envirolyte®

Leader in the EcoWorld

Sterilization
Disinfecting
Water purification

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Executive Summary

"Envirolyte Industries International Ltd is privately owned company incorporated under the laws of the Estonian Republic that designs and manufactures systems that generate biocide on-site using simple reagents

"Generating on-site can replace, eliminate or reduce delivered chemicals

"Envirolyte technology has multitude of different markets where we work closely with industry leaders to prove and develop new and exciting applications. We consider water treatment as one of our primary markets

An ideal potable and wastewater disinfection technology:

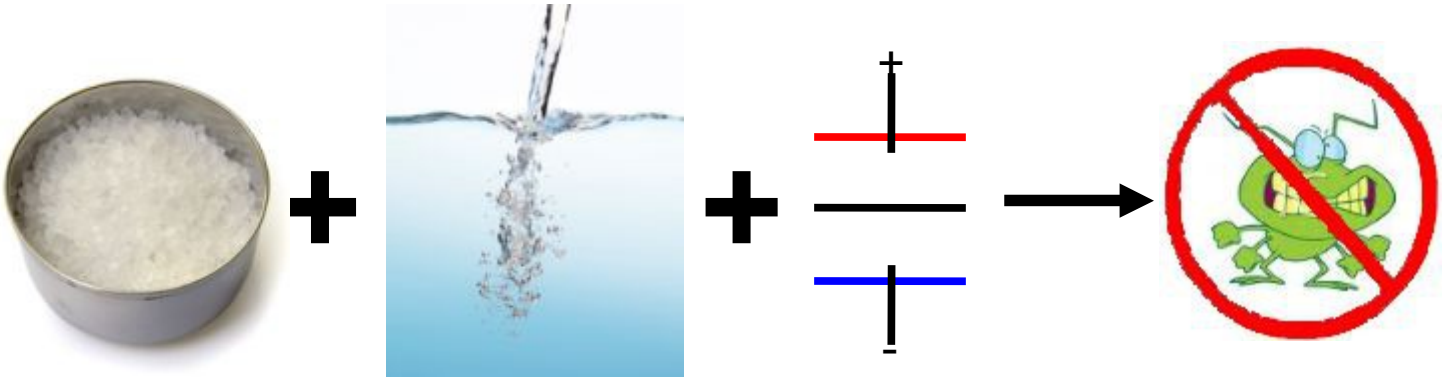
- Kills all potential pathogens in the water;
- Adds no toxic compounds to the water;
- For potable water, provides lasting residual disinfectant without excess chemicals;
- Is safe, easy, and inexpensive to use;
- Meets current and upcoming regulations;

Why Envirolyte might be used in the water purification sector

- Potential to improve biocide performance over current methods
- Improve safety through the elimination of hazardous (real or perceived) chemicals
- Enhance environmental stewardship by reducing or eliminating objectionable biocides
- Reduce cost over typical chemicals used
- Compact system lends itself to mobilization

- What is Envirolyte ANW process and what is the product?
- How does a Environment system work?
- How might it fit with the water purification?
- Where is it used now?

On-Site Generation
Anolyte is generated using Salt and Electricity



Salt **Water** **Power** **Disinfectant**

- Salt is added to water and passed through double- chamber- membrane electrolytic cell
- A high-strength active biocide - anolyte - is created in the form of HCLO

Envirolyte manufactures systems generating anolyte which demonstrates the ability:

- Destroy microorganisms such as salmonella, e-coli, listeria and anthrax spores;
- Purify water ; and
- Clean and Degrease

Anolyte fluids are strong oxidizing solutions with a pH range of 2.5 – 8.5 and an Oxidation-Reduction Potential (ORP) of +600 to +1200 mV. Anolyte can potentially be used as a broad-spectrum germicidal agent to kill all types of microorganisms including viruses, fungi and bacteria.

Based on our extensive research, anolyte fluids:

- Are environmentally friendly
- Are non-toxic to both humans and animals
- Do not require special handling;
- Are powerful biocides;
- Can be safely disposed of in sewage systems;
- Are fast-acting;
- Can be generated on-site, thus eliminating handling and storage of chemicals;
- Can be produced on-site from any source tap water and salt in required quantities and concentrations of active ingredients and pH;

The characteristics described above position Envirolyte equipment for potential application in water purification market.

Anolyte has enhanced oxidation power

“It is already a known fact that hypochlorous acid (HOCl) is a strong oxider, disinfectant, antimicrobial, etc. This technology was originally discovered by Michael Farraday when he developed his Laws of Electrolysis in 1834. Conducting electrical current across two electrodes in a salt brine solution may produce chlorine gas, sodium hypochlorite (bleach or NaOCl), hypochlorous acid, sodium hydroxide, hydrogen gas, ozone, and traces of other nascent oxidants. **Although they are similar, hypochlorous acid and hypochlorite are still very different.** It would be like comparing grape juice to wine;

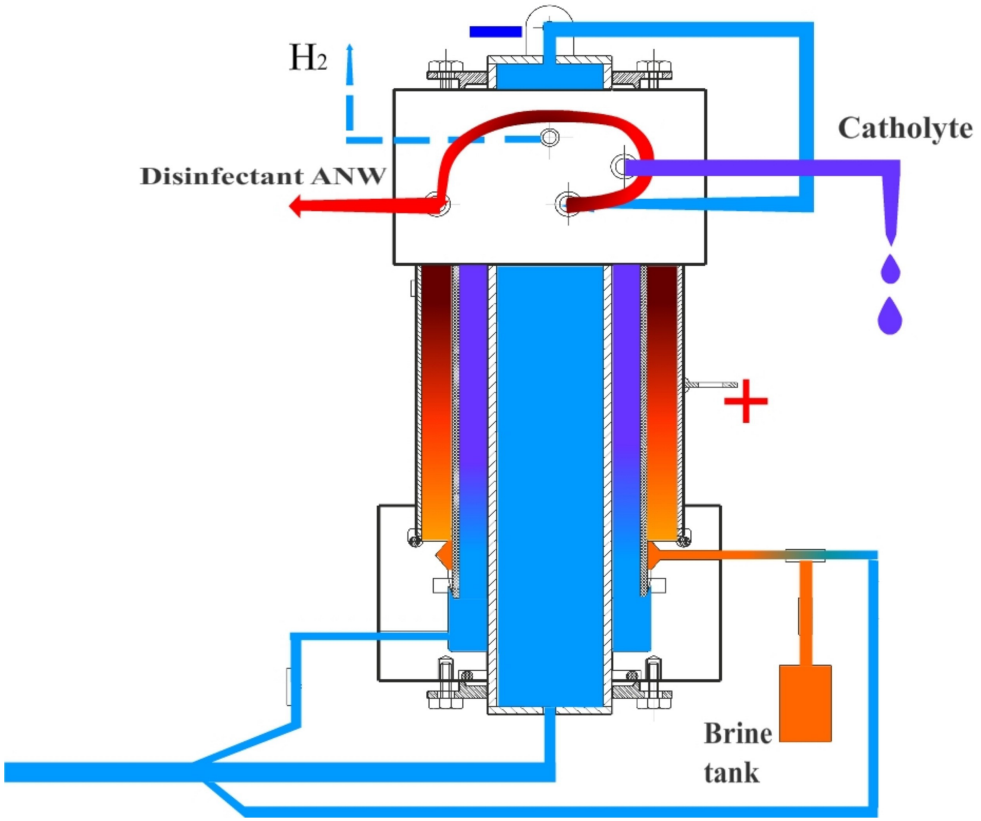
“Water chemistry dictates the chlorine species present in aqueous solutions. At a pH of between 5-6, the chlorine species is nearly 100% hypochlorous acid (HOCl). As the pH drops below 5, it starts to convert to Cl2 (chlorine gas). Above a pH of 6, it starts to convert to the hypochlorite ion (OCl-). A tremendous amount of published data exists to show that hypochlorous acid, not the hypochlorite (bleach) ion, **is the efficacious specie of chlorine;**

“Hypochlorous acid is a weak acid (pKa of about 7.5), meaning it dissociates slightly into hydrogen and hypochlorite ions: HOCl <=> H+ + OCl- .Between a pH of 6.5 and 8.5 this dissociation is incomplete and both HOCl and OCl- species are present to some extent. Below pH of 6.5, no dissociation of HOCl occurs, while above a pH of 8.5, complete dissociation to OCl- occurs. As the germicidal effects of HOCl is much higher than that of OCl-, chlorination at a lower pH is preferred;

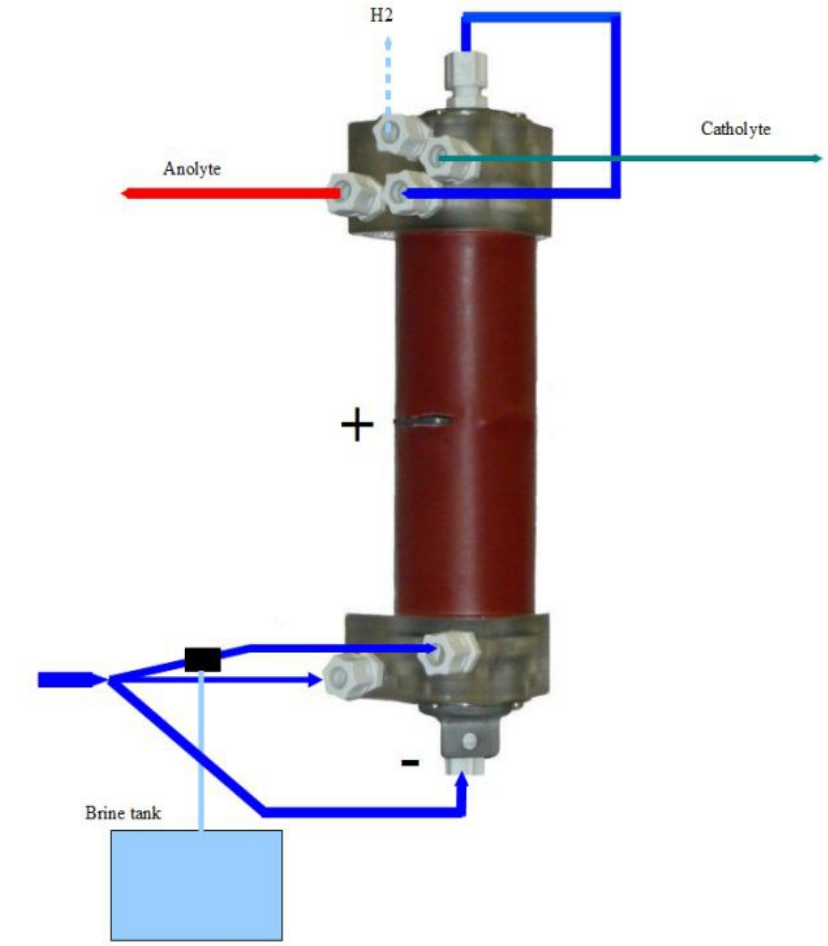
“pH. **The germicidal efficiency of hypochlorous acid (HOCl) is much higher than that of the hypochlorite ion (OCl-)**. The distribution of chlorine species between HOCl and OCl- is determined by pH, as discussed above. Because HOCl dominates at low pH, **chlorination provides more effective disinfection at low pH**. **At high pH, OCl- dominates, which causes a decrease in disinfection efficiency;**

“The alkalinity of the sodium hypochlorite solution also causes the precipitation of minerals such as calcium carbonate, so that chlorination is often accompanied by a clogging effect. The precipitate also preserves bacteria, making this practice somewhat less effective;

The general layout of On-Site Biocide Generation



Actual ANW cell hydraulic layout



The core elements of Envirolyte WDS

R-40 or ~40LPH

R-80 or ~80LPH

R-120 or ~120LPH

R-200 or ~200LPH

R-250 or ~250LPH

R-300 or ~300LPH

R-400 or ~400LPH

R-600 or ~600LPH

R-1000 or ~1000LPH

R-1200 or ~1200LPH

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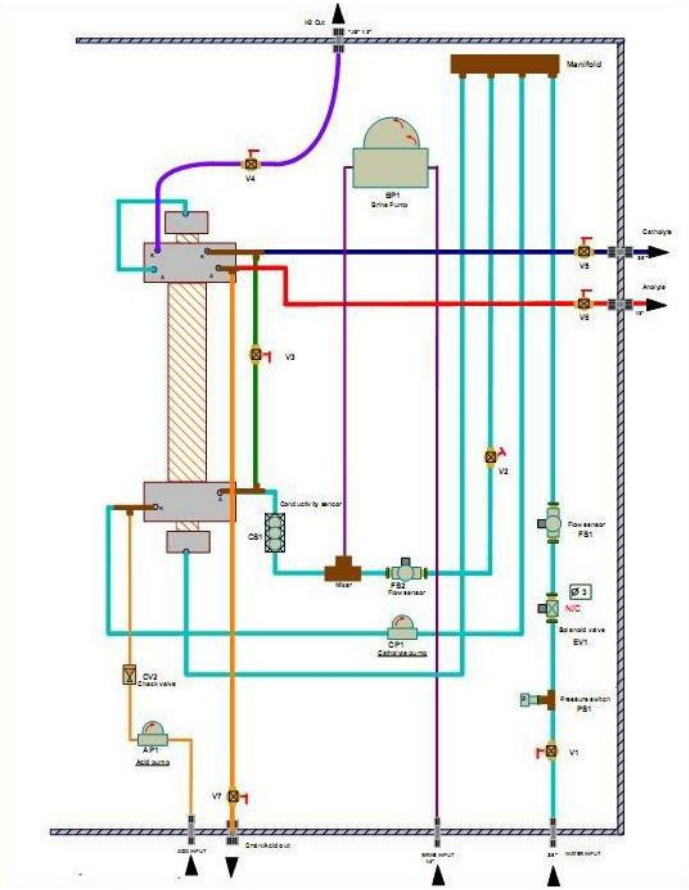
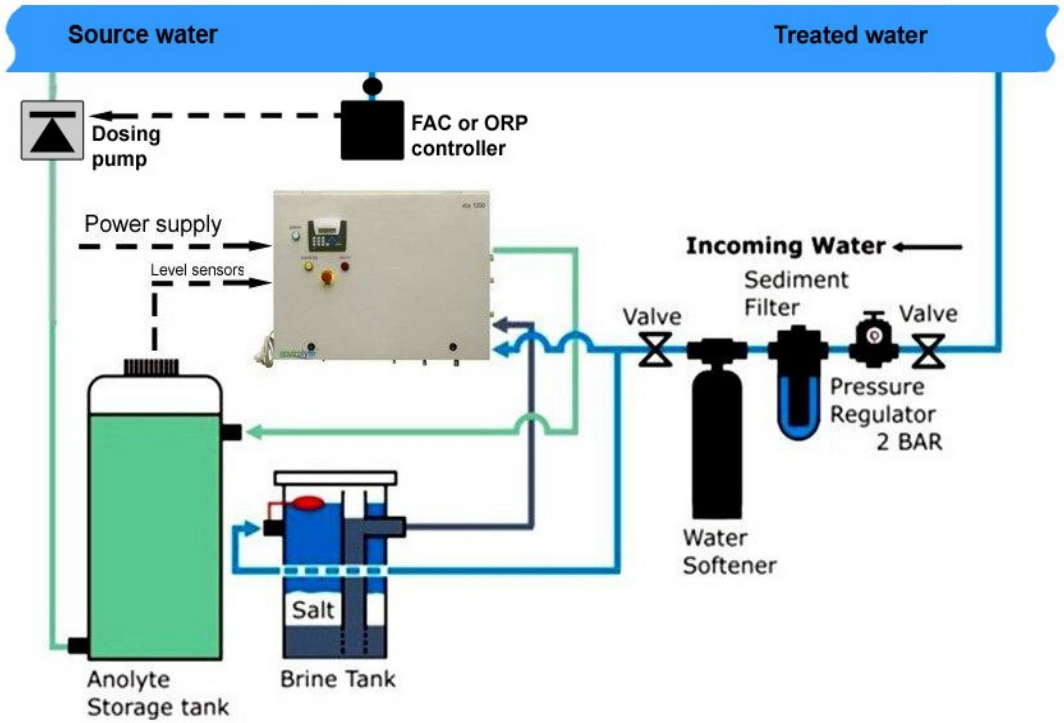
General Schematic of Envirolyte ANW machine



Sensor controlled dosing layout of Enviorlyte water disinfection system



A range of capacities to meet customer's needs

ELA-400
40 LPH

ELA-1200
120 LPH

ELA-3000
300 LPH

ELA-6000
600 LPH

ELA-10000
1000 LPH

ELA-20000
2000 LPH

ELA-40000
4000 LPH

Envirolyte ANW systems are easy to use and have many beneficial design features

- Proprietary self-cleaning system
- Superior flow control
- Low life cycle cost
- Expandable capacity
- Air and water-cooled power supply
- Controller with a wide variety of options
- Robust design

Generic benefits Include…

- Increased worker safety
  - Only salt and dilute solution is stored
- Reduced environmental impact
  - Transportation reduced
  - Less potential for leak hazard
- Solution generated where needed when needed
  - Better control of initial ingredients inventory
- Reduced Cost
  - Low cost to generate
  - More stable cost structure than bulk bleach
  - Attractive ROI in many cases

Why Envirolyte technology is better than traditional (non membrane) electrolysis

❝ Although seemingly analogous to chlorine, anolyte is unique and clearly superior to sodium hypochlorite in the destruction of spores, bacteria, viruses and other pathogen organisms on an equal residual base. Sodium hypochlorite in concentration of 5% is effective only in disinfection, but not sterilization. Sodium hypochlorite is enffective against cysts (Guardia, Cryptosporidium);

No.	Place of taking samples	Contact time/min	C a.c. immediatel y after dosing (mg/L)	Coliform bacteria (CFU in 100 ml.)	Termotolera nt coliform bacteria (CFU in 100 ml.)	C a.c. residual after contact time (mg/L)
1	Before treatment	-	-	$3,3x10^6$	$3,0x10^6$	-
2	After chlorination	30	2,8	$3,3x10^4$	$1,8x10^4$	1,5
3	After dosing anolyte	12	1,0	$2,7x10^4$	0	0,93
4	After dosing anolyte	30	2,0	0	0	1,15
5	After dosing anolyte	30	3,2	0	0	2,3
6	After dosing anolyte	30	5,0	0	0	4,4

- Elimination of sodium and caustic soda by the use of high rejection membrane technology produces pure hypochlorous acid at a neutral pH and therefore makes disinfection possible in short contact times without the high pH elements associated sodium hypochlorite.

- Oxidation Reduction Potential (ORP)(expressed in mili-volts) describes the oxidation potential, the level of sanitizing ability, or the "killing potential" of treated water irrespective of the kind of disinfectant or pH. Any water, for example, treated to have an ORP of greater than 500mV for more than one hour (approx.) would be assured of being free of *E. coli, Listeria, Salmonella* and other pathogens. High ORP levels in Anolyte are possible due to the elimination of the caustics.

- All water disinfection will result in the formation of disinfection by-products. Anolyte is no exception, but has the advantage that it does not contain the hydroxl ion and will oxidize organic material to form lower levels of chlorates thus reducing halogenated by-products. The inorganic by-products, (trihalomethanes (THMs), chlorite, chlorate and chloride ions) formed when Anolyte is used, are held in balance at much lower levels. Thus, lower disinfection by-products are produced in the process, about **30% - 50%** compared with sodium hypochlorite and other oxidants. This is because OCl- is the active reagent for THM formation, and this represents less than 4% of the FAC in Anolyte solutions, as 96% of FAC was found to be in the form of HCLO.

pH	% as HOCL	% as OCl-
8.0	22	78
7.8	33	67
7.5	48	52
7.2	66	34
7.0	72	34
6.0	96	4
5.0	100	0

❝ Most of the pathogens, particularly water born, develop resistance to Sodium hypochlorite over time. Anolyte application, as water disinfectant on a daily basis for more than ten years, demonstrated that microorganisms do not develop resistance against anolyte over time;

❝ Sodium hypochlorite loses its activity during long-term storage and poses potential danger of gaseous chlorine emission during storage.

- Anolyte is minimally corrosive primarily due it's low concentrations and, also due, to the elimination of the caustic element normally found in Sodium and Calcium Hypochlorite;

- Anolyte eliminates existing scale and pathogens harbored in scale and blocks dissolved solids in supplied water from forming new scale. Biofilm is eliminated. Sections of a building are not required to be closed to normal use during treatment;

- Envirolyte Anolyte system does not involve hazardous chemicals or burdensome maintenance;

What to look at when comparing different electrolysis technologies

1. Generated fluids:
- properties of the fluids such as FAC, ORP and Ph;
- killing efficacy the fluids and particularly their ability to eliminate spores;
- stability of the fluids;

2. Characteristics of the cells for electrolysis;
- output capacity of one single cell;
- salt and power consumption to generate an effective disinfectant;
- life span of the cells

Some references of Envirolyte WDS

Application: Disinfection of municipal drinking water.
Location of the installation: Arsanjan City, Fars Province, Iran
City population: 15 000 people.
Drinking water consumption: ~ 4 320 m3/day.
Type of the Envirolyte equipment: ELA - 3 000ANW.

Previously use technology: Chlorine gas
The reasons for switching to new technology: Hazards of using this method and change of Government polices if favor of cost efficient, ecology friendly and efficient technologies.

Application: Disinfection of municipal drinking water.
Location of the installation: Hashtgerd City, Alborz province, Iran.
City population: 50 000 people.
Drinking water consumption: ~ 13 000 m3/day.
Type of the Envirolyte equipment: ELA - 20 000ANW.

Previously use technology: Chlorine gas.
The reasons for switching to new technology: Hazards of using this method and change of Government polices if favor of cost efficient, ecology friendly and efficient technologies.

Application: Disinfection of cold and hot water of water supply system in order to prevent Legionella contamination.
Location of the installation: 300- bed hospital in Piemonte, Italy
Water consumption: 45 m3/day of cold and hot water.
Type of the Envirolyte equipment: ELA - 1200.

Problem they wanted to solve: Legionella contamination.
Previously use technology: high temperature heated water.
The reasons for choosing Envirolyte technology: as a result of using high temperature technology the damages of the piping line were detected while Legionella contamination still persisted.

Source water: near by artificial water reservoir

Previously use technology: dosing of liquid hypochlorite. Dosing controlled manually.

The reasons for switching to new technology: Extremely poor quality of drinking water. Continues public complains about drinking water quality. Deterioration of piping system due to growing biofilms and lime deposits.

Application: Disinfection of municipal drinking water.

Location of the installation: Breitovo City, Jaroslavski district, Russia.

City population: 4 000 people.

Drinking water consumption: ~ 8 000 m3/day.

Type of the Envirolyte equipment: 2 x EL-10 000. One machine – operational and the second - as a redundancy/stand by capacity.

Hot water consumption: ~ 1,3 m3/day.
Type of the Envirolyte equipment: ELA - 400.
Previously use technology: None, newly built complex.
The reasons for choosing Environment technology: The housing complex was built with full consideration of ecological impact and therefore the builder selected the technology he considered as the most ecology-friendly.

Application: Disinfection of hot water (55ºC) for heating system in order to prevent Legionella contamination. After anolyte dosing ORP ~ 550 mV is maintaned as indication of water purity and decontamination.
Location of the installation: Libo housing project (www.libo.se), Sweden. Population of the housing complex: 4 blocks with 4 apartments each, total 16 apartments.

Application: Disinfection of municipal drinking water.
Location of the installation: Voronez City, Russia. **"Voronez utility company"**, booster pumping station to provide drinking water for 1/3 of the city population.
City population: ~ 890 000 people.
Drinking water consumption: ~ 466 000 m3/day .
Source water: well water.
Daily FAC requirement: : 230 kg.

Type of the Envirolyte equipment: 8 x ELA - 24 000ANW. Six machines – operational and two - as a redundancy/stand by capacity.
Previously use technology: Chlorine gas.
The reasons for choosing Environment technology: Multiple hazards associated with the use of chlorine gas and change of the local government polices if favor of cost efficient, ecology friendly and efficient technologies.

Application: Disinfection of municipal drinking water.
Location of the installation: Sartichala, Kvemo Kartli, Georgia
City population: ~ 5 000 people.
Drinking water consumption: ~ 1000 m3/day.
Type of the Envirolyte equipment: 2 x ELA - 2 000
Previously use technology: chlorination
The reasons for choosing Environment technology: The Municipal Development Fund of Georgia has implemented rehabilitation works for Sartichala city water pipeline system with the financing of European Investment Bank (EIB). https://www.facebook.com/video/video.php?v=167493270046892
Rehabilitation works for the above-mentioned project started on April 24, 2012 and were completed on October 15, 2013.

After project completion population of village Sartichala will benefit from improved water supply as well as from improved water quality.
Rehabilitation works included replacement of 33.0 km of pipeline system and upgrading of disinfection facility. Also 250,0 m gabion and water intake reservoirs were constructed to ensure availability of the necessary volume of drinking water. It's worth mentioning that after project completion water supply problem will be solved for Sartichala population, therefore project implementation is a very important issue for locals.

Application: Disinfection of municipal drinking water.
Location of the installation: Ardbil City, Ardbil Province, Iran
City population: ~ 565 000 people.
Drinking water consumption: ~ 4 320 m3/day.

Type of the Envirolyte equipment: ELA - 3 000ANW.
Previously use technology: Chlorine gas.
The reasons for choosing Environment technology: Dangers associated with the use of chlorine gas what resulted in several explosions and Government polices if favor of cost efficient, ecology friendly and efficient technologies.

Application: Disinfection of cold and hot water of water supply system in order to prevent Legionella contamination.
Location of the installation: 50 - room **Hotel Europa** in Bardonecchia city,Turin region, Italy
Drinking water consumption: ~10 m3/day of cold and hot water.
Problem they wanted to solve: Legionella contamination.
Type of the Envirolyte equipment: ELA-200.

Previously use technology: high temperature heated water.
The reasons for choosing Envirolyte technology: as a result of using high temperature technology the damages of the piping line were detected while Legionella contamination still persisted.
Installation: Cold and hot water is treated 24/7.Water softener is installed prior to ELA-200. 20 LPH pump is used for injecting anolyte. Disinfection is controlled via FAC residual.

Envirolyte drinking water disinfection system for rural developments

Clean drinking water for rural population or remote locations is normally provided from the water treatment plants, which get the raw water from dams or water pumped from rivers. Still many rural areas particularly remote villages in developing countries are still without water from these sources because of the remoteness of their locations or because it is not economical to provide these villages with the treated water since village population is too small or location is difficult to reach with traditional water supply/disinfection infrastructure.

However, there's water everywhere near or in the villages itself either from the river sources or from the tube well. All what is needed is to treat this water and provide it to the villages concerned using a system that is reliable and economical. Envirolyte Industries International Ltd. has experienced in rural water disinfection system that can meet the above requirements effectively and overcome limitations associated with traditional technologies.

Envirolyte rural drinking water disinfecting system at KG Kemangi at Baling in state of Kedan, Malaysia

Envirolyte rural drinking water disinfecting system at KG Kemangi at Baling in state of Kedan, Malaysia

Envirolyte is used successfully in many applications.

Municipal	Industrial	Aquatics	Food prosessing	Livestock
				
Drinking water Wastewater Reuse	Power plants Cooling towers Beverage processing Heavy industry	Hospitality Pools Spas Water parks	An effective sanita-tion solution to chemicals in food processing	History of success with poultry, pig and dairy industries

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Worldwide with over 2,500 installations