarily for "emergency systems"), it is observed that the integrity test is a necessity. If not available, it becomes necessary to add a second barrier, such as UV disinfection. It is observed that the system becomes then more complex and costly.

This observation raised a fundamental question: if the group fixes a high level of performance and quality, can we avoid the risk of designing a system too complex and too expensive for application in developing countries. In other worlds, shall we design a less sophisticated system, with a lower level of control and guarantee for developing countries, to facilitate its acceptance in many areas (a more affordable system). The idea of having a cheaper membrane with larger pores has been proposed.

The group agreed to say that on long term view the cost of these technologies shall decrease, and the technology would continue to improve and get more reliable enabling high performance systems. However, on short and medium term view, less sophisticated solutions might be possible, if they lead to a considerable improvement of the current situation at reasonable costs.

3.4.3 *Envisaged applications fields*

The difficulty to design a system adapted to each and every situation has been raised. An emergency case for instance will not demand the same level of performance that a long term system. A low performing solution is better than nothing. A solution for small scale system will not be adapted to a Point of Use system: for a small scale system, an operator can be nominated to take care of the system. This operator could be accepted and may be paid by the community. This operator quickly gets enough technical background to maintain the system. For a point of use system, each user is responsible for his system. However, it is observed that when treated water storage is not maintained correctly, or when a water distribution network is not perfectly controlled, it is sometimes safer to deliver treated water directly to the end user than through a water distribution system.

In addition to the above mentioned specificities, a regional specificity shall be added. For instance, in Eastern Europe, industrial and agricultural pollution generates a large part of the contamination of raw waters whereas in Madagascar (for example), organic pollution is more frequent. For the first case, elimination of Arsenic or nitrates with UF membrane alone is not feasible: a reverse osmosis membrane shall be used, which cannot be considered taking into account the high pressure required to feed such membranes, or additional physical-chemical treatment steps. For the second case, a pre-treatment may be required to prevent high fouling of the membrane, for instance a biosand filtration, or a carbon filter. The level of saturation of the carbon may then be monitored, which is difficult to consider in remote small scale systems in developing countries.

The autonomy in terms of energy is mentioned as a potential criterion to design the membrane system. Solar energy is a first solution, but a specific design shall be considered to avoid the peak power demand for the membrane backwash. A solution could be to slowly pressurize a vessel during the filtration phase, and to use this pressure for the backwash energy. Solar energy is also mentioned for the disinfection of the treated water. Wind energy is also a possibility, with the same kind of limitation in terms of maximum power delivered.

3.4.4 *Final "Take Home Messages" of participants*

The following paragraph includes the most important ideas as indicated by each participant after the discussion.

Uwe Mueller (TZW): The best membrane material shall be investigated according to the fouling properties of each material. The backwash process shall be investigated to improve its efficiency. The ceramic membrane shall be developed since it appears to be easier to clean.

Peer Kamp (PWN): The key issue concerning the membrane is its fouling properties. The material of the membrane shall be adapted to each raw water fouling characteristic. It is important to give the priority to the quality and robustness of the system, instead of developing equipments or methods to control this quality: these equipments may not be used after a while.

Wim Bruggink (Philips): Since the small scale systems including POU systems shall be accessible to small communities including households, it is important to establish clear guidelines and standards to validate these systems. The guidelines will help in creating awareness and confidence at consumer level that a system is still effective, and delivers safe and drinkable water.

Bengu Bozkaya (Anjou Recherche): Due to the great possible variation of raw water to be treated, the more universal solution may be the combination of a reactor and a membrane. A simple analytic method shall be developed and distributed to the end users, for them to check the quality of the water their system produced. As a matter of facts, different countries have different problematic (heavy metals, organics, energy). In addition, different size can drive to different solutions: it appears important to classify these cases, and to propose different solutions.

Marc Caligaris (Anjou Recherche): The bioreactor with membrane (MBR) could be an answer for raw water with high organics. A large experience exists for waste water but not much for drinkable water. Aeration combined with a biosand filtration, followed by the membrane could also be a solution.

Eric Hoa (KWB): Since the price of the membrane is getting cheaper, it is important to reduce the cost of the environment required to operate the membrane. A specific focus shall be made for renewable energy because energy is not always available in remote areas, interested by small scale systems.

Clemens Fritzmann (RWTH): Different systems shall be designed for different cases, such as emergency cases, decentralised systems for poor countries, decentralised systems for rich countries, desalination requirements…

Stein Wold Osterhus (NTNU): Different solutions shall be designed for different situations, according to raw water, end user, size.

Laurent Pred'Homme (OPALIUM): The membrane has a great interest as it is a physical barrier which becomes affordable. However, it appears important to have a pre-treatment to prevent excessive fouling of the membrane, and a post treatment to disinfect the water and bring a security in case of integrity failure of the membrane. We shall develop a solution which fits with a large number of cases, and to test it in several sites throughout Techneau.

4 Next Steps

The 2nd workshop of the 3S "Small Scale System" Task Force will be organized on 5th June 2008, in Prag, Czech Republic, along with the TECHNEAU Regional Technology Platform.
Regarding decentralised water supply, the focus will be set on:
- Monitoring techniques
- Risk assessment
- Epidemiological studies
- Presentation of the two WHO Networks "Households Water Treatment and Storage"and "Small Communities Water Supply Management"

Information on 3S Task Force and future workshops:
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