

1 Executive summary

Diseases caused by bacteria, viruses, fungi and other parasites are major causes of death, disability, and social and economic disruption for millions of people. Water is an important environmental source and agent for transmission of many of these pathogens. The **AQUALITY** solution is an online water monitoring device for microbiological contamination analysis, that allows industries and environmental protection agencies to replace the routine activities of sampling and laboratory testing of pathogens. The new system is able to real time monitor the quality of industrial process water and effluents basing on an opto-ultrasonic device and on a lipid-based diagnostic kit. To realize the device, the focus of the first project period was on the conceptual design and development of the single components. During the last phase of the second project period, the AQUALITY consortium dedicated its efforts to the system integration and verification.

Starting from the analysis of the User and System requirements, the technical specification of all the components have been defined on the base of the requirements and specification set up by the beneficiaries and end users. **The final architecture of the AQUALITY system has been drawn.** The main components of the system are: the mechanical layout; the Ultrasound Unit; the Optical Unit and the Control system. Thanks to the effort dedicated to this delicate phase, the following steps of design, development and integration preceded with less risks and uncertainties, permitting to recover the extra time invested in this phase and, above all, permitting to have an integrated device able to measure and detect bacteria.

The part of the AQUALITY project concerning **liposomes** was driven by the CNR and involved efforts in three main activities: synthesis of lipid components (positively charged lipids) to engineer liposomes and make them more sensitive to the interaction with bacteria; formulation and characterization of liposomes and evaluation of the liposome/bacterium interaction. Two liposomes formulations have been developed, composed of the natural lipid DOPC, a cationic surfactant and the fluorescent probe umbelliferone, suitable to be efficient nanosensors to be integrated in the AQUALITY device.

The **system integration** was led by LABOR, with the support of CNR and USOUTH. The main output of the activities performed was the integrated AQUALITY device. The system can be considered made up by two main subsystems: the hydraulic and the electronic (control) with their external interfaces which permit the integration of the two subsystems in the complete prototype. After the system integration, the system has been tested at lab scale. The purpose of the initial AQUALITY prototype system tests is to verify the overall system functionality and to perform tests with calibration beads. As first step, each single component was tested separately. Then, new tests with the entire system were performed. These tests were needed to verify that every single operation ran with the others in the correct way. Therefore, these were a verification that the hydraulic system worked properly. These were necessary also to verify that the phases of loading and discharging of all liquids in tanks ran properly. **In conclusion, the hydraulic system worked properly and the results reported were coherent with the input.**

Finally, the prototype was finally ready to be installed on site (Norway) for the **final tests and validation**. The pilot project will be set up for demonstration purposes in Norway at ROROS water treatment plant. In this task TI will take care of the installation of the AQUALITY online monitoring system at ROROS plant. TI will be the responsible, in this task, of realizing the report on the installation and will take care of validating the system and of granting the possibility, for ROROS, to remotely monitor its facilities through AQUALITY technology. The activity includes test run and training session as well as preparation of instruction manual for the operator of the AQUALITY prototype. The results of the testing and operation of the AQUALITY system for a 3 weeks period has been evaluated and the results from of the microbiological parameters is compared to water samples analyzed at an accredited laboratory. In addition, the system validation includes identification of key provisions according to Norwegian legislation (“Drikkevannforskriften”) with regards to water quality and monitoring program. Existing practices and costs for water quality monitoring at Rørosmeieriet and Røros Water Plant have been also identified and described.