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NVAqua®

An innovative water treatment system for the production of clean drinking water

Compact, ecological and mobile turnkey units for the treatment of surface water

1. Presentation

NVTerra, a company located in Monthey, Switzerland, has engineered NVAqua®, a water system to treat contaminated water, giving access to clean drinking water to people in remote areas. This innovative system is effective with various forms of pollution, economical, robust and simple to use and maintain. It consists of mobile and “ready to use” units, equipped with a remote control system that allows monitoring via internet as well as giving support to local technicians and users.

Our systems are particularly useful in small communities where water purification is unattainable or impractical, notably in developing countries, as well as in areas struck by natural disasters. In addition they produce, as “by product”, a disinfectant (bleach) that can be used or commercialized locally.

Finally, the installation of these units is part of a concept designed to create activities around the production and use of water. As soon as they are in production, training is given to local people to assure the functioning of the systems and a continuous delivery of clean water.

Beyond the treatment of water, NVAqua® presents an interesting ecological side because it does not use chemical products. It uses only salt, iron and electricity, with the small quantity of energy required being possibly generated on site by solar panels.

NVTerra first applied for a patent for its innovative technology in 1995, followed by new ones in 2009. A patent application for Europe, as well as an international one, are in the process of being filed. The inventor, Jean-Marie Fresnel, is an electrochemical engineer, who worked at the Battelle Institute in Geneva, at Alsthom, at Diamond Shamrock and at Eltech Electrosearch. He has registered several patents in different domains: batteries, bio-electrochemistry, materials, disinfectants and electrolysers.

Prototypes have been successfully tested in France, Greece and Switzerland. In Greece the prototype was installed on 4 different sites with very different water qualities. Local, regional and national authorities who visited these sites have shown a keen interest for the system and the results obtained.

NVAqua® and its concept were presented to the “Economic Summit on Africa” in Geneva in June 2002, with the support of the Foundation “Fonds d’Aide Internationale au Développement ”, to various conferences held in the UN center in Geneva in 1999 and 2000, organised by the NGO “ United Towns Agency for North South Cooperation”, and to conferences organised in Paris in March and September 2009 by the NGO “Think Africa”.

2. How does the innovation solve a particular problem?

The World Health Organization (WHO) reports that in some areas of the world, as much as 80% of all transmittable diseases are spread by consumption of contaminated drinking water. A staggering figure that is directly, or indirectly, the largest single human mortality factor. Nor is this situation isolated to one geographic area. It has been estimated that one quarter of the earth's population, that is more than a billion-and-a-half people, still do not have enough clean, safe drinking water for their daily needs. This shortage of clean drinking water has an additional impact upon the lives of many peoples. In many lands, much of each and every day is spent traveling to an uncontaminated water source, and returning heavily laden with what is needed for just that day.

The NVAqua® units can treat unsafe water from lakes, ponds, rivers, streams, wells or reservoirs and produce clean drinking water where people live, reducing or eliminating the water fatigue for women, young girls and children. The units can be installed on dry land but also on floating structures, an appropriate solution for people living along rivers or on flood plains or in lake dwellings.

The big challenge in terms of technological innovation is to propose a simple system, economical, robust and easy to use for the local population in order to ensure its longevity. NVAqua® combines all these elements with turnkey units, fulfilling the WHO guidelines for drinking water quality.

NVTerra provides different types of water treatment units depending on the needs of the local communities, the application and water source. For example, the NVAqua® UF-CA system pictured below, can produce 100’000 litres (27.000 gallons) per day.

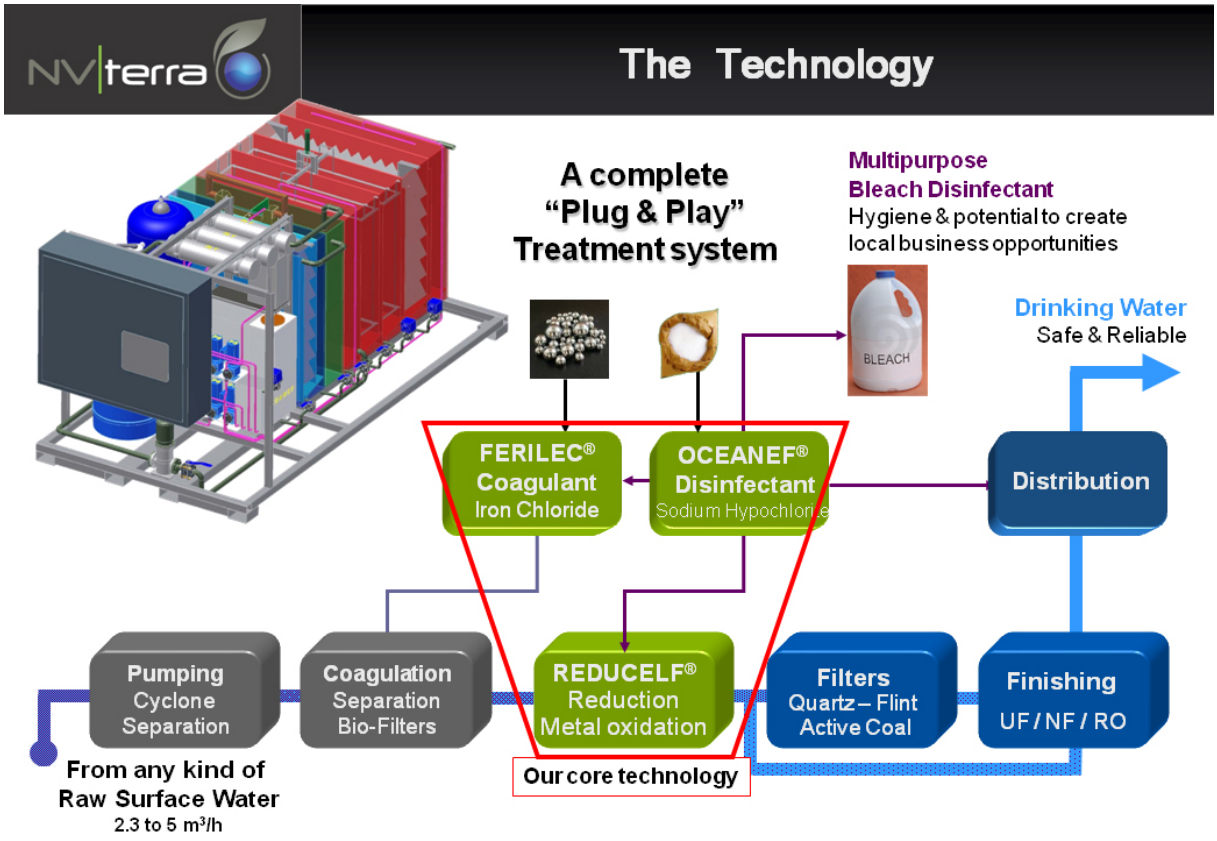
To treat unfit water and produce clean drinking water does not only mean disinfecting and filtering it to make it clear. The treatment process must be able to remove disease-inducing substances, such as viruses, bacteria or chemicals. It was one of the goals that the development team was pursuing when they started. Another goal was to build turnkey and easy to install units, tested before delivery and shipped in a container. There is then no complex pre-installation; it is possible to operate the NVAqua® unit directly into the container, converted and equipped with solar panels where appropriate. In this case only a concrete flooring, a delivery pipe for the unsafe water and an outgoing pipe for the drinking water are needed. In addition, the units do not require a sophisticated maintenance; NVTerra can train local technicians and assist them via the remote control system. As a result, the systems are well adapted to local needs and will be the foundation of a new life for the people and the catalyst for the creation of sustainable activities.

Once a NVAqua® unit is installed, the aim is to produce 30.000 litres to 300.000 litres of drinking water per day in order to distribute 30 litres of safe water per day and per person to communities of 1.000 to 10.000 inhabitants. The production cost of the water is low. It is in the range of 0.37 to 0.53 Euro per 1.000 litres of water produced, depending on the use or not of solar panels. It is an operating cost, including consumables, spare parts, local maintenance and remote assistance. Taking into account the depreciation cost of the unit, the total production cost for 1.000 litres of water is 1.28 to 1.59 Euro, depending on the type of installation and the amortization period. The local community is encouraged to organize and manage the production and the distribution of water, and to save money in order to be able to replace the production equipment after an operating period of 15 to 20 years. This strategy allows not only to provide healthy living conditions for people, but also to create sustainable activities.

3. NVAqua® in practice

The innovative technology NVAqua® offers a complete integration of the water treatment chain in easily transportable compact modules, based on the use of cheap and easily available commodities.
The basic process is based on filtration and electrolysis. It requires only salt, iron and electricity. Salt and iron are used for producing in-situ disinfectant (sodium hypochlorite) and coagulant (iron chloride). Through the different steps of coagulation, sedimentation, biological treatment, disinfection, oxydoreduction, sand filtration, activated carbon filtration, microfiltration and in some cases, depending on the composition of the water, ultra filtration or nano filtration or reverse osmosis , all contaminants are removed or brought down to levels below those required by the WHO and various national or international regulations. The amount of energy required is small and can be supplied by photovoltaic cells of solar panels.

In outline, the technology works as follow:

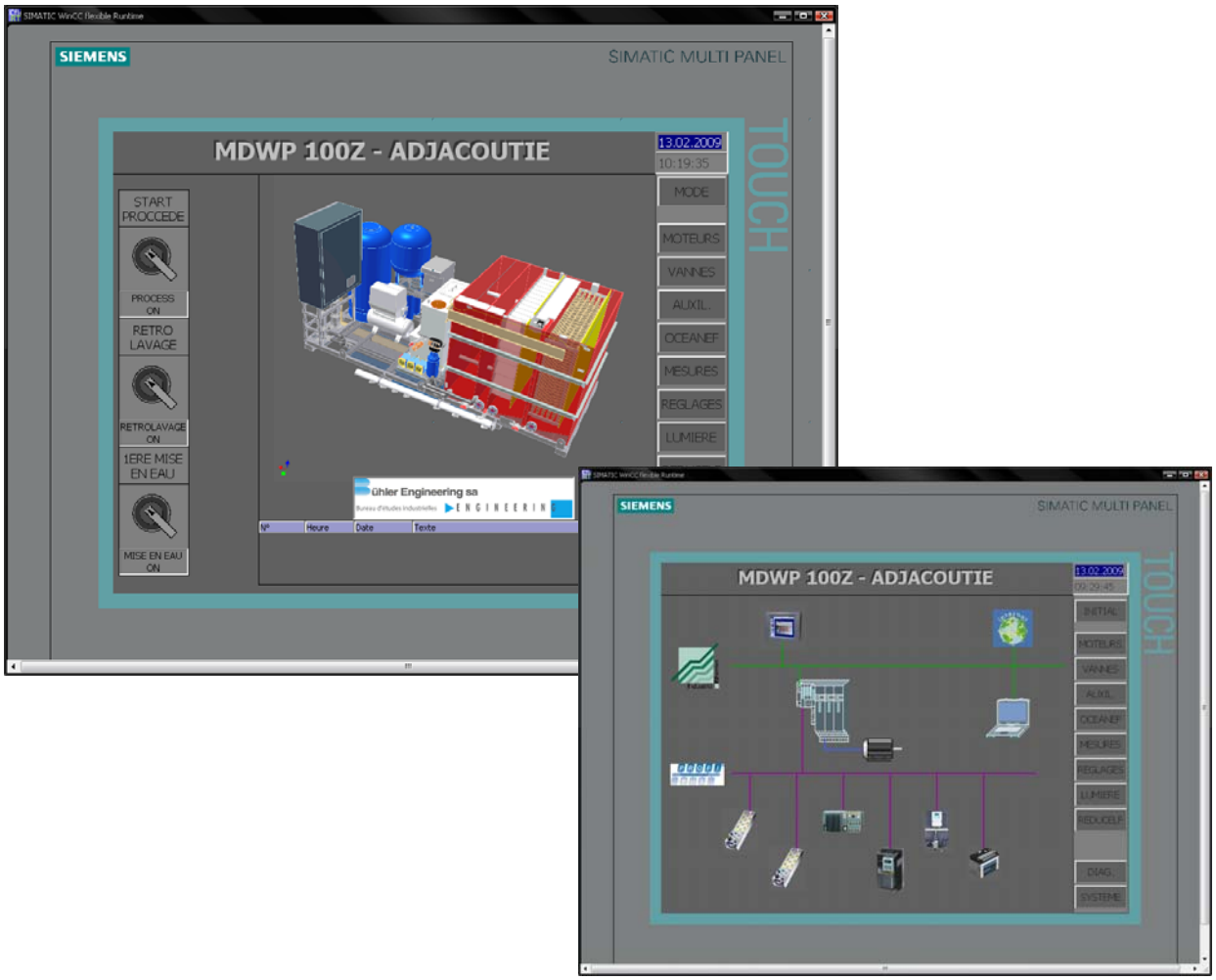


The mud resulting from the process is saved and can be used in agriculture in most cases, unless the treated water contained toxic contaminants (in which case the part of polluted mud is isolated). Trained staff on site is assisted in their maintenance tasks through the computer program that displays the progress of the operations and indicates the potential interventions. They are also assisted through the remote control system.

The development process has been long. The NVAqua® units meet the necessary economic and water quality requirements and, more importantly, have the appropriate technology to assure its perenniality. Indeed, after several discussions with the NGO representatives in the field, the concept NVAqua® has grown into a robust technology, adapted to hard conditions and fitted with a remote control to support maintenance. A technology poorly suited for these applications only ten years ago.

A long series of tests on prototypes have proved the reliability of the units and their efficiency in eliminating all kinds of contaminants that can be found in water: mineral compounds, phosphates, nitrates, arsenic, chromium, lead, biological contaminants, organic pollutants including fats and oils.

As already emphasised, one advantage of the technology NVAqua® is the low cost of the commodities, salt and iron, as well as the easiness to obtain, store and manipulate them. The possibility of using solar power and the production of disinfectant (bleach) to be used or commercialised by local people are additional benefits of this technology. It also has a feature that gives some people food for thought when it is made available to people in developing countries: it is a sophisticated technology using modern techniques and generating high quality products. In our society with mobile phones, the internet and satellite television, it is what everybody is looking for. It is for these people a mark of trust and respect to make available the best technology and train them so that they understand it, know how to use it and maintain it in good working condition.



4. What are the results?

Various tests and analyses were conducted in the past with water from rivers, ponds and lakes by the Institute Pasteur in Lyon (France) and the “Laboratoire Cantonal” in Sion (Switzerland). The results proved that the water is drinkable after treatment by the units.

Additional analyses were realised in June 2009 by the “Laboratoire Cantonal” in Sion and the laboratory of the company Cimo in Monthey (Switzerland), after pollutants and toxic contaminants were intentionally added to water from a canal in Monthey heavily charged with mud. The test results below, on samples taken only after the first two stages of treatment, show that the units are already effective in reducing concentrations of nitrates, phosphates, arsenic, lead and cadmium. The flow of raw water input was 4.550 litres per hour and its turbidity was 65 UT/F90°.
The following results were obtained:

Contaminants present or introduced in water	**Quantities contained in water input**	**Quantities contained in water after injection of coagulating sedimentation**	**Quantities contained after coagulation, sedimentation and passing through the bio filter**
- Germ aerobies mesophiles /ml	250	220	95
- Escherichia Coli U/100 ml	51	50	00
- Enterocoques - U/100 ml	180	160	02
- Arsenic ug/l	50	<0,01	<0,01
- Lead ug/l	110	<0,01	<0,01
- Chromium ug/l	200	132	95
- Cadmium ug/l	20	13	<2
- Nitrate NO_3^- mg/l	60	29	3,4
- Phosphate P mg/l	3,10	0,45	0,40
- Cyanide CN^- ug/l	60	<10	<10

After these first two stages of treatment, the following stages lead to clean drinking water according to the accepted criteria.

5. International Interest

To make possible a sustainable development in remote areas in developing countries, people must be healthy and have access to clean water. They must then have perennial water treatment installations, easy to use and maintain, as well as an easy and cheap access to the commodities required to operate them. Once drinking water is made available, then the encouragement of small scale artisanal production and agriculture makes sense. To achieve this, the whole concept includes the collaboration with the NGO working with local people and advising them in their choice of activities. For example the NGO “Think Africa”, whose mission is to help African people to develop sustainable activities, starts by teaching people the proper use of drinking water and of untreated water.
Two levels of training are proposed: a simple one made locally for the daily production and distribution of water, and a more sophisticated one for water inspectors, chemists and maintenance technicians who will be formed in a production center of NVAqua® units.
These different stages of the project have been requested and approved by the representatives of local authorities who recognize this is a way to increase the living standards of the communities.

Three NVAqua® units have been ordered by the “Direction de l’Hydraulique Humaine (DHH)” of the Ivory Coast and will be installed shortly in three villages. Local engineers have been formed and will be entrusted with the installation of these units. During the installation, in each village, local people will also be formed. These people will then be at the center of all the activities linked to the production and distribution of water.

6. To use NVAqua® in other countries

A very young company, NVTerra, has now taken over this project and will ensure its commercial development. The two companies, BEM and F-TEC SYSTEMS, which have supported the development of the NVAqua® technology will remain in support for production and logistic aspects.

Over the past few years, it was found that introducing NVAqua® in developing countries is a very long acquisition and negotiation process. We would like to propose our units to countries and communities facing a critical shortage of drinking water. Local authorities in these countries would like it too, but money is often an obstacle. It is not easy for a young company to have access to sources of financing for exporting to developing countries. In addition to the support of the leaders of these countries, we need the support of international financial, humanitarian and development organisations, as well as of NGO specialized in sustainable development, training and distribution of water.

We believe that the intervention of a foundation or a donors' group would help our project, by sponsoring it or by paying in advance two pilot systems. These two units would serve as models and references for the introduction of following ones. Thanks to them it would be possible to make requests for grants from donor agencies and for loans from financial institutions. With the help of the population, with the support of a steering committee and the assistance of a local or regional NGO, water production would start after a few months and the proceeds of the sale of water would be used to reimburse financing. It would then be demonstrated that these units can be self-financed and make additional installations a lot easier. With the foundation understanding, the reimbursed pre-financing would then be used for new installations, awaiting subventions and grants.

Simultaneously with the start of the installation, the NGO will approach the people concerned to raise awareness of hygiene and health aspects in relation to water quality. Also, the personnel in charge of maintenance, technical support, administrative management and distribution of water will be trained, creating jobs locally.

This project's ambition is twofold: to facilitate access to drinking water with satisfactory economic and social conditions and give the opportunity for the community to own theses installations and operate them profitably and on a sustainable basis.

During the installation of the systems, the acquisition of knowledge for operating and managing the operation and distribution of water, and prior to the transfer of ownership, local people will be part of the entire process under the control of a steering committee. The project sponsors will however remain responsible until the demonstration of the project's viability will be given.

This project is therefore the opposite of all other projects which have consisted of delivering systems without giving enough importance to the context in which they could be used and transferring the necessary knowledge for its maintenance, resulting in a succession of failures and generating mistrust towards this type of action.

Another approach is required here with the sponsor's group (foundations, donors, NGO or companies) retaining ownership of the systems until conditions are met to transfer the ownership and the responsibility to the local community (under conditions which will be contractually defined). The steering committee will be dissolved once the mission is achieved.

In summary, each operation consists of the following three steps:

1. Socio-economic, technical and financial analysis, establishment of a steering committee, role definitions, acceptance of the principles of management and financing, sharing of responsibilities.
2. Technical Achievements.
3. Training, operating, assessing the degree of technical autonomy and management, reimbursement of financing, transfer of ownership.

From the beginning of each operation, the necessary steps will have to be taken in order to obtain the financing that will repay the pre-financing.
These steps must be undertaken at various levels: state, local government, donor agencies and organizations. Among them, we can mention:

• World Bank
• Fonds de Solidarité et d'Intervention pour le Développement de la Communauté (CEAO/FOSIDEC)
• Banque Ouest Africaine de Développement (BOAD).

7. To find out more

For additional information, please visit our website www.NVTerra.com or read the article (in French) published in “Le Nouvelliste” (newspaper from Valais, Switzerland) on the 15th of May 2009, pages 1, 2 and 3: http://www.lenouvelliste.ch/fr/news/valais/de-l’eau-potable-pour-tous 9-143496

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