SYSTEMS TO PURIFY
REUSE URBAN AND INDUSTRIAL
WASTEWATERS

ECO-SISTEMI
®ADVANCED ENVIRONMENTAL SOLUTIONS

About us

Philosophy

ECO-SISTEMI Srl is involved in research, development, planning and building of biological systems for the purification and reuse of urban and biodegradable industrial wastewaters directly in place: compact, energetically sustainable, self installing and virtually maintenance-free solutions, particularly indicated for treatment, reuse and saving of water in communities far from big centralized wastewaters treatment plants and their sewerage network.

INDUSTRIAL

LIFESTYLE

SERVICES

- System RCBR and its functions
- Wastewaters process treatment
- Performance and case of studies
- Technical characteristics
- Energetic sustainability
- Efficiency

- Biolake system and its functions
- Biolake process
- Installation and dimensions
- Phytoremediation gardens

- Improving performances of existing WWTP
- Design and realization of natural treatments
- Didactics and Training

Industrial

SYSTEM RCBR

The brand new machine conceived and produced by ECO-SISTEMI (patents: IT MI 2013A001257; PCT IB2014063030; IT MI 2014A001268) has many advantages that make it suitable to be used as a stand-alone system or in combination with other technologies for civil and industrial wastewaters treatment.

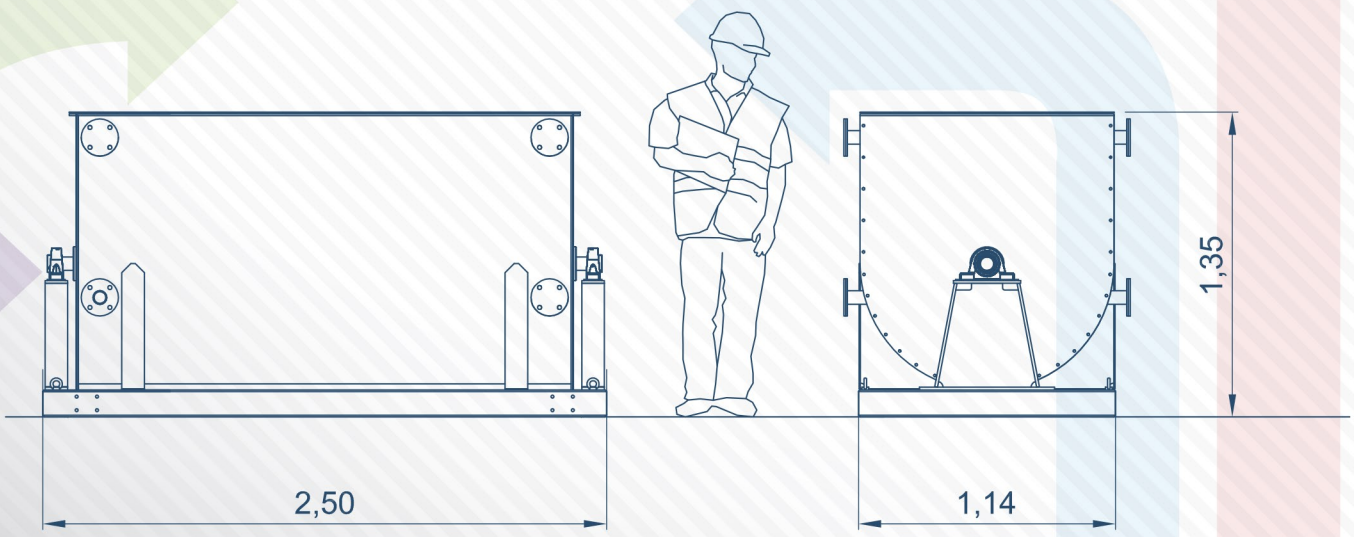
The functioning of our machine is based on the efficient and reliable technology of moving bed biofilm: the heart of the system is a rotating reactor containing a multitude of filling elements or “bacterial carriers” similar to that commonly employed in MBBR plants.

THE PROCESS

RCBR is suitable for all types of biodegradable wastewaters of urban and industrial origin (i.e alimentary industry, agro-zootechny). The machine can work both as carbon oxidizer, nitrifiers and denitrifiers. Carbon oxidation occurs by partial immersion of the reaction cell in the sewage, while after the degradation of the carbon load and biofilm maturation, ammonia nitrifier bacteria start nitrification (i.e. the oxidation process of ammonium) (fig. 1). Denitrification of nitrates (NO_3^-) to nitrogen (N_2) gas is obtained by the total immersion of the cell into the sewage, deprivating oxygen in the reaction cell and promoting the growth of denitrifiers bacteria (fig. 2).

RCBR devices are self-installing modules: they have very reduced dimensions and they achieve the removal of biodegradable organic pollutants, made by carbon, nitrogen and phosphorous by a biological process known as "biofilm system".

Particular of the reinforced reaction cell without central shaft. This structure increases massively the room available for the biofilm carriers, therefore the efficiency of the treatment in a small machine. The reaction cell, put in rotation by an electric engine, makes the biofilm nourished with sewage determining its purification.



PERFORMANCE

RCBR starts forming the activated biofilm in a week time after the installation and provides more than 90% reduction of biodegradable pollutants (COD, Suspended Solid, nitrogen and phosphorous compounds) after only three weeks of functioning: Energy consumption of the whole system is < 2 kWh.

Parameter	Reduction
Total Suspended Solids	99.5 %
COD	98.7 %
NH_4^+	99.3 %
$N\text{-}NO_3^-$	92.0 %
$N\text{-}NO_2^-$	93.0 %
Tot P	84.0 %

Fig. 1 - The reaction cell is partially (40%) plunged in the sewage and partially exposed (60%) to the air by slow and constant rotation of the cell. Heterotrophic and autotrophic (*Nitrosomonas spp, Nitrobacter spp*) bacteria grow as biofilm on the carriers in a week time promoting both carbon removal and ammonia oxidation.

Fig. 2 - The reaction cell is 100% plunged in the sewage. Denitrifying bacteria grow as biofilm on the carriers promoting nitrates reduction to nitrogen gas.

A CASE STUDY OF APPLICATION

(Hordeum Srl – Novara, Italy): RCBR stand-alone system applied to brewery wastewaters.

Characteristics of influent waters (daily emission):

Q_{24} = 5.5 m^3/day - **BOD_5** = 2.200 ppm - **COD** = 3.500 ppm - **Tot N** = 50 ppm - **Tot P** = 17 ppm

ECO-SISTEMI suggests the following RCBR stand-alone system made of:

1) Lifting and flow rate equalization

Electric pump to be positioned in the septic tank:

Engine: 2 poles, triphase,400V, 50Hz

Power: 0.55 kW - Prevalence: 7 m

Flow rate: 2 l/s

2) Biological treatment - n. 2 RCBR 300 modules

Moved by a single electric engine built in nitro/denitro modality:

Engine: 0.55 kW

Ist stage RCBR: rotating cell Ø 1.00 m; length 1.50 m

IInd stage RCBR: rotating cell Ø 1.00 m; length 1.50 m

Material: stainless steel AISI 304

Total dimensions: L. 3.30 m; H 1.50 m; W. 1.30 m
(including tanks)

3) Sedimentation, recirculation and discharge

Sedimentation is obtaned by a sedimentation tank:

Dimensions: diameter 1.00 m; height 2.00 m

Capacity: 1.5 m^3

Hydraulic retention time: 2 h

Material: stainless steel AISI 304

Sludge recirculation is obtained by an electric pump:

Engine: 2 poles, triphase, 400V, 50Hz

Power: 0.3 kW

Prevalence: 3 m

Flow rate: 2 l/s

System RCBR

THE DEVICE

RCBR device is a stainless steel reinforced rotating cell which slowly rotates inside a stainless steel tank. The cell is 100% full of recycled plastic carriers (bottle caps) that can be partially or totally submerged in dirty waters developing bacterial biofilm.

THE PROCESS

The cell rotation in atmosphere promotes the natural oxygenation first of heterotrophic bacteria, removing carbon load, second of autotrophic nitrifying bacteria, transforming ammonium in nitrates. A second device, with its cell completely submerged in dirty water provides the reduction of nitrates to nitrogen.

INSTALLATION AND DIMENSIONS

RCBR are modular devices of very small size. They are delivered ready to be connected to the existing septic tanks with instructions for their fast installation. Modularity and plug and play system guarantee the opportunity to transfer the devices from one side to another or increase treatment efficiency in a friendly and economic way.

ENERGETIC SUSTAINABILITY

A whole RCBR system made of two 300 people equivalents units consumes less than 2 kWh. We are very proud to reduce so much effectively wastewaters treatment costs! Let's consider the value of the process not only by its building costs but also by its functioning costs!

EFFICIENCY

RCBR starts forming the activated biofilm in a week time after installation and provides more than 90% reduction of biodegradable pollutants (BOD, COD, Total Suspended Solids, Nitrogen and Phosphorous compounds) after only three weeks of functioning.

ELECTRIC PLANT

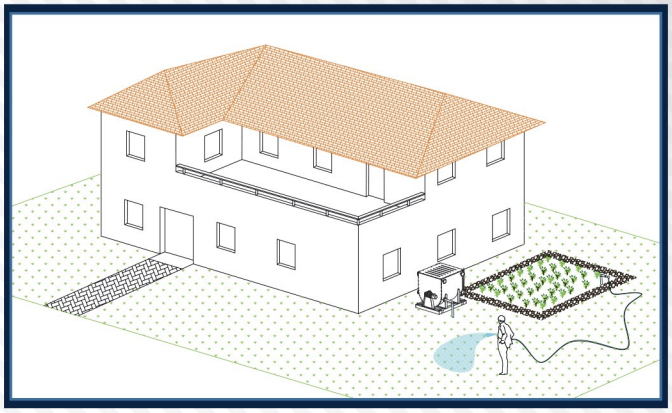
The electric connections are world standards. They can be easily performed by the customer on an existing switchboard following the instructions given in the CE users manual. ECO-SISTEMI can provide personalized switchboards with indication of instant power consumption and remote control GSM data transmission unit (you can read realtime performances of the system on your smartphone, pad or pc).

TECHNICAL CHARACTERISTICS

- Simplicity and durability
- Built in inox steel AISI 304 (or other materials)
- Built with its own containing tank also in inox steel AISI 304 (or other materials)
- Transport “friendly”
- Rotation cell without central shaft (preventing its mechanical breaking)
- Adjustable rotation speed
- Plug and play settling procedure
- Quality green: recycled high quality plastic material (HDPE plastic caps) as biofilm carriers
- Small and powerful: it develops ten time the active surface given by a conventional rotating biological contactor of the same volume
- Energetically sustainable: 300 people equivalent wastewaters are treated using less than 2 kWh energy

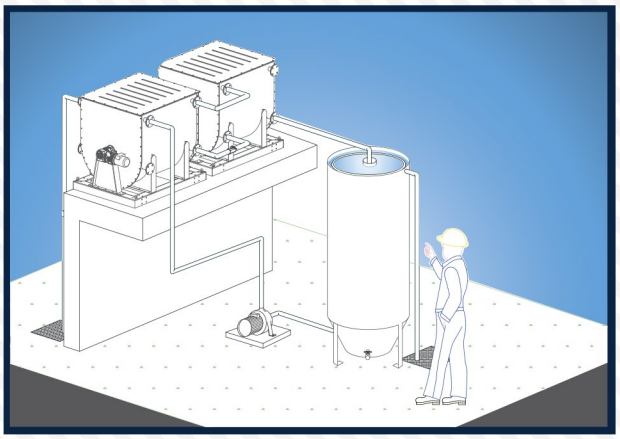
The RCBR technology has been developed under the EU funding scheme PO 2013-2017 FESR of the Trentino Alto Adige Province – Seed Money.

OPTION 1 – RCBR coupled with reconstructed wetland/phytoremediation garden



A single RCBR device is installed in “nitryfing” modality (i.e. rotating part in the sewage and part in the air). Treated waters contain an high concentration of nitrates (NO_3^-) that represent nutrients for the vegetation. Therefore, treated waters can be pumped into a small impermeabilized reconstructed wetland system that uses nitrates for plant growth, provides bacterial disinfection of treated waters and the opportunity of reusing such waters for any application, apart from drinking. Moreover, this application, so called integrated phytoremediation does not produce muds.

OPTION 2 - RCBR stand - alone system



A stunning compact solution for treating biodegradable wasterwaters constituted by the following modules: a) RCBR nitrifying module, 2) RCBR denitrifying module, 3) Sludge recirculation and sedimentator unit. This solution is applied when ground availability is lacking, thus when there is not enough room for integrating a reconstructed wetland plant.

RCBR MODELS AND PRICES We offer the following 8 standard models of the RCBR technology

Number of equivalent inhabitants (e.i.)	Space occupied* by RCBR (lenght x width x height) in meters	Engine kW	Selling price in Euro + VAT
50	1.2 x 0.6 x 0.7	0.12	12.000
100	2.2 x 0.6 x 0.7	0.18	18.500
300	1.5 x 1.2 x 1.4	0.50	23.000
500	2.6 x 1.2 x 1.4	0.75	32.000
750	2.0 x 1.9 x 1.9	1.10	46.000
1.000	2.5 x 1.9 x 1.9	1.50	60.000
1.500	2.0 x 2.4 x 2.4	2.20	90.000
3.000	3.5 x 2.4 x 2.4	4.00	150.000

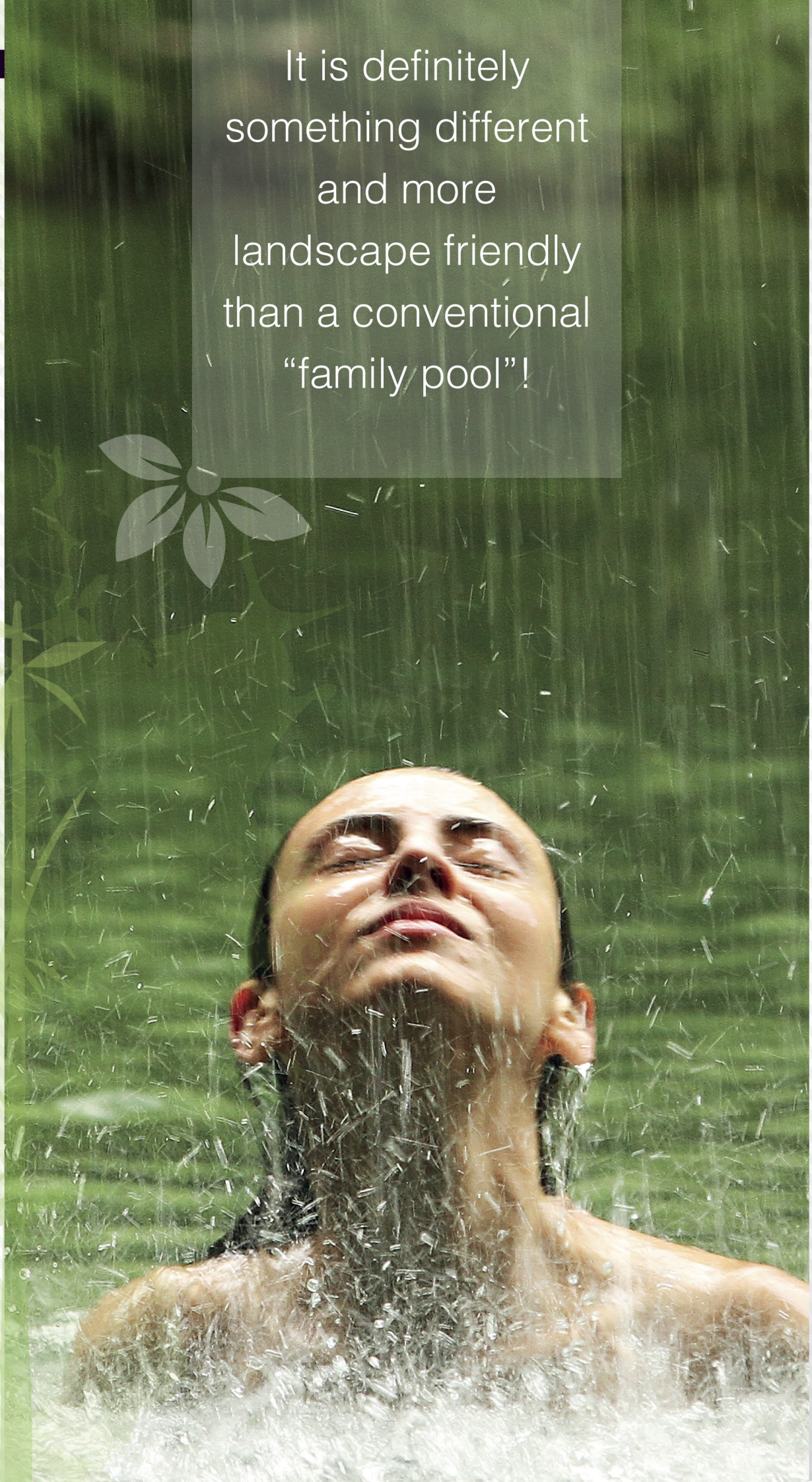
*Devices are built on commitment; we cannot exclude the possibility to realize halfway, larger or smaller dimension models than the standard production range, to the customer's needs.

A NEW STYLE IN RECREATIONAL SERVICES OF WATER – BIOLAKES

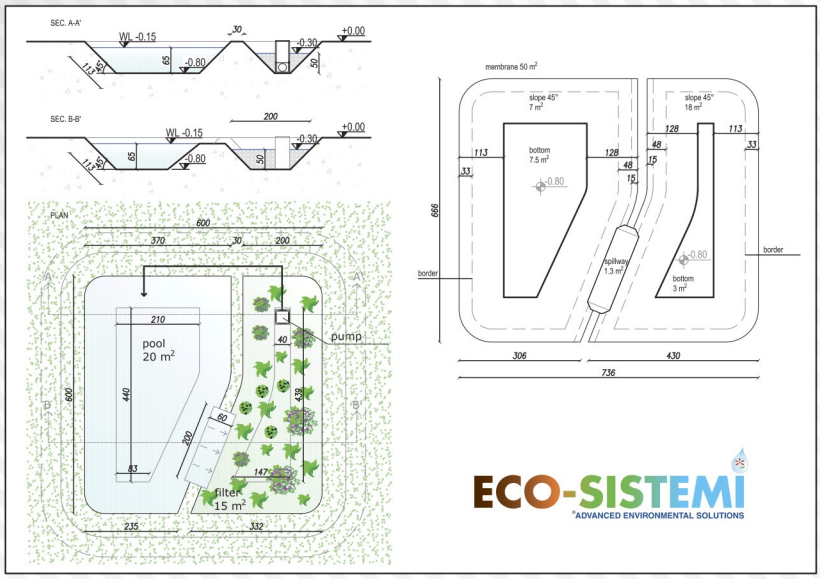
ECO-SISTEMI designs and reinvents a new way of building small bathing biolakes for domesti.

This 36 m^2 biolake provides recirculation of bathing waters between a biological filter constituted by marsh plants (e.g. *Thypa latifolia, Iris pseudacorus, Nimphea alba, Juncus effusus*), pond fishes and bivalves (*Carassius sp., Unio sp*) and a bathing pool. The system is chemical free (no chlorine or other chemicals are needed). We have studied a process that recreates perfect natural equilibrium in this reconstructed water ecosystem. Therefore there is no need for artificial maintainance of bathing sanitary parameters. Bathing waters are cleaned up by *Escherichia coli* and *Pseudomonas areuginosa* bacteria by natural ecological processes occurring in the regeneration filter of the lake.

The ECO-SISTEMI biolake is an object of precious design in your garden, a living water ecosystem that you can observe changing day by day and season by season without any artificial intervention. Children can play observing animals and plants growth while bathing.


It is definitely
something different
and more
landscape friendly
than a conventional
“family pool”!

PROJECT, BUILDING AND COSTS



ECO-SISTEMI delivers its biological process design to building partners (landscape architects and designers, gardens builders). ECO-SISTEMI biolakes can be realised without any use of concrete or mechanical/electric filters.

Building costs are slightly lower or at least comparable to the installation of a traditional swimming pool, taking into account that no massive civil works are needed (no concrete use). Costs can vary depending on the design of the surrounding deck. The sample in the picture we've realized is made with regenerated stone paving and natural stones provided by Bowland Stone (Bristol, UK). A simple grey in colour EPDM membrane is used for the impermeabilization of the basins. A replicate installation will have a total cost ranging from 10.000 e 20.000 euros considering the strong variability of manpower prices in Europe. ECO-SISTEMI biolakes are fast building projects. The whole system can be put in place in only 3/4 working days (24-32 hrs). The projects can be easily scaled up in dimensions till 144 m².

BIOLAKE DESIGN

We are able to build from scratch or convert pools to systems that do not need chemicals (e.g. chlorine, bromine) or energy-consuming filters (membrane, electrolysis) in order to reach bathing-water standards.

Tap water and rain water can be mixed and reused with 100% efficiency in closed recirculating systems, allowing you to save water and energy, and require very little maintenance, which can be easily provided by your own gardener.

PHYTOREMEDIATION GARDENS

ECO-SISTEMI has the know-how to create gardens with fragrant plants and flowers that grow thanks to your waste and filter and store clean water that can be used to irrigate your garden, vegetable patch or orchard, thus avoiding unnecessary consumption of drinking water. That is a smart way to increase green areas in towns, to reduce CO_2 emissions, to improve microclimate conditions in your house and garden and to create landscaping works of art. Have any of you ever proudly shown your septic tank to friends?

Self purifying garden in the Italian Embassy in Brasilia.

Thanks to our products, you will surely be proud to show off your purifying garden.

SERVICES

ECO-SISTEMI SRL

was born in the Academic environment of the University of Pavia, its strong link with European Higher Educational Istitutions made this company a leader in organizing applied summer courses for university students on green technologies for wastewaters remediation.

ECO-SISTEMI realized the first EU Summer School in Wastewaters Treatment Innovation WISEWATERS.

(http://www.eco-sistemi.org/wisewaters-eu-erasmus-project/)

ECO-SISTEMI provides general services to public administrations concerning management plans of water treatment and supply new process studies and cooperative research projects on water sanitation issues. Moreover, it organizes taught and applicative courses to professionals in environmental engineering technologies for wastewaters treatment.

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