European Union's Horizon 2020 research and innovation programme

Project title: Self-Sustaining Cleaning Technology for Safe Water Supply and Management in Rural African Areas

Project Acronym: SafeWaterAfrica

Research and Innovation Action, Grant Number: 689925

Project duration: 2016-06-01 – 2019-11-30

Summary Report (public)

1 Summary of the context and overall objectives of the project

In the Southern African Development Community (SADC), more than100 million people have limited or even no access to clean water. The overall goal of the SafeWaterAfrica project was to research and develop an autonomous and decentralized "Made in Africa" water treatment system for rural and peri-urban areas which is highly efficient in the degradation of harmful pollutants, and which is accepted by the members of rural communities. The system was to be designed to provide 300 people in rural areas with safe water.

The project represented a consortium of European partners from Germany, Italy and Spain, providing European knowledge on new technologies for water purification. Academic and industrial partners from South Africa and Mozambique completed the project consortium by adding knowledge on additional technologies and system integration.

An integral part of the solution is a new European water treatment technology based on the energy efficient production of strong oxidants, produced electrochemically from the water, called "CabECO". It does not need additional chemicals for the effective degradation of persistent organic pollutants as well as for killing pathogens.

2 Work performed and main results achieved

Two sites for the build and installation of the two SafeWaterAfrica Demonstrator units were selected, one in South Africa (Waterval, Klip River) and one in Mozambique (Ressano Garcia, Incomati River). A year-long seasonal water quality footprint for both rivers was designed and performed. In addition, stakeholders were identified and hosted at four stakeholder engagement events held in South Africa, Germany and South Africa.

The design of the electrodes for the CabECO cells and operation parameters to be used in the prototype and in the Demonstrators were developed. The research highlighted the importance to add pre-treatments to the CabECO cells to guarantee an efficient continuous operation and to reduce the risk of fast aging and fouling of the electrodes. The CabECO cells have been tested and calibrated in tap water and reverse osmosis water, with the monitoring, control and operation philosophy. In addition, a modified version of CabECO is integrated in the SafeWaterAfrica system to produce residual disinfectant in the product water by oxidizing inter alia naturally occurring chloride to hypochlorite.

The design of the prototype took into consideration typical water qualities from different sources in South Africa and Mozambique. The building of the prototype was completed and commissioned on the site of CSIR. The remote operation monitoring system of the prototype was developed and installed. The system displays all data received from the prototype in an easy to read manner, measures the water quality and assures the effective operation of the installations, taking into account the legislation of both South Africa and Mozambique. An investigation program to operate the prototype, including all technology modules such as

chemical coagulation, flocculation and filtration, the novel pre-treatment technology electro-coagulation and electrochemical disinfection in different process parameter constellations has been performed. The results of these extensive tests were used to design the Demonstrators.

The final design for the first Demonstrator for South Africa has integrated different process units, including a novel pre-treatment in a pre-disinfection column as well as disinfection with ozone produced with the CabECO technology. The Demonstrator has been built and installed at the test site near the Klip River. Malfunctions of the Demonstrator are detected during operation and measures to secure correct operation in the field tests have been taken. A re-engineering for the installation in Mozambique led to building of a slightly modified Demonstrator, which also accounts for the less-contaminated raw water of the Incomati River. The Demonstrator at the Klip River was in operation for 14 months, producing water according to WHO and SANS 241 standards. The same is valid for the Demonstrator at the Incomati River, however, because of delays it was in operation for about 6 months. The Demonstrator at Klip River was also used to demonstrate direct reclamation of final wastewater effluent, removing a wide range of micro-pollutants.

Demonstrator 1 in Waterval, South Africa, powered by solar panel

Demonstrator 2, placed in the village of Ressano Garcia, Mozambique

Student process controller, operating Demonstrator 1, South Africa

Student process controller, operating Demonstrator 2, Mozambique

To disseminate the results and to identify potential partners for exploitation, the consortium contributed to ten conferences and one industrial fair, published nine scientific peer-reviewed papers, organised eleven workshops and published various press releases, news and videos, for example a Futuris video published by Euronews (link).

Extensive work has been done on market research and product design for marketable SafeWaterAfrica systems. These activities resulted in cost calculations for the systems and business models for the roll-out of the technology. Business models include the addressing for different market segments as well as different financing models. Different interested parties from public and private sector from the partner countries as well as third countries have been identified. Negotiations with interested parties are ongoing. The Demonstrators will be operated after the end of the project on the basis of project financing.

The SafeWaterAfrica solutions are integrated into undergraduate courses, postgraduate projects, and project developments at the academic partners. For capacity building, students were involved in the installation and operation of prototype and Demonstrators.

The coordinator took all measures to keep the project running well, concerning the progress as well as concerning all legal, financial and reporting aspects. Delays occurred for the installation of the two Demonstrators. However, these delays did not have a significant effect on the results, as the Demonstrators have been operated for up to 14 months.

To minimize the risks to research participants, safety rules from the participating countries were collected. To comply with the ethical standards of H2020, a thorough analysis of documents about ethical aspects in research was performed and the results integrated into the training of the operators of the Demonstrators.

3 Progress beyond the state of the art and potential impacts

The two jointly developed Demonstrator systems for autonomous water purification using integrated technologies from Africa and Europe are successfully producing water according to WHO and SANS 241 standards. The construction, installation and operation, completed by South African partners, has great benefits against imported solutions. These benefits are:

- adaption to local needs and markets,
- involvement into and deep understanding of the solution (no black box),
- increased acceptance, responsibility and ownership,
- local business and job opportunities.

The system solutions based on SafeWaterAfrica will produce high quality water under controlled conditions. This water will be safe for consumption which is not always the case for decentralized water supplies in the SADC countries. It will thus improve the health situation and promote social well-being.

The impact for the European partners is based on the securing and creation of sustainable jobs, in the broadening of technological knowledge in the field of carbon-based coatings, in intercultural business experience, and in African-European scientific cooperation. The project already led to future cooperation in the field the Water-Energy-Food nexus.

4 Address (URL) of the project's public website

https://safewaterafrica.eu/

5 Beneficiaries

- Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Fraunhofer Institute for Surface Engineering and Thin Films IST, Germany (Coordinator)
- CONDIAS GmbH, Germany
- Università degli Studi di Ferrara, Italy
- Universidad de Castilla-La Mancha, Spain
- Advance Call Pty Ltd, South Africa
- Virtual Consulting Engineers VCE (Pty) Ltd, South Africa
- Tshwane University of Technology, South Africa
- Stellenbosch University, South Africa
- Council for Scientific and Industrial Research, South Africa
- Salomon LDA, Mozambique