

NEW TECHNOLOGIES FOR SAFE DRINKING WATER IN COLOMBIA

By Aude Gago



Fudación Humedales Team Trained to Maintain Filtering Unit



THE PROJECT AIMED TO INSTALL AND RUN A NEW WATER PURIFICATION SYSTEM ABLE TO SUPPLY 100% SAFE FRESHWATER TO 250 PEOPLE IN EL CHARCO.



El Charco

Water and Rural Areas in Colombia

Development in rural areas of Colombia can be very limited, poverty rate in 2012 was about 46.8% and extreme poverty was 9.1% (DANE). In those regions, sewage and aqueduct systems coverage is below 70%, and if there is any infrastructure already installed, the majority of it remains inoperative due to a lack of financial and/or technical capacities of most of the municipalities to fully maintain and operate the treatment plants for either water purification for human consumption or wastewater treatment. Water management in Colombia is a major infrastructural issue, a technical challenge that has to evolve to become a climate change adaptation strategy, minimizing impact on water sources and therefore maximizing their availability, quantity and quality. It is for that reason that Fundación Humedales (Colombia) got involved in different initiatives, to offer, formulate and implement water purification for human consumption and waste water treatment systems that respond to the described situation. A successful example of how, simple, eco-friendly and cost-effective solutions can tackle the difficult reality that rural communities are facing concerning safe access to drinking water, was the joint project carried out with the efforts and will of the non-profit organizations Fundación Humedales (Colombia), Wilo Foundation and Global Nature Fund (Germany), and the private company Arisu (Germany) to provide fresh and 100% safe water, by using Arisu technology, to El Charco, a rural and remote village within the municipality of San Miguel de Sema, Boyacá in Colombia.

Challenge

El Charco is a small village located 15km northwest from the urban centre of San Miguel de Sema. Its population, described as rural, has low incomes and relies only on agricultural activities for their

livelihood. The influence area of the project includes 30 households, one primary school, a secondary school and a chapel. The schools, all together, receive up to 200 students per day, the main direct beneficiaries of the project. Further beneficiaries are the population inhabiting the nearby households (50 people), with a total of 250 direct beneficiaries.

In the past years, around 2000, a basic infrastructure was implemented to improve water quality for human consumption in El Charco. The treatment system consisted in one intake well collecting water from a natural spring, a desander, a trickle tower, two 10.000 liters storage tanks and a distribution network. The unit of disinfection with chlorine taps, installed between the trickle tower and the storage tanks, was in a very poor state to well-functioning.

This context reveals clear reasons why the inhabitants of El Charco have been facing problems related with water-borne diseases (especially coliform bacteria). The minimum required treatment for drinking water in Colombia is direct filtration and disinfection. In El Charco, no real filtration was made and if disinfection unit failed, as it has been the case, water-borne diseases risk increases, despite having a fairly good water quality in the source. Another factor to be considered was the high concentrations of iron in the spring that feeds the system.

The water from the spring contains iron oxide, typical of high-Andean groundwater because of pyrite dissolution and iron oxidation after contact with the atmosphere. Iron oxide accumulates in the filtering media clogging it at high rate. Besides, unusual iron concentrations in the water might cause kidney failure.

The challenge in Colombia is to find and provide low operational costs and easy to maintain systems. In rural areas, with rarely presence of professional labor and high restrictions in terms of maintenance, budgets do not allow the implementation of strategies that demand either of those requirements. That is why, facing the fact that in these little rural villages does not exist the possibility of a long-term functionality of conventional water treatment plants, compact water units as the one implemented by the partners, fit perfectly in the context of El Charco and in thousands of villages throughout the country. www.fundacionhumedales.org

Solution

The project aimed to install and run a new water purification system able to supply 100% safe freshwater to 250 people in el Charco as the pre-existing infrastructure was not totally functional, but delivering only partially treated water.



Arisu Aqua Compact 1000 Filter Unit



All Partners Carried Out Installation and Connexion of Filtering Unit

Before the intervention, Fundación Humedales and Arisu made several recognition journeys in order to design an implementation plan in which the installed infrastructure remained operative and complementary to the compact filtration and disinfection unit provided by Arisu.

Aqua Compact 1000 filter unit, Arisu's modified purification system consists in the pre-existing well, desander, the trickle tower and one of the two 10,000 liters storage tanks, from which raw water is pumped into the Arisu's disinfection water unit. Once the unit has concluded with the filtration and disinfection of water, treated water is transferred to the second 10,000 liters tank that directly feeds the distribution network. Within the treatment system the trickle tower functions as an iron oxide

trap, preventing clogging in the first filtering unit. The first 10,000 liters tank is equipped with a floating switch to turn of the pump when water level is too low and therefore preventing the malfunction of the pump. Downstream the pump there is a pressure control, when the filtering and disinfection unit stops working, pressure rises and the pump turns itself off. Moreover, the filtering unit has a floating switch that is activated when the second 10,000 liters tank is full, so no water is wasted by overflowing. Once deactivated, because of water consumption, the switch allows the purification unit to start again with a delay of 1 hour, so it does not start in a turn off and turn in loop when level in the second tank is close to the floating switch.

After an evaluation, the team decided to install a filtering and disinfection unit with capacity to treat 1000 liters per hour with an approximate operation time of 10 hours per day. The estimation of the volume of treated water required to fulfill the demand is based on a 100 liters daily consumption per inhabitant.

The installation of the new equipment was accompanied with a complete flush of the distribution network with a high concentrated chlorine dilution to prevent future bacterial grown in pipes and intermediate small size storage tanks.

No bacteria will flow in the network after the disinfection unit starts to operate, therefore, after the network cleansing, no bacterial growth should be presented during proper operation of the system.

Technical Description of Treatment Plant

After the evaluation of the water conditions in El Charco, various water purification technologies were taken into account and under assessment, being Arisu Aqua Compact 1000 the most appropriate for the characteristics of the location for several reasons:

- ▶ **Power Demand:** The village of El Charco has a basic electricity network, but the supply of energy is not very reliable and costly. Therefore the unit installed with an average energy consumption of 900 watt per hour (900 watt per 1000 liters of purified water) requires five less energy than a Reverse Osmosis solution with a similar output.
- ▶ **Operation and Operational Costs:** Located 160 km north of Bogotá, the requirement to operate any kind of water purification system without technical trained and educated personnel is important. Although the project manager of Fundación Humedales has been trained on-site, the treatment plant works automatically. Hence operational costs only include the provision of electricity. "Virtual" costs such e.g. the costs of losing fresh water for backwashing are also almost zero (99.9% of the raw water is processed into drinkable water).
- ▶ **Maintenance:** The staff from Fundación Humedales was trained on-site to with the capacities needed to exchange ware parts and maintain the water purification plant, including the activated carbon, the fine filter and UV-light.



Involved Community

The Arisu Aqua Compact 1000 system consists of six components, including:

- ▶ **Pre-Filtration:** Via a multi filtration process, pollutants are filtered out of the unprocessed water.
- ▶ **Electro-Chemical Oxidation:** By this process the water will be oxidized regardless of the respective substance class to carbon dioxide and water. The water will be completely detoxified. The electrolytic production of free chlorine reliably diminishes germ figures of microorganisms.
- ▶ **Depot-Bed:** With an extra depot-bed, the reaction in the reactor becomes more efficient.
- ▶ **Activated Charcoal:** Water is fortified with oxygen and hydrogen. The molecules are processed in an active carbon bed. The activated carbon causes absorption of pesticides, herbicides as well as hydrocarbons and chlorine.
- ▶ **Fine-Filtration:** Water is filtered via a 1 µm filter to remove the smallest particles in the cleaning process.
- ▶ **UV-Light:** Disinfection of the water by an ultraviolet-C-burner working with radiation frequency of 254 nm (100 % germ free).

Each component can easily be exchanged and accessed through the front door of the outer cabinet. No chemical dosing is needed, hence the system itself is very safe to operate and maintain.

The teams from Arisu and Fundación Humedales together with the community's support from El Charco, carried out the installation and connection of the water purification unit to the existing tanks and the water source.

The water flowing out from the installed purification treatment is totally safe for consumption, and fulfils most of the indicators in Colombian regulations for drinking water. However it has to be mentioned that residual and free chlorine parameters are not met because there is no chlorine dosage. Phosphates content is a bit higher and pH is more acid than expected, issue that will be solved by extending the treatment unit with two bottles of Everzit Phat and two bottles of Everzit Carbonat.

Parameter	Regulation Limit	Result
Total Alkalinity	200	50 mg/L
Aluminium	2	< 0,05 mg/L
Calcium	60	4 mg/L
Total Organic Carbon	5	3,16 mg/L
Combined Residual Chlorine	0	0,00 mg/L
Free Residual Chlorine	0,3 – 2,0	<0,30 mg/L
Chlorine	250	12 mg/L
Total Coliforms	0	0 UFC/100mL
Colour	-----	<5 UPC
Electric conductivity	1000	50 µS/cm (25C°)
Total Hardness	300	16 mg/L
E. Coli	0	0 UFC/100mL
Fluor	1	<0,05 mg/L
Phosphates	0,5	1,74 mg/L
Iron	0,3	<0,1 mg/L
Magnesium	36	1,46 mg/L
Manganese	0,1	<0,03 mg/L
Molybdenum	0,07	<0,01 mg/L
Nitrate	10	<0,44 mg/L
Nitrite	0,1	<0,023 mg/L
Smell	Acceptable	Acceptable
pH	6,5 – 9,0	4,98 pH units
Taste	Acceptable	Acceptable
Sulphate	250	<10 mg/L
Temperature	-----	18,2 °C
Turbidity	2	<0,30 UNT
Zinc	3	0,07 mg/L

As far as water analysis is available, the general set-up of these six components can be adapted individually. Nevertheless every solution has its limits, e.g.: salinity, nitrate or chemical contaminations like mercury should be treated with other technologies.

Not Only Access but also Water Management is Important

One of the major issues in Colombia is the difficulty of some rural municipalities to understand and apply the Colombian drinking water law. Fundación Humedales took the role of mentoring El Charco community and its leaders to get organized as a formal rural aqueduct. The process included the formation of a new aqueduct general assembly, the establishment of the rural aqueduct as legal participatory organization, the installation of electric power facilities assigned

exclusively to the rural aqueduct, and the request and approval of the water concession license from the environmental and sanitary authorities. The strengthening of social structures and reinforcement of participatory initiatives enabled El Charco community to be prepared and fulfill Colombian sanitary law, as well as to operate a complex system through planned contribution schemes designed by the rural aqueduct entity and established locally in their technical and administrative regulations.

Drink Water Supporters

With the common objective to provide safe drinking water to rural areas in Colombia contributing to poverty alleviation of those communities, multiple and fruitful synergies among different stakeholders made possible the implementation of the Drink Water project described. The local implementing partner Fundación Humedales (Colombia), Global Nature Fund (Germany), private company Arisu (Germany), the Germans foundations Wilo Foundation and Foundation Ursula Merz came together for the support of the project. Of particular importance have been the support, enthusiasm and the involvement and participation of the local community.

About the Author

Aude Gago holds a degree in Water Science and Technology from the Politech'Montpellier Engineering School with master expertise in Water Sciences from the same University in France. She finished her master's degree by doing an exchange at Universidad Católica del Norte (Coquimbo, Chile) where she specialized in environmental management, marine resources management and risk analysis. Aude has experience in integrated watershed management and wastewater treatment with green filters having worked in France, New Zealand and Colombia.

Fundación Humedales is a Colombian non-profit organization, dedicated to the stimulation of social processes directed to land use, ecosystems, and natural resources management, focusing on wetlands, Páramos and aquatic ecosystems in general. Fundación Humedales counts with strong scientific bases due to the long professional experience of its members on biology of conservation, ecology, biology of fisheries, environmental education, conflict resolution, and sustainable development.

To know more about the author and contributor, you can write to us. Your feedback is welcome and should be sent at: mayur@eawater.com.