Aquavalens Project

"Protecting the health of Europeans by improving methods for the detection of pathogens in drinking water and water used in food preparation."

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Deliverable D11.3

Implementation of Pilot treatment stations in selected locations

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EXECUTIVE SUMMARY

The construction and implementation of the Treatment Stations at Small Supply Systems is strictly related to the promotion of a better microbiological water quality to the served population. Furthermore, it is of great importance to evaluate which is the impact of the implemented solution on the small systems population.

Three different Small Sites were selected to install the Treatment Stations within two countries (2 stations in Portugal and 1 station in Serbia). In order to identify and choose the Small Sites location selection criteria was established and implemented. This criterion relied mainly on bad water quality and on how it affects the population.

This report describes how the three customized Treatment Stations were engineered, constructed and how they are being implemented on selected sites.

The water for microbiological analysis is automatically sampled and triggered by turbidity measurement, in addition to the routine sampling (also automatically) ones. Meaning that each time an event occurs (turbidity reaches the defined maximum value), water is sampled and technical people is informed to collect the sample and microbiologically analyze it. The daily information about all the monitored parameters (pH, chlorine and turbidity) is available at a web-based platform at www.diveil.com.

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Implications of the results of Deliverable Report 11.3

Implications of the results for the Work Package (WP 11)

This deliverable explains how the Small Sites locations were identified and discusses what is the water problematic on such small systems. A description of the Treatment Stations and their customization to the three chosen sites is presented. The sampling modes, the monitored parameters and the data logging are also explained. The performance of the Treatment Stations are very important to the WP11 since they will allow to further understand and study the water microbiological quality before and after treatment and to link such results with monitored parameters like turbidity. It will also contribute to further evaluation of the needs, perceptions of the population regarding water problematic.

Implications of the results for this Cluster 3, Small Systems – Pathogen detection in small water supplies across Europe

The output of this Deliverable is very important to Cluster 3 since it delivers the Treatment Stations and describes the strategy used to determine how these systems can contribute for the minimization of the risk for public health on the scope of the Small Systems. Furthermore, turbidity will be monitored online in order to trigger water sampling. Turbidity appears a strategy to indicate about poor microbial quality of the drinking water. Being so, this deliverable report will also be important to for Cluster 4 within the scope of human health protection and water safety Plan.

Implications of the results for the whole project

This is an important deliverable for Cluster 3, WP11 and the whole consortium because it delivers the systems and information which can effectively contribute for the improvement of the microbial water quality in Small Sites. This solution is completely aligned with the WHO guidelines and presents itself, not only as a traditional disinfection Treatment Station, but as an integrated approach for water quality problematic. Within these integrated approach, treatment (physic and chemical) is strictly linked to online, in real-time monitoring, and sampling. The integration of such key features and the outputs from it will also be crucial information of Cluster 4.

Indicate key external stakeholders interested in the results of Deliverable Report 11.3

This report will be of interest to the FP7 programme, other (EU) projects involved in health, drinking water, and fresh food, and those involved in the regulation of these subjects, at national or European level.
It will also be very important to evaluate if the online measurement of turbidity can indeed be an indicator for microbiological contamination. WHO already recommends turbidity as an indicator for such contamination, and within the scope of the AQUAVALENS it will be very important to understand if automatically sampling triggered by turbidity can be an improvement regarding discrete sampling.
A successfully Treatment Station implementation will also benefit the local communities who are highly affected by the microbial problems in the water.

Which internal partners should your deliverable be sent to

All the 39 internal partners in Aquavalens should receive a copy, it will be particularly important to those active in Clusters 4. This report will help with dissemination planning.

1. PRELIMINARY WORK – MAIN PROBLEMS ENCOUNTERED AT SMALL SYSTEMS

The main goal of the Treatment Stations construction and implementation is to provide water in proper microbial conditions to the Small Systems habitants. A preliminary work was conducted in order to choose the places to install the Treatment Stations. This work, which involved several AQUAVALENS partners, National Regulatory Entities, Local Authorities and Small Systems population, allowed to find out the main issues regarding the water problematic:

(a) the major problem associated with water quality that is perceived by the populations, is related with the weather seasonality - both during floods and extreme dry weather;

(b) in many populations, there is no information about their water supply systems (these information often relies on old people knowledge);

(c) in some cases, the raw/ source water is stored in tanks which are very dirty (biofilm, dead animals like mouses or birds, algae, mud, etc) – like **Figure 1** from a small population area in Serbia;

(d) other rely on very rudimentary disinfection systems, which are fully dependent on man work to manually correct (most of the time retroactively) and adjust the necessary precautions;

(e) generically, both local authorities and habitants, are aware of the water related problems, although it is not easy to find documentation which supports such problems (e.g. hospitals report);

Furthermore, during this preliminary work it was possible to identify the main constraints for the Treatment Station implementation:

(a) lack of electricity;
(b) small number of population (many inferior of 10 persons);
(c) lack of local means to construct the infrastructures which support the equipment.

Figure 1: photos from the water distribution tank and the distribution network for the houses from a small population in Serbia (it is not perceptible from the photo of the tank but it had a dead mouse on the water)

2. SMALL SITES LOCATION

The preliminary work was also very important to define the criteria that would be used to select the places for Treatment Stations implementation. This criterion relies on the following items:

(a) Placed in an urban population area with no water disinfection or with deficient disinfection programs;

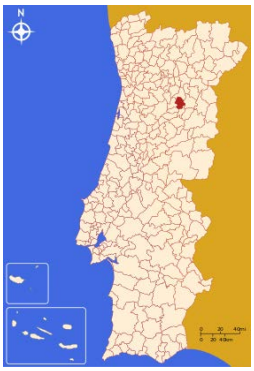
(b) With evidences that the population is being negatively affected by the lack of proper disinfection systems; this evidence is most of the time based on the report of the different intervenient in the water supply chain (local authorities, habitants, regulatory authorities, etc);

(c) The following constraints were also introduced in order to allow an uniformity between the different sites considered, which allowed a subsequent comparison on the efficacy of the disinfection:

   a. Number of habitants: 40 – 60;
   b. Electric supply (220 V) and 3G connectivity for telemetry purpose;
   c. Implantation area of 10 m^2;

Based on these criteria the chosen locations are: 2 sites in Portugal and 1 site in Serbia.

@PORTUGAL



Colherinhas belongs to Aguiar-da-Beira municipality. Aguiar-da-Beira has an area of 203.68 km^2 with approximately 5500 habitants (2011) divided into 10 parishes. Colherinhas has 40 habitants and after the water capitation it has a treatment spot with Sodium Hypochlorite, which is very fragile and needs constant technical supervision and adjustment. The worst scenarios are observed on floods or very dry weather (this region is very hot in the summer).

Trancoso (Torres) belongs to Trancoso municipality. Trancoso accounts for 10 000 habitants distributed by an area of 364.54 km^2 and divided in 21 parishes. Torres has around 40 habitants, but in the summer the local populations might be around 60 people. The water is taken gravitically from the source to a concrete tank (placed in the ground) where it is stored and served the population without any chemical or physical treatment.

Both Trancoso (Torres) and Aguiar-da-Beira (Colherinhas) belongs to Guarda District – which is signed in red in the map of Portugal.

@SERBIA

The Treatment Stations will be places in a local population in the city of Svilajnac. Svilajnac (signed in red in the map of Serbia) is a town and

municipality located in the District of Pomoravlje with around 9 100 habitants. In this specific local, population is around 30 people, with some fluctuations in Summer time. The water in this small population aggregate is gravitically taken from its source on the mountain and distributed to the habitants with no chemical or physical treatment.

3. TREATMENT STATIONS

The Treatment Stations were engineered and designed in order to have an efficient disinfection performance, with low maintenance (due to the local limitations) and with incorporation of an indicator parameter of the water quality which will trigger water sampling.

3.1 Physic-chemical treatment

The Treatment Stations comprises the following unitary steps:

a. Oxidation of the organic matter, iron, manganese, etc and pre-disinfection of the water source;
b. Water filtration, for oxidized matter and suspended solids reduction;
c. Storage of the filtered water; with measurement and adjustment of the chlorine residual;
d. Distribution of the water to the served population;

The systems were designed for a peak consumption of **0.15 m^3/ h/ habitant**.

3.2 Treatment Stations Configuration

Following what was described on point 1 regarding the lack of local conditions to fulfill the needs of the Treatment Stations a strategic decision regarding the sites construction was taken. Two of the sites (Serbia and Trancoso) were assembled in a sea container relying in an almost plug-in plug-out approach. Without this approach, there was a very high risk of not having local conditions which allowed the Stations to work properly (or even being installed). For Colherinhas, the Treatment Station was built in a skid configuration, which also easies the implementation, maintenance and if necessary. These approaches harmonize the integration of the different elements of the Treatment Stations (like pumps, sampling, telemetry, hydraulics, etc) since they are based on a logic that eases interconnections at the places and minimizes eventual interventions.

3.3 Monitoring, Water Sampling and Data Logging

The Treatment Stations are prepared to monitor the following parameters from the water: turbidity, pH, chlorine (second phase). These parameters will allow a better understanding of the events that might occur on the source water and to fine tune the levels of chlorine in the treated water.

The systems comprise two sampling modes: programmed sampling and event sampling. In the first mode, the system is programmed to periodically sample water (according to the sampling program).

The event sampling relies on the continuous monitoring of turbidity which is the triggering parameter. This means that if the measurement of turbidity is above the defined set-point, it will perform a non-programmed sampling of the water which is entering the system and alerts (via Diveil webpage for Serbia, and via Text message for Portugal) the responsible for the site management (from AQUAVALENS) to proceed with the microbiological analyses. The turbidity set-point is defined for each site according to their specificities in terms of total (organic and inorganic) suspended solids.

Each of the 3 systems is equipped with telemetry systems, which allows that the information is being continuously monitored (and gives an alarm if any parameter is below or above the defined and expected ranges) and daily registered at the webpage: www.diveil.com. With a specific username and password the users can access the information of the sites.

3.4 Alignment with World Health Organization Guidelines (WHO)

The approach described in points 3.1 and 3.3 are fully aligned with the WHO Guidelines for drinking water. According to such recommendations (WHO Guidelines for drinking Water quality, 4th edition, 2011) states that:

(a) '*Although turbidity per se is not necessarily a threat to health, it is an important indicator of the possible presence of contaminants that would be of concern for health, especially from inadequately treated or unfiltered surface water. Data are emerging that show an increasing risk of gastro intestinal infections that correlates with high turbidity and turbidity events in distribution. This may be because turbidity is acting as an indicator of possible sources of microbial contamination'*. Moreover, these parameters will be continuously monitored and data logged and turbidity will be used as trigger for water sampling;

(b) '*Turbidity can seriously interfere with the efficiency of disinfection by providing protection for organisms, and much of water treatment is directed at removal of particulate matter before disinfection'*. The Treatment Stations were designed for a high disinfection performance relaying on automatic filters (with automatic operation and backwash) and on integrating all the collected information like the indicators mentioned in point (a);

(c) *'The parameters selected for operational monitoring should reflect the effectiveness of each control measure, provide a timely indication of performance, be readily measured and provide the opportunity for an appropriate response. Examples include measurable variables, such as chlorine residuals, pH and turbidity'*. The Treatment Stations operationally and control are based on this idea of measuring the raw water quality and adjust the systems performance automatically.

3.5 Two working phases

In order to be able to test the turbidity as a trigger for water sampling, as a potential indicator of water microbiological troubles, the Treatment Stations are ready to operate in two distinct modes.

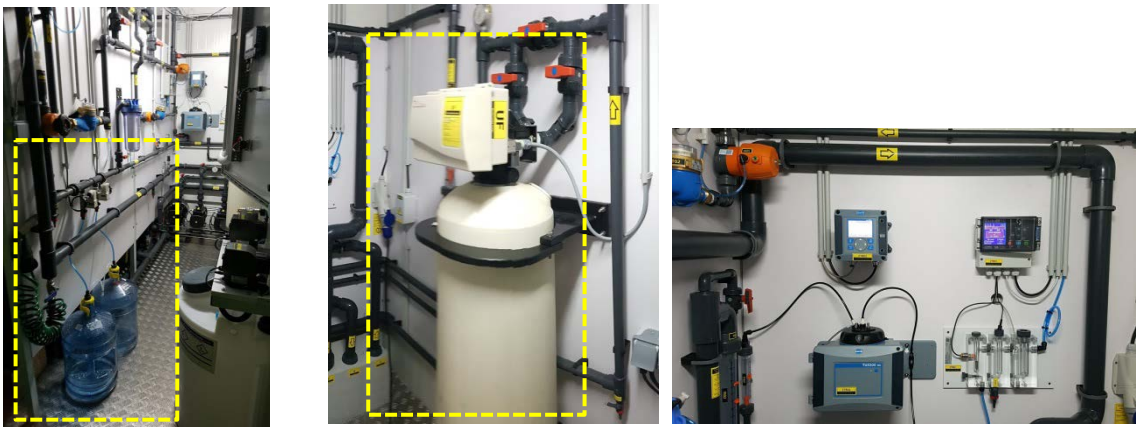
- 1rst phase (around 4 months): no source water is treated (disinfected); the system is set to monitor pH and turbidity and to perform the sampling procedures;
- 2nd phase: in this phase, the disinfection mode is turned ON and the raw water is disinfected according to the steps previously mentioned;

3.6 Photographic Information

An album with the several photos from the disinfection system construction for the several sites can be found at (this album will be updated along with the evolution of the work and with relevant photographic information): https://goo.gl/photos/joguJ2B9onNA7PHa7

Relevant photos regarding: (a) Treatment Station engineering, (b) on the instrumentation, filtration and sampling and (c) on the transportation and reception of the Stations are presented, respectively in Figure 2, 3 and 4.

Figure 2: overview of the construction steps of the Treatment Stations that was engineered to Trancoso (TORRES) site



Sampling Unit (2 sampling bottles of 5L/each for event and programmed sampling)

Filtration Setup

Turbidity, pH and Chlorine measurement

Figure 3: close view to the instrumentation (pH, chlorine and turbidity) and sampling systems of the Treatment Stations

Figure 4: overview on the transportation of the Treatment Station to Serbia [1] and on the reception at the final destination [2]

3.7 Information on the Treatment Stations implementation

The physical implementation of the Treatment Stations on site is still being accomplishes. Due to several problems related to weather, lack of infrastructure that support the Stations, etc the system are still being installed on the different Small Sites.

@ Serbia (Svilajnac) – the system was delivered on December 2016 and due to the very rigid weather conditions (very low temperatures and snow) it was yet possible to construct the concrete layer which will support the sea container and to make the holes to pass the tubing underground;

@ Trancoso (Torres) – the system was already delivered to Trancoso and it is also waiting for the construction of the concrete support; also the municipality is still arranging electricity;

@ Colherinhas – the system is still being engineering and will leave to the Small Site within two weeks;

It is expectable that the three systems will start to operate on the end of February.