



Towards Sustainable Treatment and Reuse of Wastewater in the Mediterranean Region

Abstracts of Stakeholder Workshop presentations on the theme Changing the paradigm of wastewater reuse



Organized by the Lebanese University
at the Doctoral School of Science and Technology, Tripoli
on 25 July 2020

Citation:

AQUACYCLE. 2020. Technical Report 2020. Aquacycle, ENI CBC MED, Doctoral School for sciences and technology, Faculty of Public Health, Lebanese University, Tripoli Lebanon.

Welcome Message from Project Team Leader

Session 1 Introductory and Roundtable Session

- **The ENI CBC Mediterranean Sea Basin Program**
(Prof. Mohamad Khalil)
- **The importance of reuse of treated effluent in water scarce regions**
(Dr. Ahmad El Moll)
- **Nature based solutions for grey water recycling: Potential for cities in Lebanon**
(Dr. Yaser Abunnasr)
- **Scope of AQUACYCLE & Role of partners in project**
(Dr. Ahmad El Moll)
- **Outcomes from desk reviews, stakeholder interviews & SWOT analysis**
(Dr. Tawfik Al Naboulsi)

Session 2 The APOC Technology and Roundtable Session

- **Design & Development of an eco-innovative & cost-effective domestic wastewater treatment technology**
(Dr. Fatima Yahya)
- **The 3 demonstration units of the APOC technology**
(Dr. Tawfik Al Naboulsi)
- **APOC Technical Guide**
(Dr. Fatima Yahya)
- **Planned Training Events on the APOC Technology**
(Dr. Tawfik Naboulsi)

Session 3 AQUACYCLE WebGIS and Brainstorming Session

- **Prototype design of the AQUACYCLE WebGIS: an online decision support tool that is under development (Part 1 and Part 2)**
(Eng. Omar Nachar)

Welcome Message from Project Team Leader

The importance of reuse of wastewater in Mediterranean Region: Economic, social and environmental considerations

Honorable attendees, ladies and gentlemen,

Water resources are essential to all development activities, not only in terms of the quantity available but also in terms of quality. Population growth and high level of urbanization increases the number of water users and their use rates, which makes water resources ever more scarce and polluted. Changing rainfall patterns due to climate change exacerbate these effects in many regions of the world. Recycling and reuse is central to a circular economy approach and can provide important strategies for improving water supply through better management of wastewater.

On the other hand, water scarcity, due to material shortages or pollution, has become one of the most pressing issues globally, a matter of social, economic and environmental insecurity. There is no doubt that there are many techniques for treating wastewater with a view to reuse, but the choice of technologies must be based primarily on criteria which take local priorities and capabilities into account as well as the economic viability of regions with severe water shortages, high water tariffs and transportation costs.

Clearly, it has become necessary for the value of wastewater to be estimated and recognized as a "new" source of clean and suitable water for multiple uses, including the agricultural sector. The positive benefits of wastewater reuse are numerous and include improved agricultural production as well as a reduction in energy consumption associated with water production, treatment and distribution. In addition, there are significant socioeconomic and environmental benefits.

One of the most important objectives of the ENI CBC Med funded project AQUACYCLE is to promote the safe reuse of treated wastewater through the adoption of an eco-innovative, low-cost and environmentally friendly technology. In the agricultural sector, the technology is set to improve the conditions of a large group of farmers, and at the same this will be positively reflected in supporting the sustainable development goals in respect of water and sanitation.

Through this stakeholder workshop with a set of presentations as well as round table discussions, we pursue to discuss the importance of reuse of wastewater in water scarce regions and to improve water governance in the Mediterranean Region. We consider that this project brings the opportunity to provide innovative and environmentally friendly solutions to contribute to solving the sanitation problems in Lebanon. The planned demonstration unit (decentralized) of AQUACYCLE's eco-innovative wastewater treatment technology here in Tripoli, aims to showcase a clear example of the much needed transition to a circular economy through the conservation of natural resources and liquid waste management. We strongly believe this will contribute to innovation, economic growth and job creation through training courses on the new technology.

Needless to say that we are determined to communicate with all institutions concerned. We keenly look forward to cooperate with the municipalities and water institutions in addition to the respective ministries in Lebanon (Energy and Water, Agriculture, Environment, Health) to set standards and guidelines for the safe reuse of treated wastewater in the agricultural sector.

The concerted efforts between all actors in Lebanon is very necessary to solve the sanitation problems in the North Lebanon Governorate and all of Lebanon.

EIMoll Ahmad

Session 1 Introductory and Roundtable Session - Abstracts

The ENI CBC MED Programme

Mohamad Khalil, Faculty of Engineering, Lebanese University

Abstract

The mission of ENI CBC Med Programme is to take up the major development challenges by adopting a strategy based on 2 objectives: 1) Promote economic and social development and 2) Address common challenges in the environment. The Programme contributes up to maximum 90% of the total eligible budget costs of the projects, with a co-financing of minimum 10% provided at project level. At least 50% of the project budget must be dedicated to activities implemented in Mediterranean Partner Countries to encourage a real co-ownership of project outcomes. The four priorities of the thematic objective with respect to environmental protection, climate change adaptation and mitigation include Water Efficiency, Waste Management, Energy Efficiency & Renewable Energy, and Integrated Coastal Zone Management.

Keywords: ENI CBC Med, economic and social development, project budget, environmental protection, climate change adaptation, mitigation.

The importance of reuse of treated effluent in water scarce regions

EIMoll Ahmad, Faculty of Public Health, Lebanese University

Abstract

The Mediterranean Region is faced with common challenges: water shortages, climate change and untreated wastewater. In the first part of this presentation, these challenges are illustrated based on maps including: overall water risk, water stress, water depletion, drought risk, coastal eutrophication potential and untreated connected wastewater around the Mediterranean.

The second part of this presentation brings a focus on the AQUACYCLE case studies: North Lebanon Governorate, the Murcia Region of Spain and the Zaghuan Governorate of Tunisia. The importance of reusing treated effluent in these water scarce regions is illustrated by maps including:

- 1) North Lebanon Governorate: desertification, land use, water resources, wastewater treatment plant locations
- 2) Murcia Region of Spain: Desertification, location of wastewater treatment plants and water demand for agriculture
- 3) Zaghuan Governorate of Tunisia: Land use, water resources and agriculture areas.

Keywords: Wastewater reuse, Mediterranean Region, water scarcity, water shortages, wastewater treatment, circular economy.

Nature based solutions for grey water recycling: Potential for cities in Lebanon

Yaser Abunnasr, Department Head and Associate professor of Landscape Architecture and Planning at the Department of Landscape Design and Ecosystem Management at the American University of Beirut, Lebanon

Abstract

Nature based-solutions provide multiple benefits in cities. Green roofs, green walls, constructed wetlands provide ecosystem benefits that help clean water, reduce temperatures, increase biodiversity, and clean the air and many other benefits. Recycling gray water is becoming a mainstream of sustainability, yet highly engineered solutions are costly and energy intensive. Nature based solutions provide economically viable solutions to recycle gray water at the individual scale. This presentation introduces nature-based solutions as a novel approach to gray water recycling and its potential applications and opportunities for cities in Lebanon.

Keywords: Clean water, Biodiversity, Recycling gray water, cities in Lebanon.

Scope of AQUACYCLE & Role of partners in project

EIMoll Ahmad, Faculty of Public Health, Lebanese University

Abstract

The scope of AQUACYCLE is to address a set of challenges: water shortages (imbalance between water requirements and water supply due to population growth, urbanization and economic development), changing climate in Mediterranean region (lower rainfall and more extensive droughts), untreated wastewater (40% of cities are not connected to any wastewater treatment plant), economic slowdown (due to the reduction in investments and a lack of sufficient employment opportunities). These challenges are addressed in the AQUACYCLE project through the application of an eco-innovative wastewater treatment (APOC) system, thereby promoting the circular water economy by providing an alternative, supplementary source of clean water. Secondly, the project targets improved water governance through the active involvement of the local communities in the development of waste water treatment and reuse action plans, and finally, the project is intended to prepare the ground for future investment in the new technology, increase employment opportunities and stimulate the long-term endogenous economic growth. The benefits of the APOC system include low cost of operation due to the utilization of solar energy, the production of biogas and the minimization of the excess secondary sludge and production of a solid by-product (fertilizer).

The final part of this presentation brings the timeline of the project activities and the role of the 7 partners from 5 countries in the project: Greece, Malta, Spain, Lebanon, and Tunisia and the 4 associate partners: PPCR (Greece), CNRS (France), AESVT (Morocco), SEAAL (Algiers). The role of the Lebanese University team in the AQUACYCLE partnership is summarized in three points: Communication, WebGIS and APOC System, Control and monitoring of the APOC system.

Keywords: Challenges, water shortage, changing climate, untreated water, economic slowdown, timeline, partners, associate partners.

Outcomes from desk reviews, stakeholder interviews & SWOT analysis

Tawfik Al Naboulsi, Lebanese University

Abstract

The SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) of the local Governance Framework is based on a desk review of studies and available reports, and interviews with representatives of the public authorities involved at the national, regional and local level. The analysis was conducted for the three locations where the eco-innovative wastewater technology brought by the AQUACLE project are planned to be demonstrated: Lebanon, Spain and Tunisia.

The SWOT analysis has been carried out around three main themes: 1) the current situation with respect to wastewater treatment and sanitation, 2) the current situation with respect to wastewater reuse and 3) the steps or initiatives taken to address the identified challenges.

To start with, the presentation brings into focus the main stakeholders in the AQUACYCLE project and of the national policy context in Lebanon, Spain and Tunisia. This is followed by the elaboration of the outcomes of the semi-structured questionnaire that was employed to organize the stakeholder interviews.

Finally, the outcomes have been employed to develop a strategy addressed to each of the case studies, including a dedicated strategy for Lebanon.

Keywords: guideline, irrigation, SWOT analysis, wastewater, stakeholders, training, government, community.

Roundtable 1

The first roundtable invited the participants to share viewpoints on how to change the paradigm on wastewater reuse. The discussion was opened with the question:

What in your opinion, are the main challenges faced to increase the reuse of treated effluent in Lebanon?

Session 2 The APOC Technology and Roundtable Session

Design & development of an eco-innovative & cost-effective domestic wastewater treatment technology

Fatima Yahya, Lebanese University

Abstract

This presentation focuses on domestic wastewater treatment technologies in which the APOC system is compared with conventional technologies. The latter includes pre-treatment, primary treatment, secondary treatment, and tertiary treatment, and sludge treatment either by thickening, or anaerobic digestion. The APOC system distinguishes itself from these conventional technologies by its simplicity in design and construction and its low cost in terms of operation and maintenance. The APOC system comprises three compartments: anaerobic digestion as secondary treatment, constructed wetland as tertiary treatment, and photocatalytic oxidation as post treatment. The main benefits of the APOC system include: production of a clean water (final effluent) that is reusable and safe for the environment, utilization of solar energy, the potential to generate biogas and the minimization of excess secondary sludge which can be used for land fertilization. Moreover, the APOC system can be implemented using local skills and know-how to provide context-specific sanitation services and obtain optimum system efficiency.

Keywords: conventional wastewater treatment technologies, APOC system, anaerobic digestion, constructed wetland, photocatalytic oxidation.

The 3 demonstration units of the APOC technology

Tawfik Al Naboulsi, Lebanese University

Abstract

This presentation focuses on the administrative geolocation of the 3 APOC demonstrations units: North Governorate of Lebanon (Melloule – Saky Shmeli demo unit location), Murcia Region of Spain (planned constructed wetland at Blanca wastewater treatment plant), and Zaghuan Governorate of Tunisia (Bent Saidane demo unit location). The presentation also draws the attention on some aspects to be considered such as: COD Average Efficiency Removal, SS Average Efficiency Removal, Organic matter containing sludge, and sludge Destiny (as fertilizers).

Keywords: Wastewater treatment, Demo plant, Melloule, Blanca, Bent Saidane, COD, SS, sludge.

APOC technical guide

Tawfik Al Naboulsi, Lebanese University

Abstract

This presentation introduces the technical guidelines covering each component of the APOC system: anaerobic digestion as secondary treatment, constructed wetland as tertiary treatment, and photocatalytic oxidation as post treatment. The APOC technical guide includes specific chapters detailing the advantages and limitations of the system, design (general considerations, design equations), construction (general considerations, materials), operation & maintenance (range of operating conditions, maintenance guideline). Furthermore, the guidelines include a review of: 1) five types of anaerobic digestion reactors applied for domestic wastewater treatment, 2) a classification of constructed wetlands based on water flow regime and vegetation type, 3) the difference between wastewater treatment processes (physical, chemical, and biological) occurring in constructed wetlands, and 4) a description of three types of constructed wetlands frequently applied for domestic wastewater treatment.

Keywords: technical guideline, APOC system, anaerobic digestion, constructed wetland, photocatalytic oxidation, general considerations, operation, maintenance.

Roundtable 2

The second roundtable invited the participants to share their needs and expectations with respect to the eco-innovative APOC system.

The discussion was opened with the following two questions:

What are your expectations from the APOC system, from a technological perspective?

What are your expectations and training needs on the APOC technology?

Session 3 AQUACYCLE WebGIS and Brainstorming Session

Prototype design of the AQUACYCLE WebGIS: an online decision support tool that is under development (Part 1 and Part 2)

Omar Nachar, Lebanese University

Abstract

The first part of this presentation brings a brief introduction to Geographic Information Systems (GIS) and examples of its main applications of use are followed by the prototype design of the AQUACYCLE WebGIS, which employs the Open Data Cube (open access software) and its proposed functionalities.

The second part brings an example of criteria which could be used to define optimum reuse of treated wastewater for the Blanca case study in Spain.

Keywords: GIS, WebGIS platform, Open Data Cube. Use case scenario, Lebanese data, maps.

Brainstorming

The brainstorming session invited participants to provide feedback on the proposed design of the AQUACYCLE WebGIS and how it could be improved to serve their needs and expectations. The session also provided the opportunity for the Lebanese University team to invite participants to discuss which of the proposed data information layers could be available in preferably digital format.