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SWIM- Sustain Water MED

Network of Demonstration Activities for Sustainable Integrated Wastewater Treatment and Reuse in the Mediterranean

A Project Funded by the European Union and the German Federal Ministry for Economic Cooperation and Development (BMZ)

Regional Conference on:

Sustainable Integrated Wastewater Treatment & Reuse in the Mediterranean

1-2 December 2014

Sharm El Sheikh, Egypt

Abstracts

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Message from the Conference President

It is a pleasure to launch the SWIM-Sustain Water MED conference 'Sustainable Integrated Wastewater Treatment and Reuse in the Mediterranean Region' from December 1-2, 2014 in Sharm El Sheikh, Egypt.

The southern Mediterranean region is experiencing increasing water shortages. This situation is exacerbated by climate change impacts as well as rising water demand resulting from growing populations and expanding economic sectors in the region's countries. The safe use of non-conventional water resources offer viable options for sustainable solutions.

The conference will address the latest and most pertinent issues regarding non-conventional water resources.

The two-day conference is organized as part of the SWIM Sustain Water MED project, funded by the European Union and the German Government. The project aims to demonstrate context-adapted and cost-effective technologies for improved non-conventional water resources management as well as highlight necessary accompanying stakeholder engagement, capacity development and management measures. In this

context, pilot projects are implemented in Morocco, Tunisia, Egypt and Jordan and a regional exchange network for mutual learning is established.

By organizing this conference, the SWIM Sustain Water MED project aims to exchange and disseminate knowledge on engineering best practices, successful case studies, and innovative solutions in the field of non-conventional water resources management. The SWIM Sustain Water MED Conference will be the platform that brings together water professionals, policymakers, private institutions, industry leaders, experts, consultants, regulators, academics, and practitioners.

We look forward to all presentations of qualified and enthusiastic experts whether speaker or an attendee. In this sense, we would hereby like to wish us all a successful and an interesting event.

Dr. Ismail Al Baz

Senior Project Manager,

SWIM Sustain Water MED Project

BIOGRAPHIES

Mr. Hachmi KENNOU
Directeur Executif
Gouverneur au Conseil Mondial de L'Eau
Mediterranean Water Insitiute
Marseille,
France

hkennou@ime-eau.org, mroussel@ime-eau.org

Mr.Hachmi Kennou started his career as a technician within a group of applied research in the Fluids Mechanics Institute of the Hydraulic School of Engineers in Toulouse (France) on water pollution in France. Through this experience, he learnt the basics of the modeling of water resources management (quantity and quality) into the hydrographic basins of "Garonne and Adour". Back in Tunisia, he started working in the Urban Hydraulic Division of the Public Works Ministry and started his career in urban sanitation and the protection of cities against floods.

For more than thirty years, Mr. Kennou has developed his experiences as an expert and manager in the environmental field from urban sanitation to urban development in particularly during his time as the Director and after as the Chairman of the National Sanitation Authority (ONAS) and General Manager for two urban development societies.

Mr. Kennou had the opportunity to deal with all engineering issues (studies, works, management, operation…). He took part in various environmental issues and specially the depollution of industrial wastewater. He also participated in technical missions in Morocco for the National Office for Potable Water (ONEP)

In 2002, ***Mr. Kennou*** extended his expertise to cover the southern Mediterranean region (Maghreb, Machrek) as a consultant for the Southern Mediterranean.

Since 2002, ***Mr. Kennou*** is in charge of the General Secretary of the Mediterranean Water Institute (IME), a professional water network in Mediterranean region. Hachmi Kennou represents IME within the Global Water Partnership in Mediterranean region (GWP-MED). In fact, IME is a founding member of the GWP-Med, which is the facilitator of the MED-EUWI component.

Since 2003, ***Mr. Kennou*** was elected Governor to the World Council and has participated in several world water forums (Kyoto, Mexico, Istanbul and Marseille).

Mr.Kennou carried-out a facilitator mission with national authorities of the region in the MEDA Water Programme (Programme for local water management funded by the European Commission). He has also worked as an expert in the field of urban sanitation that gave him easy access to ministerial and technical departments related to de-pollution of the Mediterranean.

Mr. Jean Antoine FABY
Directeur de la Chaire Eau pour Tous
International Executive Master OpT

AgroParisTech-ENGREF

MONTPELLIER , FRANCE

Jean Antoine Faby was head of the engineering and studies department at the International Office for Water (IOW) from 1999 to 2009, supervising with his team 20-25 projects per year related to the implementation of water policies in France or abroad (Europe, Mediterranean, Africa, Haiti, etc.) on topics such as: participatory management and planning, water policy, socio-economics, water law, water technologies, hydro-electricity, etc. He has extensive knowledge in drinking water production and distribution thanks to the three years that he spent as a network development and operations engineer in Paris (CEP), as an expert for the National Office for Water and Sanitation (ONEA) in Ouagadougou in the 90s, and as a professor in Sanitary Engineering at the Interstate School of Rural Equipment Engineers (EIER, which became 2iE).

He has led several studies in Europe and in France on the technical level (involving various state-of-the-art technology), as well as financial levels (with the European Union), or on the

governance of water services (including in a number of European capitals). He has written several books on performance indicators, on overviews of service management methods and on asset management practices. He has founded the knowledge management & information service centre at the IOW and has been at the origin of EMWIS/SEMIDE's creation in the Mediterranean basin.

Since May 2009, he has been Director of the Water for All Chair at ParisTech, backed by AgroParisTech for the management of the International OPT Executive Master and by Mines ParisTech for the Research. This International Executive Masters OPT program is designed for managers of urban water and sanitation services in emerging countries and is presented to you today.

Prof. Dr.-Ing. Matthias Barjenbruch

Head of the Department of Urban-Water Management, TU Berlin, Germany

Matthias.barjenbruch@tu-berlin.de

Prof. Dr.-Ing. Matthias Barjenbruch is the Head of the Department of Urban Water Management which belongs to the Institute of Civil Engineering at the Technical University of Berlin (TU Berlin), Germany. He is one of the leading experts on Sanitary Engineering in Germany since more than 25 years. His main research activities are focused on “Wastewater disposal in rural areas especially decentralized treatment processes” and “Advanced Wastewater treatment”.

Prof. Dr. Matthias Barjenbruch has been project leader and partner for many international and local projects that focused on rural sanitation, advanced wastewater and sludge treatment, stormwater treatment, energy and water as well as wastewater re-use and industrial pollution. He also researches on modern sanitation concepts, climate change initiatives, odour and corrosion and capacity development. Furthermore he has actively chaired international conferences and managed many workshops and environmental training courses.

Prof. Matthias Barjenbruch has published over 150 research papers in different water journals and he is reviewer of a number of scientific journals.

2012, he was awarded with the Badge of Honour of the German Association of Water, Wastewater and Waste (DWA) which acknowledge his strong engagement in the capacity development of the workers at wastewater treatment facilities. He is responsible for carrying out the “Neighbourhood program” in which the workers of sewage plants, sewer systems and water bodies are trained

Prof. Matthias Barjenbruch is deeply engaged in the DWA working group "Advanced wastewater Treatment" since nearly 20 years. Also he is the head of different other working groups like the “Neighbourhood system” or “Aquaculture”. Furthermore he has a lot of experience in the Arabian region. Within of the TU Berlin Campus El Gouna he is the elected Vice Dean for research and at the water department he is responsible for education and research in the field of Sanitary engineering.

Prof. Dr. Fatma A.El-Gohary
Water Pollution Research Department

National Research Center

Cairo, Egypt

Dr. Fatma El-Gohary currently holds the position of an emeritus Professor in the Water Pollution Control Research Department of the National Research Centre (NRC) in Egypt. Dr. Fatma acquired a Doctorate degree in Civil Engineering from the Technical University in Hannover, Germany. Dr. El-Gohary has held several leading positions in the NRC; she was the former head of the Water Pollution Control Research Department followed by the Environmental Research Division.

Dr. El-Gohary has had a very prominent presence on the international level as well thanks to her contributions in international conferences, research projects and expert group meetings. Over one hundred papers have been published in scientific periodicals and over 40 Master's and PhD candidates have been supervised by Dr. Fatma.

Her work over the years has been acknowledged through various awards and merit. In 2014 Dr. El-Gohary has been awarded Al Nil Prize for Advanced Sciences. She has also been awarded The State Merit Prize for Advanced Sciences for the 2002, the National Prize for scientific Excellency in the area of Advanced Sciences for the year 1998, the Global 500 award from UNEP

for the year 1988, and the Eisenhower Fellowship for the year 1986 (USA). She has also received the National Research Centre Prize for Scientific Excellency in the area of Environmental Science for the year 1985 and the State Prize Environmental Sciences for the year 1979.

Prof. Dr. Uwe Tröger
1975Diplom-Geologe

1980Dr. rer. nat.

1987Dr. habil.

University Experience

- 1974-1972Fellow at the National Engineering Laboratory (Lisbon, Portugal)
- 1980-1976Scientific Assistant at Institute of Geology and Palaeontology, Technical University of Berlin (TU-Berlin
- 1985-1981Associate Professor at Institute of Geology and Palaeontology, Technical University of Berlin (TU-Berlin)
- since 1989 Full professor, head of Department of Hydrogeology, Institute of Applied Geosciences (Technical University of Berlin)
- Courses for InWent on Hydrogeology in developing countries
- Invited professor for field hydrogeology courses to the universities of Brasilia, Curitiba, Santiago de Chile
- Dean of the course of Water Engineering TU Berlin El Gouna
- Director of TU Central Institute El Gouna
- Member of ASIIN – Accreditation of Higher Education Study Courses

Some research fields

- Socio-economic land stabilization by aquifer storage and recovery (artificial recharge) in southern Portugal
- Water supply of Charroux de Allier (France)
- Contamination of aquifers south of Berlin by sewage farms
- Sewage farms of Abu Rawash and Gabal El Aswar (Cairo)
- Marine water intrusion in the delta of the River Nile
- Hydro-tectonics in southern Portugal
- Characterization of the thermal aquifer of Caldas Novas (Goias,- Brazil)
- Rehabilitation of contaminated aquifers in old mining districts in Brazil
- Water supply of Damascus from deep karst aquifers in the Anti-Libanon
- Water supply from Khors for Port Sudan
- Water supply of new cities in Russia and Armenia from different aquifers
- Water in the Atacama desert (various studies)

Practical experience

- 1976-1974Free Lancer for Klöckner Industrieanlagen (water in mining activities)
- 1990-1980Consultant for GTZ
- 1989-1986General Manager of ARGE Umwelt TEC (Consulting Company for Insurance Companies)

Memberships

DWA, IAH, FH-DGG, Urbenvironment

ABSTRACTS

“COOPERATION AND EXCHANGE OF WATER MANAGEMENT IN THE MEDITERRANEAN REGION”

By Mr Hachmi KENNOU
Executive Director of the Mediterranean Water Institute (IME)

The Mediterranean region is characterized by its geo-climatic specificity which defines it as an arid and semi-arid region. This state of affairs has generated significant tensions related to the mobilization of water resources in the region and particularly in the south-east.

Given the prospects at both the national and regional level, resorting to non-conventional resources is proving more than necessary for mid- and long-term water resources management.

Combined with an effort from southern and eastern countries aiming to establish appropriate urban sanitation infrastructure, a not insignificant contribution comes to the fore, thus allowing this effort to be taken into account in the mobilization of water resources.

The effort observed in the region around sanitation, particularly in the southern and eastern part, has only developed over approximately the last forty years.

Through the support of exclusively bilateral donors (IBRD, KFW, Arab Funds, etc.), this effort has been characteristic in several countries (Tunisia, Morocco, Jordan).

At the regional level, programmes and initiatives have been launched by donors (METAP, WFP, etc.), the most significant of which was as a result of the setting up of the Euromed Partnership, supported by the European Union.

Through the launch of the Barcelona process, in 1995, and especially the first conference held in Turin, in 1999, a regional programme was started (EMWIS, SMAP, Life, etc.).

In this framework, another regional programme for a local water management, MEDA-Water, was initiated and a budget, of 40 million Euro, contributed to ten projects, including MEDAWARE and EMWATER, directly related to reuse.

It should be highlighted that a networking project was carried out with the support of the European Commission, Med-Reunet, which facilitated the implementation of a pilot project more focused on university research.

In continuation to MEDA-Water, a regional cooperation project supported by the European Commission for an amount of 22 million Euro was able to support pilot projects such as SWIM - Sustainable Water Med.

In parallel, other regional stakeholders are working to strengthen the cooperation and above all the sharing of experiences and best practices, and this is the area in which IME intervenes.

The Mediterranean Water Institute (IME), created in 1982, works through its members to promote the regional dialogue and experiences sharing. In partnership with EMWIS and the International Office for Water (IOWater), IME aims to contribute to develop a Mediterranean Water Knowledge Platform through a project which labelled by the Secretariat of the Union for the Mediterranean (UfMS).

This project has two components:

- the strengthening of national water information systems through the setting up of a regional approach;
- the production of a White Paper on Water in the Mediterranean.

This project should concern all the countries in the region, but it will initially focus on six pilot countries in the south and east of the region, namely Morocco, Tunisia, Jordan and Lebanon, and Spain and Monaco in the north.

With the contribution of this regional conference on a SWIM pilot project, it is worth putting some thought to how to make this capitalisation of projects and data on the impact of reuse more sustainable, in order for each country in the region and

particularly all stakeholders involved to have access to best practices and success stories that come from the region.

For that purpose, based on the state of progress that you will be presenting over these two days, we should also be thinking in parallel about this sustainable networking which is to be initiated.

WASTEWATER DISPOSAL IN RURAL AREAS – AN OVERVIEW OF OPTIONS

Matthias Barjenbruch, Carsten Riechelmann

Department of Urban Water Management,TU Berlin, Germany

E-mail: matthias.barjenbruch@tu-berlin.de

Abstract

In different countries rural areas often are not equipped neither a sewage system nor with wastewater treatment. In that cases the hygienic quality is quite poor and if there are water bodies they will be continuously influenced by the purification performances of small and smaller Wastewater Treatment Plants (WWTPs). Also the re-use option of treated wastewater is limited by the quality of purification. In this paper, different methods of wastewater discharge and treatment currently available for rural areas will be presented. Today, both technical and natural methods achieve purification results which are equivalent to, if less stable than those of larger technical pants, provided that dimensioning, design, and operation are optimally cared for.

The general question will be to decide for a centralized wastewater system or for local, on-site solution installing small treatment plants. Important criteria for this decision as the distance between the houses and crucial dimensioning parameters like the amount of wastewater will be given within the report, also. Several wastewater treatment technologies will be explained and results from the SBR-System, which are applied in Germany special in smaller communities, are

discussed. The evaluation of monitoring values showed that on average the required effluent qualities could be obtained. But still one has to consider that there are technical and economic limits of the degree to which WWTPs can be cared for in rural areas. For on-site treatment the main challenge is the organization of a good operation, maintenance and surveillance.

Keywords*: rural areas, wastewater discharge; small wastewater treatment surveillance models*

BASELINE DATA, POLICY RECOMMENDATIONS AND PLANNING TOOLS FOR SCALING-UP OF SMALL-SCALE SANITATION IN EGYPT

Ph. Reymond*, R. Abdel-Wahaab**, M. Moussa***, C. Demars*, C. Luethi*

* Eawag: Swiss Federal Institute of Aquatic Research and Technology, P.O. Box 611, 8600 Dübendorf, Switzerland (E-mail: *philippe.reymond@eawag.ch)*

** Holding Company for Water and Wastewater (HCWW), Corniche El-Nil, Rod El-Farag, Cairo, Egypt (E-mail: *rifaat.abdelwahaab@hcww.com.eg*)

*** Helwan University, Faculty of Engineering, Matariya, Cairo, Egypt (E-mail: *m.moussa@delft-environment.net*)

Abstract

85% of the rural areas in Egypt remain to be covered with wastewater treatment. The challenge is very big, in a time where it is already difficult to operate and maintain the existing assets. For low and middle-income countries like Egypt and Jordan, small-scale or decentralised sanitation (here defined for settlements or groups of settlements of up to 5,000 inhabitants) is seen as a very promising and cost-effective alternative for the numerous isolated small settlements.

In the past four years, the ESRISS Project (www.sandec.ch/esriss) worked on wide-scale replication strategies for small-scale sanitation in Egypt. In a first step, the project reviewed the past small-scale sanitation initiatives in the country and assessed in detail ten of them. The success and failure factors were investigated in an exhaustive and multidisciplinary way. This research led to the definition of the enabling environment necessary for the expansion of such systems in Egypt. So far, most initiatives failed to be institutionalised, and there is no model ready for wide-scale replication. The reasons are multiple and rarely of a technical nature, but related to an absence of a solid enabling environment. Besides, rather than replicating a large number of discrete projects, scaling up requires integrative management and institutional schemes, innovative financing plans and effective inclusion of the private sector.

Most importantly, the policy should enable economies of scale, both at implementation and management level. Economies of scale at implementation level can be achieved through standardisation of the sanitation systems. A limited number of simple and robust treatment systems should be selected. Different components of the sanitation chain can be prefabricated, which contributes to lower the costs, improve quality control and reduce significantly the implementation time. In order to increase further the cost-effectiveness, a modular and incremental implementation approach should be adopted, with a

planning horizon that does not go beyond fifteen years for the treatment units.

Economies of scale at the management level imply the centralised management of decentralised systems. A management unit consisting of engineers specialised in small-scale sanitation systems should be created, with the task to monitor the planning, implementation and operation of the systems in the villages. The policy should enable the private sector and communities to take an active role in managing the systems.

The lack of baseline data characterising wastewater in the rural areas and hence the lack of context-appropriate design parameters was also identified as a major gap in the development of sound sanitation strategies for settlements under 5,000 inhabitants and an important cause of low performance of the treatment units, either because of over- or under-dimensioning. Rural settlements are very heterogeneous, which prevents the definition of one-size-fits-all options and design parameters applicable everywhere, as shown in Table 1; instead, there is a need for a case-by-case approach, and thus for a simple tool which allows local practitioners to estimate the design parameters on a site-specific basis, based on the collection of a minimal amount of first-hand data.

Table 1: The heterogeneity of wastewater characteristics in Nile Delta settlements

Parameter	Range *(averages)*
COD	400 – 2500
TS	700 – 3000
TSS	150 – 800
TN	100 - 250

The ESRISS project developed a tool package for the preliminary assessment of the situation in small settlements, based on extensive field knowledge and a simplified material flow analysis (MFA) model. Next to the estimation of the characteristics and quantities of the wastewater to be treated, the tool allows to compare sanitation system scenarios, as well as estimate the nutrient contents (nitrogen and phosphorus) in the perspective of an optimal wastewater and nutrient reuse. The user can thus anticipate a future situation and estimate the impact of different measures.

The tool focuses on the main factors influencing the wastewater quantities and characteristics, namely the number of inhabitants, the water consumption, the type of sanitation system(s), the interaction with groundwater, the liquid manure production and discharge location, and the discharge point(s) of greywater. In a context where it is difficult to get accurate data, it is important to estimate these factors through different methods and then

crosscheck the results. The tool leads the user through these steps and finally calculates the value range for the main design parameters: the flow volume, BOD, COD, total solids (TS), total suspended solid (TSS), total nitrogen (TN) and total phosphorus (TP). The tool package is now ready to be adapted and used in other areas of the MENA region.

The tool is one small step towards an enabling environment. Its learnings need to be integrated in an effective Code of Practice, which should itself be part of a clear national rural strategy. This requires a constructive coordination of the concerned ministries. A paradigm shift is needed to take up the challenge of the 85% unserved rural areas.

Keywords

Rural sanitation, Decentralized sanitation; decentralized wastewater management; enabling environment; design parameter;design parameters

SCALING UP DECENTRALIZED WASTEWATER MANAGEMENT IN JORDAN

***Mi-Yong Lee*[*], *Manfred van Afferden*[**], *Ali Subah*[+], *Essr'a Al-Hadrab*[*], *Roland Müller*[**]**

Center for Environmental Biotechnology, Helmholtz Center for Environmental Research – GmbH at the Ministry of Water and Irrigation of the Hashemite Kingdom of Jordan, Amman, Jordan, *mi-yong.lee@ufz.de* [*]

Center for Environmental Biotechnology, Helmholtz Center for Environmental Research – GmbH, Leipzig, Germany, *manfred.afferden@ufz.de* [**]

Ministry of Water and Irrigation, Hashemite Kingdom of Jordan, *ali.subah@mwi.gov.jo* [+]

Abstract

Decentralized wastewater management (DWWM) initiatives (here defined for settlements or groups of settlements of up to 5,000 inhabitants each) meet various degrees of success around the world. For low to middle-income countries like Jordan, DWWM is a very promising alternative for numerous remote settlements in order to close local water cycles (reuse), enhance sanitation, and to protect scarce groundwater resources from pollution with wastewater infiltrating from unconnected settlements. However, initiatives have yet to be institutionalised.

Barriers to this are multiple and are rather associated to the absence of robust framework conditions (enabling environment) than to technical obstacles. Up scaling to sustainable infrastructure systems on community level requires integrative management, effective institutional schemes, innovative financing plans, and private sector participation. Furthermore, efficient mechanisms to strengthen multi-sector coordination, cooperation and accountability are required.

This paper provides an assessment of Jordan's approach to DWWM through the lens of the project "National Implementation Committee for Effective Decentralized Wastewater Management in Jordan (NICE)". The project's objective is to establish framework conditions generated through multi-sector coordination with 10 Jordanian authorities (a. o. Ministry of Water and Irrigation, Water Authority of Jordan, Ministry of Health, Ministry of Environment, Ministry of Planning, etc.) in order to ensure effective implementation and sustainable management of DWWM systems in the Kingdom.

Planners have to make the most of the advantages of DWWM systems: flexibility, modularity, financial scoping, and cost-effectiveness. Principles and techniques to support such integrated planning and management are provided in this presentation: 1) DWWM systems are often more effectively implemented in stages and where built as close as possible to local needs, e.g. reuse; 2) in order to generate economies of scale (cost recovery) DWWM systems should be operated and

managed centrally, with a number of villages (cluster) to be served conjointly; 3) site selection for DWWM systems is best based on GIS analysis tailored to local conditions including socio-economic parameters.

Keywords: decentralized wastewater management (DWWM); framework conditions; enabling environment; reuse; GIS analysis

RURAL SANITATION IN EGYPT: A CASE STUDY

Joop Harmsen,

Alterra Wageningen UR, The Netherlands

Abstract

Egypt has a problem with sanitation and also with the availability of water for irrigation. No budget for sanitation is available for the large number of villages in rural areas, because cities have priority. On request of the Delta team of Water Mondial Egypt, a feasibility study is performed to find a solution for the wastewater in the villages. Key factor in the project is the reuse of wastewater after a simple treatment. HCWW has made land available to be used in combination with the reuse of waste water, which can be very interesting for private investors. Also other identified benefits of treatment and reuse may stimulate the sanitation activities in the rural area of Egypt.

The project started in June 2014 with a mission in Minya, about 300 km south of Cairo. 5 locations were visited to select a village for the first pilot, using the following preconditions:

1. It must be possible to start the pilot in a short time period (within one year).
2. We make use of the 20/80 rule: with 20% of the investment 80% of the desired result is obtained, which enables the application of simple and cheap solutions.

3. The solution makes use of the value of wastewater (water and nutrients), available land and the benefits of identified stakeholders (investors, local organizations).

In most villages no sewer system was present, which made a pilot on reuse of waste water in a short term pilot not possible. In these villages, use was made of infiltration and septic tanks. Improvements of these systems are possible and technical advice was given. The village of Deir Gebel El Teir had a sewer system and a large problem with the collected wastewater. Moreover the village has a monastery, situated at the edge of a lime stone cliff and guarding a cave where the Holy Family stayed during their escape to Egypt. Infiltration of wastewater will decrease the stability of the lime stone and may lead to a rock slide off, which would amongst others block the entrance to this Holy Place. This increases the importance to have a clean, safe and healthy environment in the village. For the water treatment, use can be made of the natural differences in heights and the presence of a wetland already created by the discharge of waste water. Measurements showed that this wetland is effective in cleaning of wastewater. We distinguished the wastewater produced in daily life and the wastewater produced during the yearly festival with 2 million visitors (peak discharge). Several stakeholders are willing to be involved in the solution, the inhabitants, the church and also organization, normally not involved in water sanitation like the Ministry of Tourism and industry within their Corporate Social Responsibility.

The solution has the following elements

- Improving the sewer system in cooperation with the inhabitants
- Building septic tanks to separate the aqueous and solid fractions
- Applying a trickling filter made of local material, in which use is made of the natural differences in height
- The natural wetland present
- Reuse of the treated water
- The solid fraction will be composted together with local available agricultural residues
- Sanitary facilities and temporary storage during the yearly festival

The solution presented is site specific, but the taken can more generally be applied in rural and desert area. Elements of the proposed solution can also be used elsewhere.

This study was carried out in coordination with: KamalGhodeif[1], M. Sherif El Tony[2], Hakiem El Wagieh[3], Enas Mekhaeal[4] ,Esam Helmy[4] , Floris van der Veen[5]

[1] Suez Canal University, Ismailyia, Egypt

[2] Malawi Irrigation Inspection, Minya, Egypt

[3]Plant Systems, Cairo Egypt

[4] HCWW, Minya, Egypt

[5] REBEL, Rotterdam, Egypt

DECENTRALIZED SANITATION MANAGEMENT IN EGYPT: LESSONS LEARNT

Eng. Ernst Doering, Senior Manager –GIZ Water and Wastewater Program, Egypt

Abstract

The core problem addressed by the project was the low coverage of wastewater systems in rural areas. Appropriate solutions for the wastewater management in smaller villages were not available at the start of the project and are still not readily at hand. The traditionally used open individual wastewater trenches pose a high risk to public health and contaminate the groundwater and irrigation canals.

From 2004 to 2011, the GIZ supported the Egyptian partners in developing and field-testing appropriate solutions for wastewater management in rural communities, focussing on (simple and low-cost) technical solutions for decentralised treatment plants and on the development of a management model that would guarantee the sustainable operation and maintenance (O&M) of the infrastructure.

In the absence of Government services, a community-based approach (CBA) was introduced that attributed full responsibility for operation and maintenance to the local Community Development Authorities (CDAs). The CBA also comprised awareness-raising measures for the communities with regard to environmental and health issues in the context of wastewater disposal. A key element of the CBA was that full ownership of the wastewater facilities was assigned to the local CDAs, whereas the communities themselves provided the land for the wastewater infrastructure. However, in the course of the project and the progressing water sector reform, the Kafr El Sheikh Water Supply and Sewerage Company (KWSSC) was taken on board to provide technical support services.

During the project period, three rural wastewater facilities were fully implemented in the pilot villages Al Moufty (operational since 2005), Om Sen (2007) and Al Koleeah (2009). This includes the completion of the infrastructure, community awareness through the training of local promoters, and enhancing the capacities of the CDAs in order to guarantee that the facilities are adequately operated and maintained. An attempt

to up-scale the community approach resulted in Egyptian Government and World Bank funding in seven other localities.

Post implementation surveys show a positive perception of the project impact. Community members are not only satisfied with the functioning of the network systems and efficient responses of the CDA to any network problem. They also point out – nearly unanimously – the hygiene, health, environmental and even economic benefits in comparison to the situation previous to the project. In addition to these general perceptions, randomly chosen households were observed more closely in order to investigate improvements in the hygiene behavior. In all cases, the household members confirmed that hygienic practices had improved.

However, a number of adverse developments and obstacles occurred towards the end of the project, that had an overall effect on the success of the project. Those are among others: a lack of permanent commitment of the CDAs, legal uncertainties with regard to asset ownership, reluctance of the KWSSC to support the communities, Law 48 with its strict requirements.

The presentation will highlight the success and risk factors as well as the lessons-learnt of the Kafr el Sheikh pilot project in light of current developments in the water and wastewater sector in Egypt.

PILOT PROJECT FOR INTEGRATED WATER RESOURCE MANAGEMENT IN RURAL MOROCCO

C. Brand, M. Elghali Khiyati, L. Djeri-Wake, C. Werner, - GIZ AGIRE, Rabat, Morocco

M. Wauthelet - Consultant, Belgique

Abstract

In the framework of the SWIM Sustain Water MED demonstration network, a pilot project was established to demonstrate the advantages of an integrated water resource management approach. The village Ait Idir in the south of Morocco, situated in the Dades Valley, 130 km north-east of the town of Ouarzazate was chosen as the site. The combination of sustainable low-tech solutions for ecological sanitation (ecosan) (Werner et al., 2009), as well as storm water management and rainwater harvesting measures were considered, which are appropriate for Morocco (Benchakroun et al., 2010). A wide range of different technology serves as a showcase to prove feasibility and the advantages of the ecosan systems, which systematically implement the reuse of energy, organics, nutrients and water.

The objectives of this pilot project are to improve groundwater quality, implement sustainable sanitation infrastructure and contribute to the adaptation to climate change.

After a diagnosis of the situation, a participatory planning process led to the chosen solutions. The area is dominated by the sanitation solution of flush toilets with soak pits, which threaten the ground and surface water quality. As groundwater is the main potable water source, this existing sanitation infrastructure will result in severe water quality and health problems.

For the planning and choice of the technology, the village was divided in different zones and appropriate solutions were chosen by a system analysis of the different zones. On the basis of a recommendation the beneficiaries of the intervention were chosen by the local partners (village development association, municipality).

Five communal sites (high school, elementary school, the municipality headquarter, the health centre and the Sunday market) as well as five individual households were identified for the demonstration. The deployed technology are anaerobic wastewater treatment (co-fermentation of animal residues with wastewater, in a brick constructed dome type digester (30 m^3) or in flexible PVC digesters (20 and 90 m^3); anaerobic baffled reactors (ABR), and a Moroccan variant of the ABR, a two-step up flow anaerobic reactor (Hafiane and Hamouri, 2005). The anaerobic technologies produce biogas, which can be used for cooking and water heating. The effluent and the sludge of these treatments are reused in agriculture or biomass zones allowing nutrient recycling. The nutrient balance is advantageous compared to aerobic treatment systems.

Urine diverting dry toilets (UDDT) are established for one household, the market and the elementary school, which allow for the safe reuse of nutrients in agriculture due to the source separation and storage. Constructed wetlands (CW) polish the treated wastewater and their biomass plantations can be used as construction material (for example giant reed – *Arundo donax*).

For a holistic approach, rain water management was also improved. The village is situated at a mountainside along the river Dades. Two large ravines pass through the village. Storm water events result in dangerous flooding and losses of fertile land. Therefore the existing dams are extended and repaired. Furthermore anti-erosion measures are being demonstrated by planting the cactus (*Opuntia ficus-indica*). Rain water harvesting is used to irrigate trees or dry gardens and is implemented with the help of the inhabitants of the village.

The feasibility to establish two dams in the dry river for erosion and flood management was examined, but the realisation was not possible within the budget of the SWIM project.

The pilot project will be continued and accompanied within the framework of the GIZ AGIRE project.

Keywords: Integrated water resource management, rural, wastewater treatment, wastewater reuse, rain water management, Ecosan.

Author and Address:

Christoph Brand, GIZ, Morocco

Programme Appui à la Gestion Intégrée des Ressources en Eau (AGIRE)

c/o Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement chargé de l'Eau

christoph.brand@giz.de

(3) Author List:

Christoph Brand*, christoph.brand@giz.de

Mohammed Elghali Khiyati*, mohammed.khiyati@giz.de

Lantam Djeri-Wake*, lantam.djeri-wake@giz.de

Christine Werner, christine.werner@giz.de

GIZ AGIRE, Rabat, Morocco

Marc Wauthelet, contact@epuval.eu

Consultant, Belgique

*Corresponding authors

LEADERSHIP DEVELOPMENT FOR WATER UTILITIES

Jean-Antoine Faby*,

* Director of the Chair ParisTech « SUEZ ENVIRONNEMENT – Water for All »

AgroParisTech - Centre de Montpellier
648, rue J-F Breton - BP. 44494 - 34093 MONTPELLIER CEDEX 5

jean-antoine.faby@agroparistech.fr

Abstract:

The sector of urban water and sanitation, especially in emerging and developing countries, faces a lack of leaders to manage the services but also a manifest lack of training for these leaders and managers, beyond existing training programs, usually focused on technical and scientific skills or MBA.

In the urban water and sanitation sector, many countries throughout the world and namely emerging or developing countries require heavy investments to face up to high demographic growth (up to 5%) and racing urban expansion, particularly as local populations generally aspire to live in cites, which, a priori, constitute attractive economic magnets. Numerous regional cities, which are sometimes referred to as secondary cities, are set to rapidly reach between 100 000 and over 1 million inhabitants, whilst capital cities often count several million people with their populations due to double by 2030. Collective drinking water production and treatment system

infrastructures therefore require significant financing, with even greater investments necessary in the case of sanitation when a collective solution is chosen.

In parallel to these essential investments and often supported by international backers, but who remain insufficient as a “single” response to water and sanitation access problems, the human means to manage these infrastructures also require investments in order to finance appropriate training programmes. The return on investment for good quality and well-assessed training is very high, even if it is difficult to quantify. And it is even higher, and namely in the short-term, when the personnel trained are already active and operational (executive managers) and in direct contact with the water and sanitation services field. **Combined with the technical training of the teams from these services (field operatives in direct contact with service users), managerial training is just as essential in order to boost the commitment and organisation of personnel and teams**.

As a consequence, alongside short professional training courses, often referred to as “continuous training” which covers specific topics and spans a duration of between several days and several weeks, it is just as essential to **develop leadership roles in a sustainable manner within service companies, via longer training programmes dedicated to service managers but also to the management executives and top-level civil servants** from establishments, which, in the country in question, play a role in the institutional workings of these services (relevant ministries, regulators, local authorities,…)

Particularisms of leadership development for water and sanitation utilities

Given the complex nature of the services business, the expertise and values which managers must possess are extremely diverse. This is all the more true in emerging and developing countries which are often faced with bigger challenges. For example, the growing population of cities tends to be composed of the poorest user categories, living in precarious conditions on rural-urban fringes or even within cities, in fragmented and poorly structured housing, where the urban density only serves to accentuate the difficulties encountered by the public service. **The expertise and the values which managers must possess include: the management of persons in a collective and individual sense, the versatility of business activities and therefore, a sense of heritage, politics and a vision, given the necessary durability of infrastructures** which will be of between 40 and 70 years or even more, a good knowledge of the rules of society of the clients benefiting from the services, **a high sense of common interest and ethics and lastly and above all, courage, passion and exemplarity** in a sector which would very much benefit from self-sacrifice and constant commitments.

Specificities of managerial training: Develop multi-disciplinary training platforms, with instructors from the professional world

Training top managers from urban water and sanitation service departments, but also training top managers from urban centres at the head of a city's operating facilities, or even future general managers (CEOs), equates to developing and forging expertise in order to:

- ensure client satisfaction, the good management of human resources, the sustainability and continuity of the service in a cost-effective manner, the management of investments and finances in keeping with sustainable development,

- manage a vision and share objectives with company personnel but also with the political authorities and local authority managers and lastly, with the service's various stakeholders (user communities, NGOs involved, representatives from underprivileged communities,…) with a finely tuned sense of societal engineering.

Managerial training for water and sanitation services consequently requires specific programmes which are practically tailor-made given that they involve transfers of expertise, of people skills and of multi-component expertise which can be broken down into 5 domains:

-*Policy and governance* within adapted institutional frameworks and which must be able to evolve
-*Manager expertise* in order to reinforce leadership as well in technical, operational, general and top management…
-*Management of service supply and demand* with a good grasp of technical solutions and costs, consequently coming within good asset management,
-*Contractual, financial, urban-planning and societal engineering* which obviously includes a finely-tuned sense of ethics,
-*Strategy and Prospects* as much in terms of vision and knowledge of evolutionary factors, whether demographic, socio-economic… in such a way as to develop short-, medium- and long-term action plans

The key issue is to develop new and adapted training programme, reflecting the management of these services and their values like a “rug woven with the common threads of consideration, analysis, world experience, professionalism, and collaboration, pro-action - the end product being inspired by personal energy and united by social integration”. In plain terms, integrating knowledge and professional practices via an iterative process between conceptual learning phases and concrete application phases for the future manager “on his patch”. .

More extensive training programmes must be developed. Such programmes should either be combined with initial training programmes leading to a qualification, or created from scratch by carefully shaping them into executive programmes, permitting executives to remain operational with respect to their services and the context of their responsibility, whilst pursuing studies of a significant duration (between several months and several years).

For these broader training programmes and for the executives destined towards career development and increased responsibility in the hierarchy, the impetus comes from their General Management who identifies them as being the “future number ones”.

GOOD WATER GOVERNANCE IN WASTEWATER REUSE: A CASE STUDY FROM THE PROVINCE OF MEDENINE, TUNISIA

Khaled Bedoui, SWIM sustain Water Med

GIZ, Tunisia

Tunisia is a North African country suffering the most from water stress (about 450 m3 / capita / year), a situation that will get worse in the coming decades. This situation has pushed the country to adopt an ambitious national wastewater reuse policy since the beginning of the eighties. In fact, 8000 ha are irrigated using reclaimed wastewater; the rate of the reuse does not exceed 25% of the available water. This rate is still low compared to the available potential and can be traced back to many problems such as the quality of treated wastewater, as well as the absence of confidence between water supplier, monitoring institutions and farmers.

The SWIM pilot activity is situated in Ouljet Elkhodher in Medenine where non-conventional water resources present a significant potential since surface water is scarce and groundwater is over-exploited. The main objective of this pilot activity is to improve the quality of the produced wastewater, to implement a new quality monitoring and early warning system and finally to strengthen the trust and a transparent communication system between all stockholders.

In this context, a new sand filter was implemented at the Ouljet Elkhodher Wastewater Treatment Plant, which treats more than

1000 m^3/d and significantly improves the quality of water. Parallel to this, the existing laboratory is reinforced by adding a new equipment and capacities to enable on-site bacteriological analyses, which will shorten the long wait for private laboratory analyses results.

The objective of this project is to install a reliable wastewater quality monitoring system and an efficient early warning system in case of degradation of the quality of treated wastewater. For this purpose, an online multiparameter readewr was installed downstream of the sand filter at the WWTP. This reader will analyze water quality parameters instantaneously (BOD, COD, TSS, TDS, PH…) and transfer the analyses results electronically in real time to an IT platform.

This IT platform will make an direct comparison between input data and national reuse standards. In case of non-compliance, it will send alerts to all related monitoring authorities and a warning SMS to farmers. This system will permit not only a permanent data sharing but also the establishment of new participatory monitoring system based on an open and transparent partnership between all stockholders at different levels (water supplier, monitoring authoritiess and farmers).

DECENTRALIZED APPROACHES TO WASTEWATER MANAGEMENT IN RURAL AREAS OF DEVELOPING COUNTRIES: A CASE STUDY FROM JORDAN

Kassab G.*, Halalsheh M., Shatanawi K., Abu Ghunmi L., Al Sharif M. and van Lier J.
*University of Jordan, Jordan

Introduction

Extending wastewater services into small rural communities in Jordan is increasingly becoming essential. To protect scarce water resources from pollution on one hand and to invest in wastewater that is progressively considered a renewable resource from which water, energy and fertilizers can be derived on the other hand (Libralato et al, 2012).

Hitherto, the concept adopted in Jordan for wastewater management is the centralized concept. In which wastewater is collected by conventional gravity sewer and treated in a centralized wastewater treatment plant. Centralized approach is a practical, efficient and economically feasible approach for highly dense populated areas. However, for remote or sparsely populated small communities centralized approach would not represent a suitable and viable option. Since for such communities the per household cost of collecting wastewater by conventional sewers and transfer it into remote centralized WWTP is relatively very high (Bakir, 2001). Accordingly, some alternatives such as the decentralized systems should be considered in order to promote the expansion of wastewater services to rural areas in Jordan.

Decentralized wastewater management implies managing wastewater as close as practical to where it is generated and to where its potential beneficial uses are located (Wilderer, 2001). This in turn minimizes the investment in trunk and interceptor sewers and focuses mainly on required treatment and reuse. Table 1 presents the key advantages and concerns associated with decentralized sanitation.

For Jordan embracing decentralized sanitation would not only extend wastewater management services to small rural communities, but also proffer source for irrigation water and fertilizers.

The project " Piloting and Strengthening Adaptation Capacity to Climate Change in the Zarqa River Basin" aimed at demonstrating planning and implementation of sustainable and feasible decentralized management for domestic wastewater produced in rural unsewered areas. The project was funded by the UNDP at Al Kfair village- located 40 km to the north of Amman the capital of Jordan. The project was implemented in cooperation with International Union for Conversation of Nature (IUCN) and under supervision of Ministry of Environment. This paper focus on presenting Al-Kfair case study and putting forward lessons learnt.

Adopted Methods

Development of sustainable and feasible approach for management of domestic wastewater produced in the study area, started with assessment of prevailing status and community needs. Followed by identification of different management approaches suitable for rural unsewered areas, and ended by planning and designing the most appropriate one. The selection of most appropriate approach was made based on sustainability assessment stated by (Seghezzo et. al., 2004). Comparison between the different approaches was according to four criteria; technical economical, environmental and social aspects. Related stakeholder were involved in each step by means of the participatory tools, Stakeholder Dialogue and Concerted Action (SDCA) and Participatory Rural Appraisal (PRA).

After completion of planning and designing phase, construction of pilot system proceeded and followed by monitoring based on technical and social aspects.

Results and Discussion

Comprehensive assessment of the study area sanitation conditions showed that approximately 50% of Al Kfair families discharge their cesspits at least once every two months with an approximate cost of 45 JOD per single discharge and transfer. Moreover, it was found that separation of grey water from black water is a common practice

prevailing at Al-Kfair village. Wherein, black water is discharged into the cesspit and grey water is applied to surrounding land. This practice is followed mainly to reduce the cesspit discharge rate and to use grey water for irrigation. Especially, that the community has high acceptance for the use of grey water in irrigation. However, continuous application of untreated grey water to the surrounding land resulted in producing septic condition around application points, and consequently odor problems, especially during summer times. Moreover, locals are following this practice with the perception that grey water is clean and safe. However, grey water samples collected from two households over 24hours showed high level of pollution and biological contamination.

Assessment showed as well that many families practice cultivation of olive trees for commercial production of olives and olive oil. Although, olive trees are rain fed, the community expressed their need for extra source of irrigation water due to the successive drought seasons. The community put across as well their need for fodders, since many of them raise livestock.

Generally, decentralized sanitation is managed either by treatment of total domestic wastewater or treatment of separated wastewater streams. The two approaches were considered for Al Kfair case and based on conducted sustainability analysis, geographic nature of the study area,

climatic conditions and community needs, a decision was made that treatment of total domestic wastewater collected by means of conventional sewer in a decentralized wastewater treatment plant is the most sustainable approach. Key advantages for this approach include; providing a reliable irrigation water supply at community level, its application incorporates management of single wastewater stream and it can be expanded as community changes and grows- under the condition that design of decentralized wastewater treatment plant (WWTP) takes into account community growth. Furthermore and since successful application of this approach necessitates commitment, cooperation and coordination on community level, development of a management framework for the decentralized wastewater treatment was under consideration.

Nevertheless, oppositions from few members of the community- especially those who own lands in the vicinity of planned WWTP- escalated and project team could not overcome the community progressively intensified worries from odor problems and anticipated decline in land prices in consequence of building a WWTP. As a result, adopted approach was shifted to treatment at household level. First option was to treat the total domestic wastewater, since grey water found to be highly polluted and since separation associates management of extra wastewater stream, which is the black water stream. Then again and due to health concerns the community had no acceptance for treatment or reuse of

total domestic wastewater at household level and source separation approach was adopted at household level.

Selected treatment systems were Upflow Anaerobic Sludge Blanket Reactor (UASB) followed by vertical flow constructed wetland for grey water and an accumulation system for black water. Twenty units were designed, built and operated. If this abstract gets acceptance, the performance of greywater treatment system will be presented in the full paper in addition to further details on study area, considered options and selection process based on the sustainability analysis.

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CAPACITY BUILDING FOR WASTEWATER TREATMENT AND NON-CONVENTIONAL WATER IN THE SWIM-SM PROJECT

C.Rizk

SWIM Support Mechanism, Lebanon

Abstract

Treated wastewater is a vital, relatively cheap, not sufficiently tapped source of non-conventional water (NCW) for irrigation and other purposes. Wastewater treatment, outside the main cities of South Mediterranean countries, is almost inexistent, the gap attributed to the lack of financial resources and know-how. Even though wastewater treatment and NCW were the subject of several projects and initiative in the region, it is clear that there is still a need for capacity building on the topics. Consequently, and as one of the activities of SWIM-SM, a capacity building program was developed and is being implemented in the framework of the Sustainable Water Integrated Management - Support Mechanism (SWIM-SM) project.

The program is structured around two main themes under the umbrella of wastewater treatment and reuse:

1. Technologies suitable for rural areas
2. Financing wastewater treatment and reuse

The SWIM project is demand driven and accordingly the choice of pillars was based on the demand of the project stakeholders expressed during meetings and project events and in regional fora such as recently the Draft Strategy for Water in the Mediterranean and the Horizon 2020 initiative.

A mix of tools and methodologies in the form of technical reports, trainings, study tours, assessments and online courses were used to reach a wide array of stakeholders. Partnerships were built for increased efficiency, reduced redundancy and sustainability. Of the used tools, it was evident that peer-to-peer exchange, through study tours was the one that was most appreciated by the participants and that yielded the best return. This paper will present the capacity development work of SWIM-SM on sustainable and integrated treatment and reuse of wastewater and shed the light on the findings and recommendations.

ADAPTIVE TECHNOLOGIES FOR WASTEWATER TREATMENT AND REUSE IN RURAL AREAS AND SMALL COMMUNITIES

Sohair I. Abou-Elela

Water Pollution Research Department

National Research Center, Cairo, Egypt

sohairela@gmail.com

Abstract

The water scarcity is a growing global problem challenging sustainable development especially in Middle East and North Africa (MENA region). Although it has 5% of the worlds populations but has less than 1% of the world's renewable fresh water. Like many countries in the region, the water sector in Egypt is facing many challenges including water scarcity and deterioration of water quality due to the rapid increase in population and urbanization. The per capita share of Nile fresh water (which is the main source of water) is about 700 m^3/y which is already below the water poverty level. In addition to water scarcity, the water courses suffer from domestic wastewater pollution especially in rural area and small communities. Hence, the problem of sanitation is considered one

of the greatest and pressing environmental problems in developing counties.

Egypt like many other countries in the region suffers from lack of adequate wastewater collection systems and treatment facilities in rural areas. There are about 3170 villages along with 26540 satellites with a total population of about 40 million capita are not covered by wastewater services. Only 7-8 % of these villages are served with efficient sanitation and hygienic acceptable systems. Disposal of untreated wastewater into surface water causes serious environmental and health impacts to human being. In addition, this practice has contributed to wide spread degradation of water quality and affects the policy of reuse of drainage water plans in Egypt. This dilemma makes developing new affordable and appropriate small to medium size technologies for domestic wastewater treatment before disposal an urgent need. Accordingly, on-site low cost options or decentralized sanitation systems are now becoming interesting solutions for application and testing.

The aim of this paper is to portray, assess and evaluate different wastewater treatment technologies which can be applied in rural areas and small communities. Two different pilot plants

decentralized low cost wastewater treatment systems were designed, constructed and put into operation. The first system is an innovative hybrid anaerobic sludge blanket (P-UASP) followed by biological aerated filter (BAF). Both the UASB and BAF are packed with innovated none woven polyester fabric (NWPF).This module of treatment can be applied when land is very limited. The second pilot system is constructed wetland consisted of horizontal and vertical flow basins and planted with three types of plants namely; Canna, Pharagmites and Cyperus. This treatment technology can be applied in rural areas with desert skirts. Performances of the tested treatment technologies, under different operating conditions, were evaluated. The results indicated that both treatments modules proved to be very promising alternatives for low cost decentralized wastewater treatment. They produced a very high quality effluent satisfying the National Regulatory Standards for wastewater reuse and safe disposal. However, the choice of the appropriate technology is governed by many factors such as legal status, land availability, ease of operation, maintenance, capital and operating costs.

IMPACT OF APPLICATION OF OLIVE MILL WASTEWATER TREATED BY DIFFERENT TECHNOLOGIES ON SOIL PROPERTIES AND PLANT GROWTH

Munir J. M. Al Rusan

Abstract

Olive oil production has a vital impact on the socioeconomical development in most countries of the Mediterranean basin, where 97.5% of the world oil is produced. However, the olive-oil extraction process generates a considerable quantities of an agro-industrial effluent known as an olive mill wastewater (OMW), which has a negative impact on the environment and biological life. On the other hand, OMW contains nutrients and organic compounds that can be beneficial to plant growth and soil fertility. The objectives of this study to evaluate the impact of soil application of treated and untreated OMW on plant growth and soil properties. The following treatments were investigated in a randomized complete block design with four replications in a greenhouse pot experiment: 1) Potable water (W); 2) Potable water plus fertilizer (W+F); 3) Untreated OMW (UOMW); 4) OMW treated by aerobic biological technology JR; 5) OMW treated by solar fenton oxidation (SFO); 6) OMW treated by an integrated microfiltration/reverse osmosis (MF+RO) process; 7) OMW treated by microfiltration followed

by nanofiltration (MF+NF). Each pot was filled with 5 kg air dry soil and three seeds of Hybrid maize were seeded per pot and then the pots were watered periodically to maintain water content at approximate field capacity. At the end of the growing period (12 weeks), the above ground biomass (shoot) was harvested and plant and soil samples were taken for chemical analysis. The results indicated that untreated OMW reduced plant growth and increased soil salinity, while the treated OMW improved plant growth and resulted in lower soil pH. The impact on other soil properties was variable depending on the techniques used for OMW treatments. Although, treated OMW enhanced plant growth compared to the untreated, the plant growth remained lower than that obtained using the potable water with fertilizers, indicating that is lacking some of essential plant nutrients. It was concluded that untreated OMW should not be used for irrigation and supplemental fertilization is required when treated OMW will be used for irrigation.

ZERO-ENERGY COMPACT UNIT (ZECU) FOR SEWAGE TREATMENT IN SMALL COMMUNITIES

A. S. El-Gendy*, T. I. Sabry**

*Department of Construction and Architectural Engineering, The American University in Cairo, E-mail: ahmed.elgendy@aucegypt.edu

**Department of Public Works, Faculty of Engineering, Ain Shams University, Cairo, Egypt, E-mail: tarek.sabry@eng.asu.edu.eg

Abstract

In Egypt, there is an essential need for sewage treatment in rural small communities. The needed treatment should require little maintenance and skills for operation and should provide effluent with good quality comparable to that produced by conventional wastewater treatment plant. Therefore, the objective of the current research is to test the performance of a full-scale system; in the treatment of sewage from a small community to produce effluent quality that complies with the limits of effluent disposal in Egypt. The pilot-scale setup; which is easy to implement and operate; was constructed at a village in Egypt named Zawat El Karatsa, El Fayoum Governorate, and was operated at a flow rate of 9 m^3/d. To evaluate the performance of each stage in the treatment, water samples were collected from the influent and effluent of each stage throughout the testing period. Collected samples were analyzed for chemical oxygen demand (COD),

biochemical oxygen demand (BOD_5), total suspended solids (TSS) and volatile suspended solids (VSS).

The system was tested using raw sewage. Although, the influent raw sewage had fluctuating values, the system treatment units had provided a buffer and the final effluent had almost constant quality. The integration of anaerobic, aerobic and polishing phases of the treatment can provide effluent quality acceptable for disposal in agricultural drains with respect to COD, BOD_5, TSS, temperature and pH according to the Egyptian Law 48 for the Year 1982.

Also the current system does not consume energy, except for pumping sewage to the system. The system is easy to construct and operate and requires no skilled labours which make it suitable for implementation in Egypt. Also, a source of energy (biogas) can be produced as a result of treatment in the anaerobic phase of the system.

DECENTRALIZED WASTEWATER MANAGEMENT IN JORDAN : A CASE STUDY OF FUHEIS

Mohammad A l-Zou'bi

Abstract

Jordan is known as one of the water poorest countries in the world. Therefore, considering marginal water resources in the country's water balance is of great importance. Hence, decentralized wastewater treatment and reuse options might be useful solution to overcome this problem.

The reasons behind the adaption of decentralized solutions in wastewater management
are to cover non-linked areas on drainage systems (38%), reduce the pressure on drainage systems, protect groundwater and natural resources, as well as considered it as a cost-effective approach.

Within the context of the SMART project, research has been carried out on one of the decentralized systems at the demonstration and test site at Fuheis, Jordan. The Sequencing Batch Reactor (SBR) has been observed and monitored to evaluate the capability of the system to produce an effluent that matches the Jordanian standards JS 893/2006.

The SBR system is a fill-and draw activated sludge system. The system receives raw
wastewater of a hydraulic loading rate (HLR) 900 liter/day. The system has three
treatment cycles of 8 hours each per day. Each cycle includes a feeding, aerating, settling and decanting process.

The system has shown an interesting performance in reducing the pollutants to a harmless level. The results were under category A and B by Jordanian standards and guidelines. SBR system has been successfully used to treat municipal wastewater. Moreover, it is uniquely suited for wastewater treatment applications characterized by low or intermittent flow conditions.

ON-SITE WASTEWATER MANAGEMENT AT THE PUBLIC SECURITY DIRECTORATE IN JORDAN

Eng. Nabil Wakileh, Dr. Ismail Al Baz+, Irene Sander+, Hesham Asalamat+

Dr. Bassim Abbassi*, Dr. Naser Almanaseer*, Eng. Sameeh Nuimat**

+Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)
*Balqa Applied University, (BAU)
**International Union for the Conservation of Nature (IUCN)

Abstract

In line with a worldwide trend, Jordan is experiencing rapid urbanization. The capital, Amman, is at the center of this expansion, having witnessed an increase in its area from 52 km² in 1952 to 1680 km² in 2007 (Wardam, 2013). Urban master plans have to incorporate a growing number of municipalities and urban zones. However, the rapid sprawl is not always being met with an equal growth in public services. Buildings are constructed yet water, wastewater, waste services and the like are still largely absent. In the case of wastewater management, a lot of

buildings in these new development zones are not connected to the central wastewater network and therefore rely on cesspools. This sanitary solution can, without existing construction regulations and monitoring procedures, cause considerable groundwater pollution, threatening already scarce water resources and public health.

This phenomenon coupled with Jordan's dire water situation, calls for sustainable sanitary solutions for these new suburbian areas. Small-scale and on-site wastewater treatment and reuse systems provide such solutions by treating and reclaiming wastewater at its source and thereby preventing the further degradation of groundwater quantity and quality, while upholding public health and environmental standards. The resulting freshwater savings also allow for important financial incentives.

Within the framework of the SWIM-Sustain Water MED Project, funded by the European Union(EU) and the German Federal Ministry for Economic Cooperation and Development (BMZ), and implemented by Balqa Applied University(BAU), the International Union for the Conservation of Nature (IUCN) and the Deutsche Gesellschaft für Internationale Zusammenarbeit(GIZ)GmbH have joined hands with the Jordanian Ministry of Water and Irrigation (MWI) to install an on-site wastewater treatment plant using the Sequencing Batch Reactor technology(SBR) as well as reuse system at the Public Security Directorate(PSD) in Moqablaine, in the outskirts of Amman.

This paper outlines the implementation steps of this pilot project, highlighting lessons-learned with regard to the

technology selection, the environmental impact assessment, cross-sector coordination and responsibilities as well as reuse standards.

Keywords: Decentralized wastewater management, reuse, peri-urban areas, Sequencing Batch Reactor (SBR), enabling environment.

CAN WATER REUSE SUSTAIN INTEGRATED WATER RESOURCES MANAGEMENT IN EGYPT ?

Prof. Dr. Dr. Fatma Al Gohary

Water Pollution Research Department

National Research Center, Cairo, Egypt

fgohary@hotmail.com

Abstract

Limited freshwater resources are one of the major obstacles to the economic development of Egypt. According to recent projections, renewable water available on a per capita basis is currently under 800 cubic meters /year, a quantity that already places Egypt among water scarce countries. With continued rapid population growth, it is expected that per person availability will decline to 720 cubic meters by 2017 and 600 cubic meters by 2025. At the same time, demand is likely to increase with economic growth, even with improved water efficiency and changes in the composition of economic output in ways that reduce the water intensity of production. Also, the problem of how to accommodate large and growing water requirements is further complicated by pollution from all sources – agricultural, domestic and industrial – which limits the use of both fresh and wastewater

without adverse economic, environmental, and health implications.

The agricultural sector is the highest freshwater consumer in Egypt accounting for more than 85 percent of the total gross demand for water. On a consumptive basis, the share of agricultural demand is even higher at more than 95 percent. With growing demand for freshwater resources in Egypt, pressure is mounting on the agricultural sector to give up part of its allocation to prime use sectors such as households and industries. Meanwhile, agriculture has to continue producing food and fiber to satisfy current and future demand for food security.

To face the challenge, various integrated management strategies have been developed over the years in response to growing water demand, such as building infrastructures to transport water to deficient areas. Because such projects require much time and money, alternative solutions are being proposed and some have been implemented, such as desalinating seawater or brackish water, water reuse and water conservation measures using water-efficient technologies such as drip irrigation. When discussing alternatives, it was important to examine not only technical solutions but also socio-economic issues such as public perceptions, risk analysis, assessment of economic benefits, as well as environmental impacts.

Experiences from around the world have shown that the water reuse option is often not only the most cost-effective solution, but it has the advantage of valorizing the social and environmental value of water, enhancing a region's resource availability and minimizing wastewater outflow with additional environmental benefits. It is an approach that favors the creation of closed, decentralized loops using alternative solutions suited to local constraints, and responding to present and future needs. Reusing wastewater with the use of appropriate treatment technologies shortens the natural water cycle.

The main constraint facing the use of treated wastewater in Egypt is the low coverage of sanitation systems and/or the large amounts of wastewater produced by large-scale centralized treatment facilities, which cannot be used for irrigation and are often discharged into receiving water bodies. Consequently, the reuse of water is a lost opportunity, as wastewater is either buried away in cesspools or discharged into receiving water bodies. So the amount of wastewater collected and treated makes up a small percentage of the generated quantities, as do the reused amounts.

This speech summarizes the existing situation and presents the results of recent research and development efforts to accelerate coverage with sustainable sanitation systems to protect the health of the people, conserve water resources and promote safe use of treated wastewater in Egypt.

IMPACT AND CONSTRAINTS OF GRAYWATER REUSE IN AGRICULTURE AT THE OLD SANA'A CITY

Al-Nozaily F.A.; Al-Eryani A. A. and Al-Ajeeli S. S.

Water and Environment Centre, Sana'a University, Yemen

drfadhl@yahoo.com

Abstract

For over 500 years, it has been known that he farmers in the old city of Sana'a use untreated ablution water (greywater from the mosques) for the irrigation of cash crops in thehistorical gardens called "Maqashem", that grow vegetables and fruits. . However, at present time these gardens have dried up and have been abandoned as a result of the drying out of the hand dug wells which were supplying mosques. This research aims to evaluate the operation and maintenance of the pilot greywater treatment unit which was implemented by the Water and Environment Centre of Sana'a University at the Al-Washali traditional garden in old Sana'a. The unit collects the greywater from both a mosque and the neighboring house. The aim of the pilot is to improve the quality and re-use the treated greywater in the rehabilitation of the "Al-Washali" historical garden. During the period of this field research (December 2010 - April 2011), the quantity and quality of the greywater emerging from both the

mosque and from the treatment unit were analyzed for physico-chemical and biological water quality. Moreover, an appropriate number of soil samples before and after the irrigation with greywater were analyzed. A site social survey was conducted to assess the beneficiaries' perception regarding the re-use of greywater from houses and mosques as a complementary source to compensate for the shortage of freshwater caused by dried-up wells. The treatment unit was maintained by removing weeds that grow around the filter as well as cleaning the aggregates of the filter, the holes of the perforated pipe inside the treatment unit and of the irrigation network. The lining layer underneath the filter was also repaired. Data was collected and analyzed using SPSS statistical software. The results showed that the average amount of ablution water amounted to 4.5 liters per worshipers. The total amount of water coming out of both the mosque and house to the gray water treatment unit therefore lies at 313 liters /day. Results also showed low concentrations of pollutants in the effluent, where COD was decreased from 172 to 35 mg /l, and BOD decreased from 137 to 16 mg /l before and after treatment, respectively. The fertility of the soil was increased through the addition of organic matter from greywater irrigation. By comparing the Yemen standard specifications (#150/2001) for irrigation of cooked vegetables, fruit trees and other crops, it is clear that this kind of greywater is suitable for irrigating the historical gardens. To scale up the project, it was recommended to connect the greywater emerging from the neighboring hotels and houses adjacent to the garden together

with the extension of the treatment unit. With regard to the total cost of the greywater treatment unit, the annual maintenance cost has been calculated as 8% of the construction cost. It was also recommended that a legislation to encourage the separation and greywater treatment and reuse at the household level and commercial facilities, supporting awareness campaigns, training of the local community to manage the use of greywater as a source of non-traditional water resource and therefore the possibility of its implementation at the level of towns and villages for the production of agricultural crops as a contribution to the effective mitigation of water scarcity and poverty alleviation.

Keywords: Greywater, Sana'a, traditional gardens, irrigation, legislation

WASTEWATER REUSE IN IRRIGATION THROUGH APPLYING THE IWRM CONCEPT CASE STUDY: EFFLUENT OF A SANA'A TREATMENT PLANT

Al-Eryani A. A.[1]; Al-Nozaily F.A.[2]; and Al-Muselehi S.W.H.[2]

[1] Agricultural faculty and Water and Environment Centre, Sana'a University; Yemen eryaniabdulrahman@yahoo.com

[2,3]Water and Environment Centre, Yemen

Abstract

The lack of fresh water supply for human daily needs and for agricultural production is heightened by growing population and changing climate. With the current emphasis on environmental health and water pollution issues, there is an increasing awareness of the need to dispose of wastewater safely and beneficially. The use of wastewater in agriculture could be an effective solution to achieve multiple goals, such as water savings through the reduction of fresh water consumption, increasing food production through increasing irrigation water supply and improving environment quality through enhancing wastewater treatment plant and phyto-remediation. This study was conducted during the period from October 2010 to February 2011, in Bite-Handhal area, one of Sana'a capital outskirts, Yemen. The overall goal of this research is To evaluate the

impacts of Sana'a wastewater treatment plant effluent reuse in irrigation. The specific objectives are: i) To assess the biological wastewater pollution risk on the health of the producers and consumers of some cultivated field and vegetable crops, ii) To Determine the heavy metal concentrations in the wastewater and wastewater irrigated soil, and iii) To evaluate the impacts of Salinity, Sodicity, sludge, and nutrient elements resulted from wastewater effluent reuse on soil productivity and its physical properties. Samples of wastewater and ground water were taken from five sources to study the chemical and biological variations among these sources which named: Inlet wastewater, Outlet treated wastewater, mixed (by bass) wastewater, ground water from a well, situated 2km from the open wastewater channel, and ground water from other well in area situated about 3km from the open wastewater channel. Also soil samples were taken from two different sites:The 1st was irrigated with wastewater while the 2nd site, was irrigated with water from wells in the same area to evaluate the influence of wastewater reuse on site soil properties. As well as samples from growing crops in different sites and different times to evaluate the health risk of Biological wastewater pollution (FC and TC) on the producers and consumers of growing crops. The laboratory tests were supported by comprehensive questionnaire to clarify another integrated water resource management(IWRM) issues related to wastewater reuse in agriculture. The results denoted that there were significant differences between studied groups in the EC, TDS, BOD_5 , COD, SS, NH_3, NO_3, FC, Na, Ca, Mg, Cu, Zn, and

Ni values .Thus reflected the effects of the treatment processes and the distance from the channel of wastewater which caused significant reduction in the Ec and significant increment in the values of pH, Mn, Cd and Pb. In regard to soil sample tests, the results revealed that there were significant variation between the two types of soils, where soil irrigated with wastewater reflected substantial increment in the OM, P, Fe, K, Cu, Zn, Co, and Mn, and substantial reduction in the P^H while irrigation with wastewater has no effect on EC , N, Na, SAR, Ni, Cd. and soil texture .Crop sample test results showed that there were significant variations between the crops irrigated with wastewater and those irrigated with well water in the fecal coliform colonies (FC) and total coliform colonies(TC), where they were higher on the crops which irrigated with well waters. the nature of the height of the crops and the irrigation period length caused differences in the density of the FC and TC colonies where they were higher in the shorter plants and shorter irrigation period.

The questionnaire results denoted that the positive economic incentives have dominate effects in using wastewater for irrigation with low awareness or ignoring of the hazardous which might be occurred on the human and animal health and on the soil productivity. It could be concluded that the examination of Sana'a treatment plant effluent was very important to get actual sequences of using wastewater effluents in irrigation. Treated wastewater reuse is a vital option to ensure water and food security under Yemen conditions as a dry land country, but

that should be companion with a good wastewater, soil and crop management .

Key words: **wastewater reuse, irrigation, human health, crop selection, soil productivity**

REUSE OF WASTEWATER IN MOROCCO: SITUATION IN 2012 AND DEVELOPMENTAL PERSPECTIVES IN 2030

***MAKHOKH Mhammed*[1]**, Mme JAOUHER Touria[2]

[1]Head of the division water quality, delegated minister of water Morocco.

B.P. 433, 10001 Rabat / Maroc, Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement chargé de l'Eau, scpedi@water.gov.ma

[2]Head of the service pollution control , delegated minister of water, Morocco

Abstract

Natural water resources in Morocco are among the lowest in the world. Indeed, the potential of natural water resources is estimated at 22 billion m3 per year, equivalent to 700 m^3/ habitant/ year, commonly accepted as critical threshold indicating the occurrence of water shortage and looming water crisis. Over half of these resources are concentrated in the watershed of North and Sebou covering nearly 7% of the national territory.

This situation is likely to deteriorate as a result of climate change. Indeed, in the last decades, Morocco has suffered from

this phenomenon with an aggravation of extreme events and a significant reduction in rainfall and hence runoff.

Within this context and to support the development of the country, Morocco has long been committed to mastering water resources through the construction of 135 dams with a total capacity of nearly 17.5 billion m3 and thousands of drillings and wells capturing groundwater.

However, the water sector still confronted with challenges related mainly to: scarcer water resources due to climate change, overexploitation of groundwater resources, the weakness of the value of mobilized water resources including agricultural sector and deterioration of the quality of water resources due to the considerable lags in sanitation wastewater treatment and reuse treated wastewater. The baseline scenario shows that most watersheds will be in deficit on the horizon 2030.

It has therefore become unreasonable to continue to reject the treated wastewater at sea and thus wasting a valuable resource that is part of the "Public Water Domain". The reuse of these new water resources for agricultural purposes, industrial including washing of phosphate, irrigation in green spaces and golf courses or in groundwater-recharge to fight against sea water intrusion in coastal aquifers, is now required.

In order to consolidate what has been achieved and to meet the above challenges including
bridging the gap between supply and demand for 5 billion m3 on the horizon
2030, the development strategy of the water sector in 2009 has set as target for 2030:

- Saving 2.5 billion m3 / year (Line water demand management).
- Mobilization of 2.5 billion additional m3/year particularly through non-conventional water resources such as reuse which it set a target of 300 Mm3/year in watering green areas and golf courses, in crop irrigation, in the industry as well as groundwater-recharge in coastal aquifers (Line Management and development of the supply).

This paper presents the overview of the situation of the REUE in 2012, constraints and the outlook to the year 2030.

MANAGING AQUIFER RECHARGE – A SUSTAINABLE WAY FOR DRINKING WATER SUPPLY

Prof. Dr. Uwe Tröger,

Technische Universtät Berlin, Central Institute Campus ElGouna
uwe.troeger@tu-berlin.de

Abstract

Water scarcity becomes important in Egypt due to the growth of inhabitants and the extended use in agriculture. The River Nile was for thousands of years the lifeline for the people and will always be the most important source for water supply for drinking water and agriculture. Groundwater up to now was not an important source with the exception in the oasis. Some hundred wells can be count along the Mediterranean Sea and the coast of Sinai.

Artificial groundwater recharge with different types of methods and water could be a contribution for a sustainable supply. In the coastal area rainfall occurs every year and runs off to the sea or evaporates. Rainwater harvesting could be a solution to recharge the aquifer and defend saltwater intrusion. Rainwater harvesting is more popular in countries with much more rainfall than Egypt or in semiarid countries where it should take place.

Temporary heavy rainfall occurs in many regions along the Red Sea result in extreme run off and flash floods. Also these waters are lost to sea. With various methods the water could be recharged and serve for drinking water supply. A few examples are known from arid countries. In Khor Arbaat in Sudan first projects started but are poorly elaborated.

Sewage could be used in different stages for irrigation or after treatment for artificial recharge. The primary treated water could be used for artificial recharge along the coast to prevent sea water intrusion. Good examples are known from Australia. In Australia the first legislation covers the minimal conditions for all types of artificial recharge.

Egypt will need all available fresh water in the future. Managing Aquifer Recharge is the first step to good practice and integrated water resources management.

TUNISIAN EXPERIENCE IN GROUNWATER AQUIFER ARTIFICIAL RECHARGE

H. Chaieb

General Direction of Water Resources, Tunis

Abstract

Tunisia has 1110 wastewater treatment plants throughout the country, which produce 232 millions m^3 of treated wastewater (2012). Tunisia has developed encouraging experiences in the reuse of treated wastewater as this practice is an inevitable part of the country' water efforts to face water scarcity problems and to satisfy the continually increasing demand for water. In this objective the strategy of the country in artificial recharge is based on the valorization of this non-conventional water resource through the installation of operational aquifer recharge projects and the development of water resources, while looking after the preservation of public health and environmental protection.

The artificial recharge of aquifers with treated wastewater in Tunisia was discovered for the first time in 1956 in the aquifer of Soukra, after creating in the region, an irrigated public perimeter with treated wastewater in the station plant of Charguia.

In December 1986 and after the RAB080 project which's financed by the United Nations Development Program, an experimental artificial recharge station of the aquifer Nabeul-Hammamet (Wadi Souhil) was constructed in an experimental agriculture farm belonging to the Ministry of Agriculture and Hydraulic Resources (INERGREF). This station is supplied by treated wastewater in SE4 station plant of Bni Khiar which is also exploited to irrigate the Nabeul region perimeter.

Since 1995 and following the creation of the irrigated public perimeter of El Hajeb-Sidi Abid by treated wastewater of the Sfax south station plant, some significant piezometric level rises were observed in the aquifer, showing up the percolation of the irrigated water towards the aquifer and the contribution in its recharge.

In May, 2008 and in the framework of the Investment into the water sector Program, a new pilot site has been built in the region of el Mida having as objective to recharge the oriental coastal aquifer of the Cap-Bon by the treated wastewater of Korba station plant.

Key words : artificial recharge, aquifer, waste water, treatment, piezometric level, water quality.

IMPACTS OF TREATED WASTEWATER REUSE ON AGRICULTURE IN TUNISIA.

Hamadi DEKHIL, Hadia KALED, Zohra SOUALHIA
National Agency of Sanitary and Environmental Control Products (ANCSEP).TUNISIA

Abstract

In Tunisia, treated wastewater represents an alternative water resource for agricultural and recreational areas. Currently 17% of the available potential is used for a total of 28 schemes (8100. Ha). A willingness to reach 50% in 2016 remains and is dependent on several factors, mainly the quality of TWW.

On the other hand, the Tunisian legislature has provided a multitude of requirements for the use of treated wastewater for agricultural purposes in order to prevent health and environmental risks associated with this practice.

The national control scheme reuse of treated wastewater in agriculture and the National Health Information System (epidemiology) are hampered by certain shortcomings which makes it difficult to monitor the epidemiological situation and the impact on the food chain related such a practice.

In this context the National Agency of Sanitary and Environmental Control Products (ANCSEP) consideres it necessary and useful to conduct a large-scale study covering 3 years, aiming at the assessment of health risks associated with the use of treated

wastewater for agricultural purposes and to identify risk factors for better control and risk prevention.

The methodology of the study is based on the analysis of contaminants (Cadmium, Lead, Mercury, Nikel, copper and arsenic) in the matrices: water, soil, agricultural products (plant and animal). The study will also include a survey of farmers in 7 perimeters, each representating a specific socio-economic region of Tunisia.

The first results concerning two areas (Borj Touil: 3145.ha and Souhil: 543.ha) reveal the following:

• Low levels of lead contamination in agricultural products (50.ech).

• The following symptoms have been observed by farmers (evaluation survey): Fever with (38%), skin disorders (32%); eye disorders and respiratory disorders.

• Neglect and / or ignorance of the use of protection meausres when handling treated wastewater.

With regards to risk prevention associated with the resue of treated wastewater in agriculture, the project makes the following recommendations based on its initial assessment:

• The quality of treated wastewater is unsatisfactory.

• Outreach workand the awareness of farmers to meet hygiene conditions and regulations is insufficient;

• Establishing control mechanisms for chemical contaminants in treated wastewater and agricultural products remains incomplete.

MUNICIPAL SLUDGE TREATMENT AND REUSE OPTIONS:SOLUTIONS FOR JORDAN

Maha Halalsheh[1], Ghada Kassab[1], Mamoun Gharaibeh[2], Nisreen Hmoud[3], Ziad Al- Ghawi[2]

[1]The University of Jordan, Amman-Jordan; [2]Jordan University for Science and Technology, Irbid-Jordan; Royal Scientific Society, Amman-Jordan

Abstract

Sludge produced by WWTPs in Jordan can implement different management options depending on the level of treatment and the situation. Currently, sludge produced at all treatment plants in Jordan meets class C biosolids, which is only allowed to be disposed at landfills according to Jordanian standards No 1145/2006. Upgrading sludge quality to biosolids that can be used for land application entails –among other requirements- achieving at least class B biosolids and solids content higher than 50%. Upgrading biosolids to class A and solids content of >90% for the purpose of eliminating reuse restrictions and allow for free distribution of biosolids necessitates more investigations especially during winter periods. Moreover, revisiting sludge standards may be required to enhance resource conservation. In addition, research related to biosolids management options in Jordan is still very limited and can be summarized by two

projects. The first project was performed by the RSS and JUST who investigated biosolids application to land for agricultural production. The second project investigated the application of biosolids for range land and was executed by the Hashemite University. However, application rates of biosolids to land were far below aspirations. Higher application rates should be investigated taking into account organic pollutants and their fate in the soil.

Considering Class B biosolids, research should be directed on enhanced dewaterablity options including the application of reed beds for sludge dewatering and treatment, textile bag filtration and storage, which can be an option for sludge produced by small wastewater treatment plants. Enhanced dewaterability will result in smaller foot print needed for sludge management (excluding reed beds option), which can be critical when sufficient area is not available.

On the other hand, different feasible sludge minimization options shall be investigated in order to prevent the formation of excessive sludge quantities. This can be a vital topic for the planned WWTPs and the expansion of As-Samra plant. It is also of particular interest to small wastewater treatment plants in which sludge on-site management is not an economical feasible option. Among attractive low cost sludge reduction options, vermicomposting and aquatic worms reactor can be considered. These options can be used to treat sludge and upgrade its quality. Another attractive option can be the oxic-settling-

anoxic activated sludge process. These technologies shall be investigated for the purpose of better understanding, which eventually will result in process optimization and significant reduction of sludge.

This paper will present different non-conventional options under investigation by a project conducted jointly between different institutions in Jordan ad funded by Scientific Research Fund. It will also present preliminary results achieved so far by the project.

DECENTRALIZED INTEGRATED SLUDGE MANAGEMENT

Bassam Ossama Hayek

Senior Expert - Eco-efficiency and Utility Management
German-Jordanian Programme "Management of Water Resources"

Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH
Amman - Jordan

Abstract

Wastewater treatment plants in Jordan suffer from the generation and accumulation of sewage sludge. The main point source is the Assamra Wastewater Treatment Plant, which is serving nearly half of the population of Jordan. The sludge resulting from Assamra is being digested with gas and in turn electricity is being captured and used at the facility. Residual digested and dried sludge is being considered for use as a fuel source in industries, such as cement kilns located nearby. The other 26 wastewater treatment plants are decentralized, serving much smaller communities. In such cases sludge is being collected and not used and poses negative environmental and economic impacts.

The treatment and reuse of sludge from the decentralized facilities is urgently needed in northern, middle and southern governorates. GIZ/Dorsch studied alternatives for the final disposal of sludge from the WWTPs (2013). According to the study, around 200,000 m^3/y (6,000 ton DS/y) of sludge is

generated from wastewater treatment plants (WWTP) of middle governorates and being wasted. Such amounts are being transported long distances for disposal. The cost of transport reaches to about 300’000 JOD per year. The practice is also responsible for high carbon emissions.

On the other hand, middle governorates like other governorates lack proper solid waste management systems and infrastructure. Only one solid waste landfill in Jordan is considered a proper sanitary land fill that serves Greater Amman. The municipalities in governorates use dump site, unlined sites that may be causing negative impacts to groundwater and the environment in geneThe ral. Jordan Valley suffers from an additional problem resulting from the use of manure. Where farmers use untreated livestock manure to provide organic fertilizers to their farms before the planting season that starts normally in September. This practice causes the development and spread of flies in nearly all parts of the Jordan Valley that affects the level quality of life and services in the region. It even has an effect on the tourism sector especially in the Dead Sea area.

This project aims at demonstrating an integrated approach for the treatment and reuse of sludge combined with other biomass sources i.e. municipal organic waste and manure. The demo

project will aim at energy generation followed by reuse in agriculture. The concept comprises the cooperation with farmers, municipalities and water utilities, as well as the establishment and operation of a system for co-digestion of sludge with other biomass sources. The biogas from the digestion process will be used to generate power to feed the facility, whereas the residual sludge will be processed further by drying / disinfection, in order to be used as treated organic mix (such as compost / soil conditioner).

IMPLEMENTATION OF 3PS FOR IMPROVING ENERGY EFFICIENCY AND SLUDGE MANAGEMENT OF MADABA WWTP

Feras Matar, Chief Executive Officer, Engicon O&M- Jordan

Keywords: PPP, Wastewater treatment, WAJ, Energy efficiency, sludge, Engicon O&M

The erection and operation of wastewater treatment plants (WWTPs) in Jordan call for high capital and annual operational expenditures. The latter is reflected through a high energy consumption of about 14% of total electricity produced in Jordan. This forms a huge financial burden on the Water Authority of Jordan (WAJ), responsible for most of WWTPs in Jordan. Of equal importance is the critical issue of sludge management, particularly sludge treatment, dewatering and disposal. The current management option entailing sludge transportation to specific WWTPs places a high financial burden on WAJ.

Due to technical and managerial attributes, the current management practices of WWTPs in Jordan have resulted in unsustainable wastewater treatment facilities associated with high operational costs and severe environmental impacts. All this urged WAJ in 2011 to apply the concept of Public Private Partnership (PPP) aiming at improving the efficiency of wastewater treatment facilities.

Local experiences with the application of PPPs in the Jordanian sanitation sector is limited and the role of PPPs in reducing

operational expenditures of WWTPs warrant investigation. This research study evaluates the first experience gained through PPP involvement pertinent to energy reduction and sludge management at the Madaba WWTP.

The data compiled, analyzed and presented in this research are based on a pioneer PPP pilot case implemented by WAJ in a consortium consisting also of private companies (Engicon O&M-Jordan and Huber SE-Germany).

An evaluation and analysis of the PPPs first year of operation showed improvements in energy efficiency and sludge management effectiveness. Compared to conventional governmental management practices, the application of the PPP concept achieved an average reduction in energy consumption of 25%, while the management costs of the sludge line were reduced by 68%. Without impacting the treatment efficacy of the Madaba WWTP, the PPP initiative reduced the annual operational expenditures (OPEX) and improved the sludge disposal path. Annual saved OPEX ensured for the sustainable operation and the reduction ofthe overall treatment costs rendering them affordable for urban residents.

In my presentation, I will highlight and present the results obtained and lessons learnt from this pioneer experience from Jordan.

STRATEGIES AND MEASURES FOR THE OPTIMIZATION OF WASTEWATER TREATMENT PLANT PERFORMANCE – CASE STUDY: El GOUNA. EGYPT

Nikolaos D. Tzoupanos, Ehab Shafik, Carsten Riechelmann, Matthias Barjenbruch
(Technische Universitaet Berlin, Campus El Gouna, Department Water Engineering, Mohamed Ibrahim Kamel Str., El Gouna, Red Sea, Egypt,
nikolaos.tzoupanos@tu-berlin.de,

Abstract

The purpose of this work is the evaluation and subsequent improvement of the overall treatment efficiency of the municipal wastewater treatment plant (WWTP) located in El Gouna, Red Sea, Egypt. The WWTP of El Gouna consists of three separated treatment units, all of them operating on the basis of the conventional activated sludge (with aeration) process and is capable of treating up to 3000 m^3 of sewage per day. Each treatment unit consists of three separated streams, whereas at one of the streams of each unit, biofilm carrier material has been added in the aeration tank. The treated water is used to cover partially the irrigation needs of El Gouna.

For this purpose, the following parameters were continuously monitored during a period of 5 months: In the main inlet and outlet samples the parameters pH, conductivity, temperature, COD, BOD, solids (total, suspended, dissolved), nitrogen compounds (i.e. NH_4-N, NO_3-N, NO_2-N, total N) and

phosphorus. Additionally, dissolved oxygen, MLS, MLSS and the respective volatiles and the sludge volume index (SVI) were determined in the samples from the aeration tanks. For comparison reasons, samples were taken also separately from the direct outlets of the aeration tanks with and without carrier material. Several elements were also determined in selected samples (Ca, Fe, K, Mg, Mn, Na).

The results were used to evaluate the WWTP's treatment efficiency as well as its response to the seasonal variations of the total number of visitors in El Gouna and of the ambient temperature. The aim of this is to optimize the WWTP's operation according to seasons. High fluctuations were detected in the effluent quality and several measures were considered and proposed. The measures focused on the improvement of fats and grease removal efficiency, optimization of the aeration conditions and of suspended solids concentration in the aeration tanks and of the nitrification process. The Egyptian standards of water reuse for irrigation purposes were taken into consideration regarding the effluent quality. Finally, considerations were also made regarding the decrease and optimization of the energy consumption during treatment.