Innovative water treatment with the Vertical Ecosystem® for an optimal and safe closed water cycle in tourist facilities

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13th IWA
Specialized Conference on Small Water and Wastewater Systems

5th IWA
Specialized Conference on Resources-Oriented Sanitation

1 alchemia nova

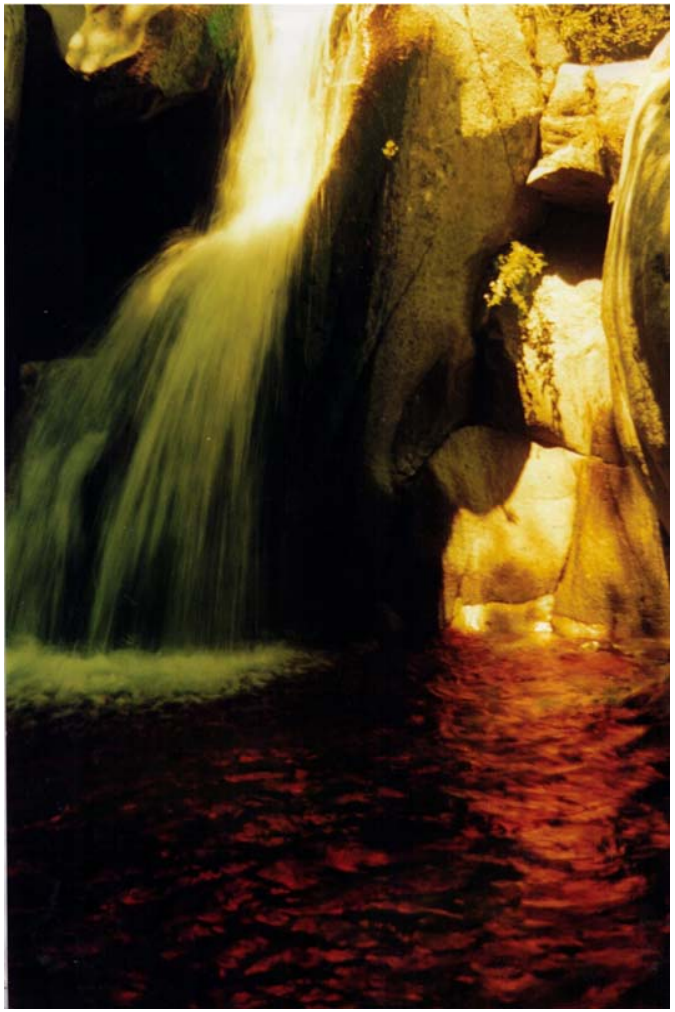
2 Radtke Biotechnik

3

4

Motivation

- Droughts (and floods) troubling concern in many areas
- Tourism - important economic activity
- High fresh water consumption - many amenities tied to high water demands (wellness, golf areas, etc.)
- Some tourism hot-spots are located in areas with acute water scarcity in summers (high-season)
- Nature offers a solid solution for intelligent water management and reuse
- → alchemia-nova's experience with phytotechnologies & circular material streams



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demEAUmed

Funded under the Water and Innovation Action of the 7th Framework programme of RTD-D of the European Union

Demonstrating integrated innovativ technologies for an optimal and safe closed water cycle in Mediterranean tourist facilities

Fraunhofer IGB

Ellenburger EUT GmbH

Radtke Biotechnik

UVOX redox

UNESCO-IHE Institute for Water Education

European Commission

SEMIDE EMWIS

LGI CONSULTING

LEITAT Technological Center

ICRA

ADASA

SambaHotels

IDROPAN-DELL'ORTO

JICO

alchemia nova

Eight technologies demonstrated at the pilot site in Hotel Samba

Funded under the Water and Innovation Action of the 7th Framework programme of RTD-D of the European Union

ELECTROCHEMICAL OZONATION

Responsible partner: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung E.V. (Germany)

REMOVAL OF MICROPOLLUTANTS BY ADSORPTION PROCESSES

PHOTOELECTRO FENTON PROCESS

Responsible partner: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung E.V. (Germany)

Partner: Ebenburger Elektrolyse- und Umwelttechnik GmbH

ELECTROCOAGULATION FLOATATION

UVOX TECHNOLOGY

POLYMER WATER DEIONISATION

Acondicionamiento Tarrasense Association LEITAT (Spain)

Responsible partner: Stichting IHE Delft (UNESCO-IHE) (Netherlands)

SMART WATER METERS

Sensors and data collection (Spain)

Partner: Wapure International gmbh (UVOX) (Germany)

SEMIDE/EMWIS - Dissemination and communication (France)

Responsible partner:

Idropan dell'Orto Depuratori SRL (IDROPAN) (Italy)

LGI Consulting - Economic and business analysis (France)

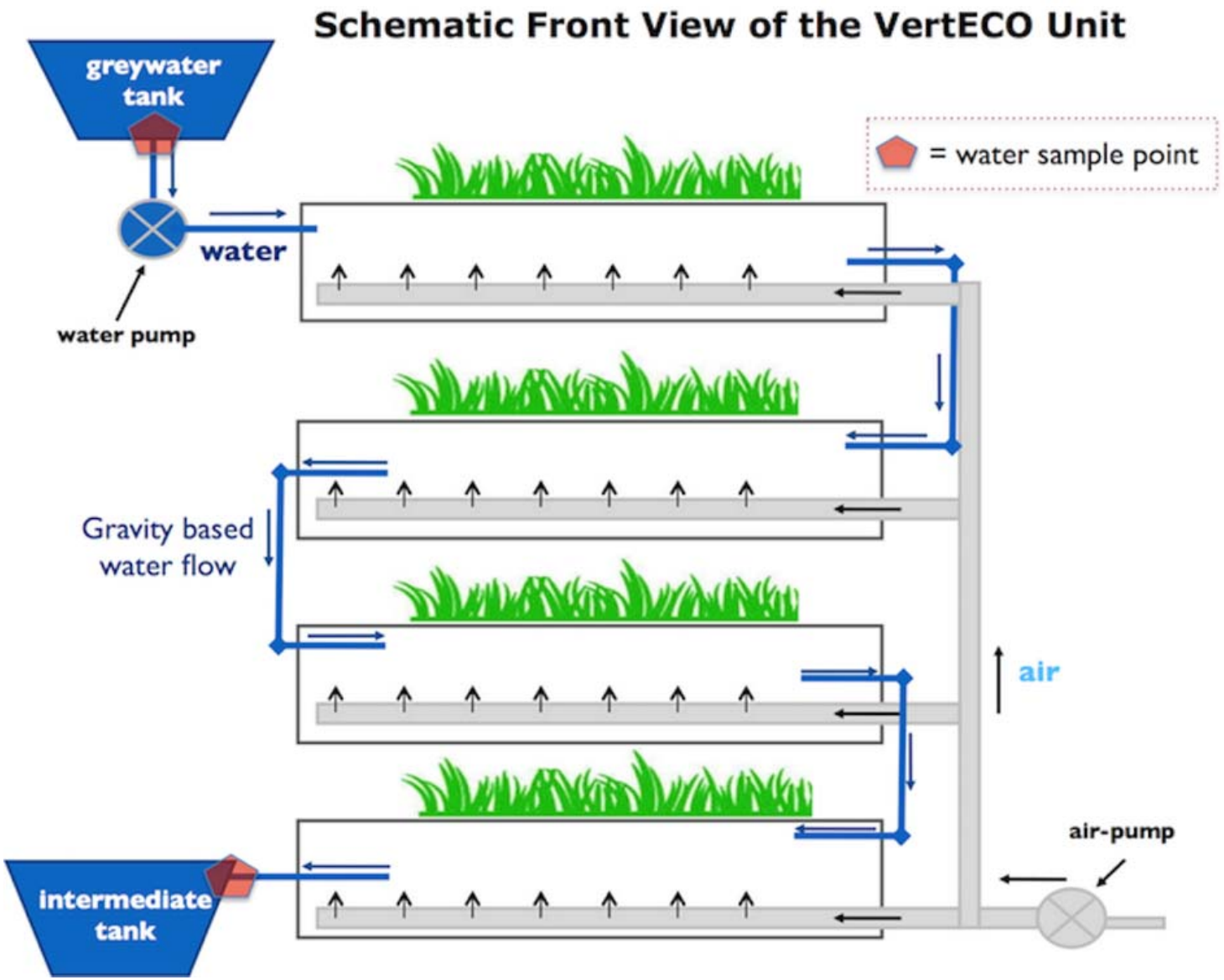
Catalan Institute of Water Research (ICRA), Girona (Spain)

More info at www.demeaumed.eu

VERTICAL ECOSYSTEM

Nature based greywater treatment for on-site water reuse

Technical outline

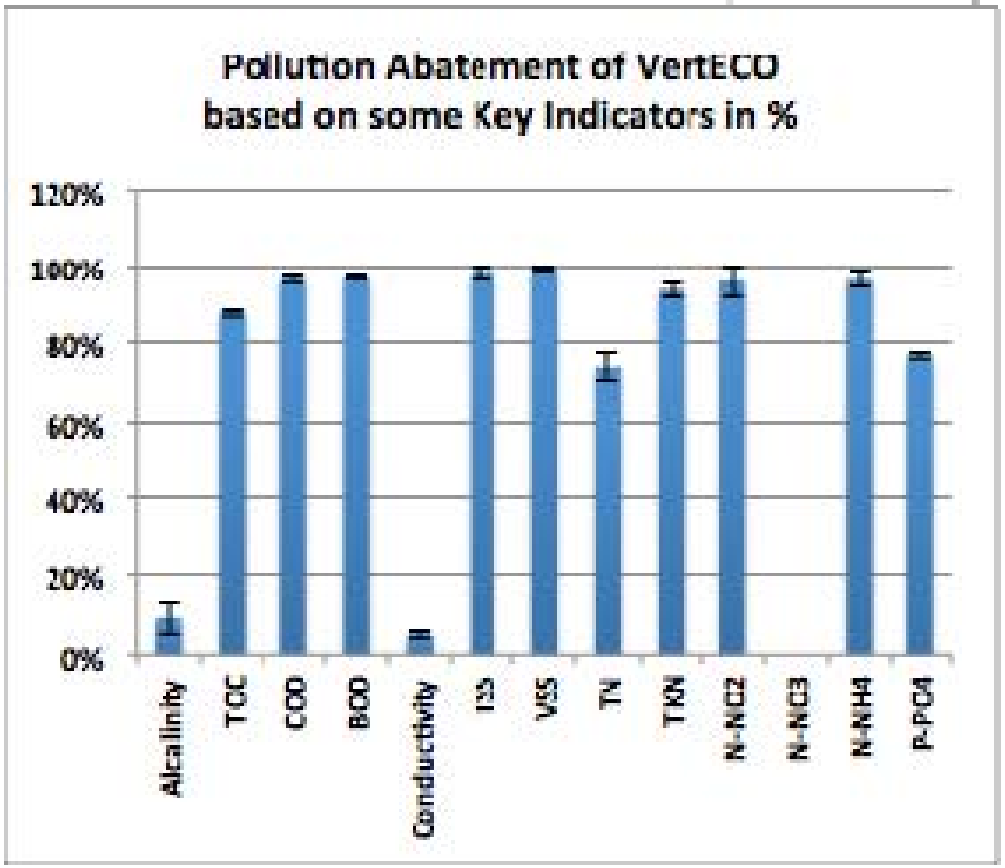


Basic technical parameters

- 4,5 m length; 1,40 m depth; 2,50 m height
- 2 m^3 of root vol. (expanded clay)
- More than 20 different plant species (from originally 120 tested)
- 1-2 m^3 of greywater (showers, lavatories) treated per day
- Currently located under a roof at the swimming-pool bar with at least one open wall front
- Analysis with sensors, offline water sampling in regular intervals by ICRA (Catalan Institute of Water Research)

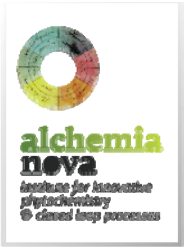
Performance results

PARAMETER	Units	greywater inflow	effluent after VertECO treatment	% removal
COD	mg O_2/L	336	8,9	97,4%
BOD5	mg O_2/L	238	3,0	98,7%
TOC	mg C/L	122	3,9	96,8%
DOC	mg C/L	109	2,8	97,4%
TNb	mg N/L	2	0,3	85,0%
NO3--N	mg N/L	0,8	0,1	87,5%
NO2--N	mg N/L	0,089	< 0,003	-
NH4+-N	mg N/L	0,04	< 0,03	-
P-PO4	mg P/L	4,0	0,35	91,3%
TSS	mg/L	130,3	2,2	98,3%
turbidity	NTU	43,9	0,3	99,3%
pH	-	5,83	7,22	-
Dissolved Oxygen	% Sat	81,83	90,8	-
conductivity	µS/cm	817,61	774,3	5,3%
Total Coliforms	CFU/100mL	3,00E+06	6,00E+03	99,8%
Escherichia coli	CFU/100mL	1,10E+06	0,0	100,0%
Total count	CFU/100mL	2,77E+07	7,17E+04	99,7%
tenside anionic	mg/L	57	0,3	99,5%
tenside cationic	mg/L	< 0,2	< 0,2	-
tenside nonionic	mg/L	1	< 0,2	-



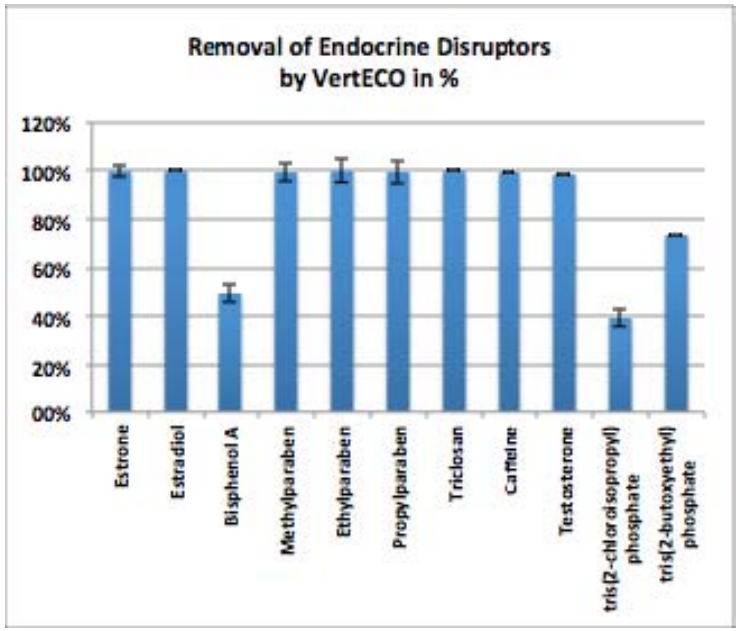
Laboratory analysis done by ICRA

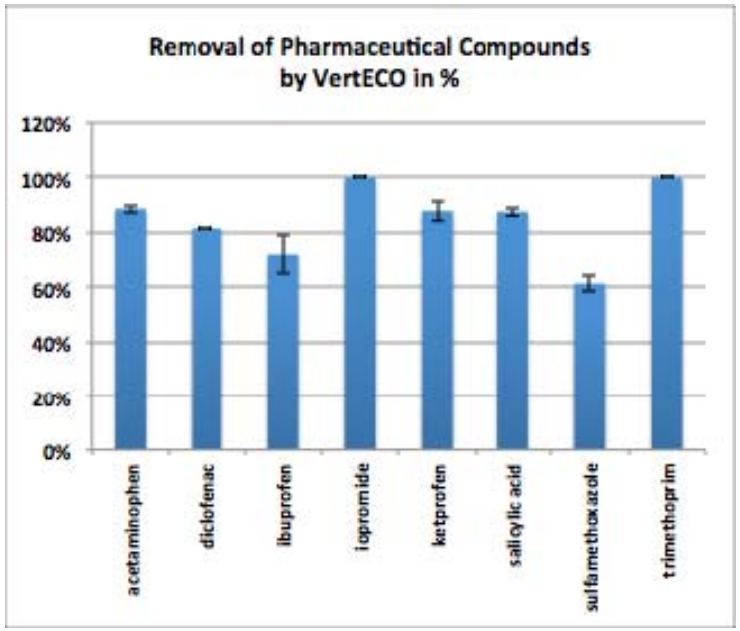
Regulatory targets



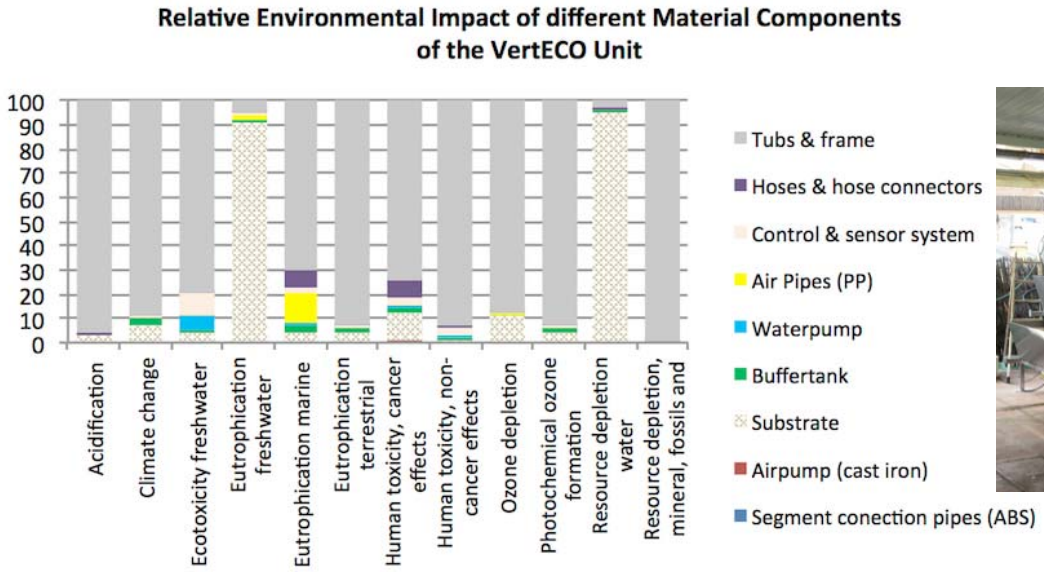
			Potential Re-uses of VertECO effluent					
	Simulated greywater effluent	Water effluent after VertECO	Laundry	Groundwater recharge		Irrigation		Toilet flushing
				Direct injection	Localized ground percolation	Private garden irrigation	Golf irrigation	
European Directive			**91/271/EC**	**91/271/EC**	**91/271/EC**	**91/271/EC**	**91/271/EC**	**91/271/EC**
Spanish Legislation				**RD 1620/2007**	**RD 1620/2007**	**RD 1620/2007**	**RD 1620/2007**	**RD 1620/2007**
COD (mg/L)	474.85	7.9	125			125	125	
BOD_5 (mg/L)	194.2	3.82	25			25	25	
TSS (mg/L)	59.83	3.61	< 60	10	35	10	20	10
Conductivity (µs/cm)	287.83	423				6000	6000	
Nitrate (mg/L)	-	1.5		25	25			
Turbidity (NTU)	-	0.3		2		2	10	2

Micropollutants





LCA assessment (by LEITAT)



LCA assessment

	Carbon Footprint (kg CO_2 equiv./m^3 water)
VertECO operational stage	1,146
VertECO + PV energy supp. oper. stage	0,086
Desalination plant	0,594
Tap water from surface water	0,0006
WWT plant (incl. ww collection)	0,960

(1 m^3 of water desalination) + (1 m^3 of VertECO treatment) + (1 m^3 treatment in a WWT)

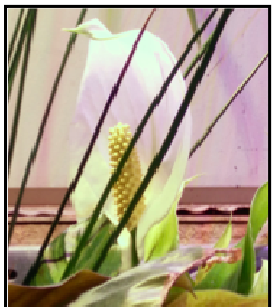
vs.

Impacts of (2 m^3 of water desalination) + (2 m^3 water treatment in a WWT)

=> CO2-savings of 13%

Key benefits

- No chemicals or consumables, easy maintenance
- Consumes 2,5 kWh electricity or less per 1 m^3 of treated water
- Corresponds to about € 0,35 energy costs to safe € 1,60 of water costs (average prices for Spain)
- Investment costs start at € 16.000
- Up to 60% of water savings possible - meaningful for regions with water scarcity - best economic results if larger green areas exist in combination with water intensive amenities like wellness areas in dry regions
- Additional benefits like
  - indoor air quality
  - microclimate improvements
  - aesthetical, calming effect
  - very clear sustainable image



Outlook

- Regulatory framework problematic in many countries for water reuse - “Innovation Deals”
- Looking for collaboration for further demonstration projects (energy, sensors-IoT, nature-based solutions, green infrastructures, food processing industries, paper industry, etc.)

Options for indoor green aesthetics, air quality & indoor climate

planning & engineering calculations

A building like a tree

William McDonough's Treescraper Tower of Tomorrow

- The building offers ecosystem services to its environment
- Energy self-sufficient or positive
- Living space for humans empowers productivity, zest for life and health
- Also habitat for plants, animals, ecosystems
- Material conservation, deconstructable
- Aesthetical, place of encounter


Thank you for your attention !
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