The new Biomassbed developed within the Life project ArtWET

3rd European Biobeds Workshop,
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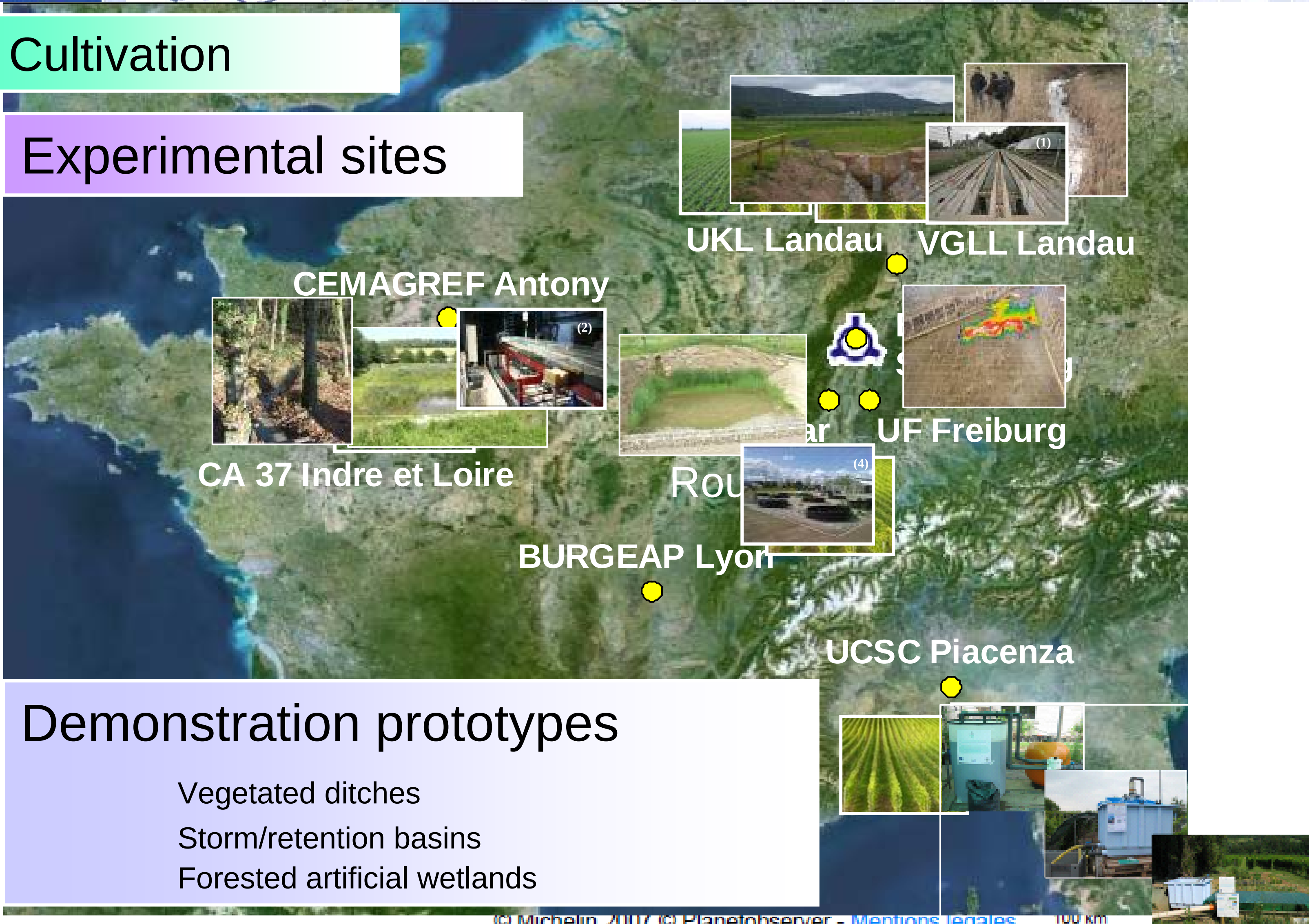
ArtWET Project:
partner, prototypes and sites

Cultivation

Experimental sites



Demonstration prototypes

- Vegetated ditches
- Storm/retention basins
- Forested artificial wetlands

The objective

Develop a system to prevent water point-source contamination in farm

This tool must be :

- Cheap
- Easy to manage
- Able to preserve from pesticide point contamination
- Implemented with organic materials available on the farm
- Adaptable to the different agronomic and meteorological Italian conditions
- Efficient for a long term

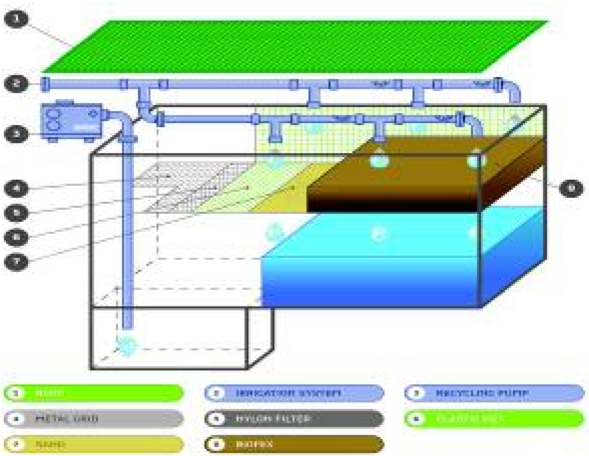
→ the Biomassbed

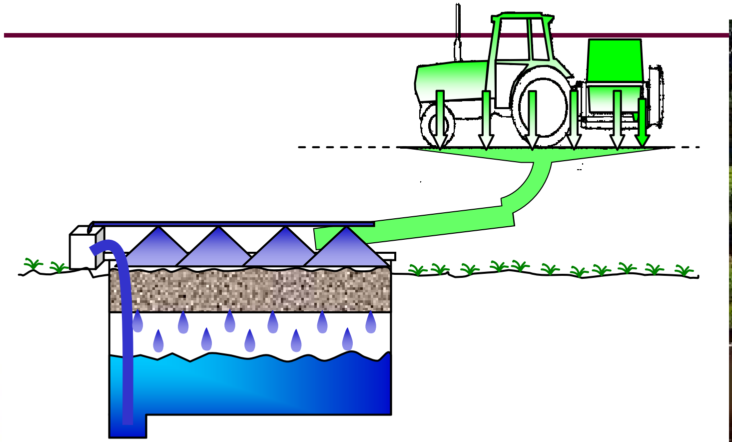
The steps

2003, the first Biomassbed in Italy

2006: Catholic University of Piacenza is partner of the Life Project ArtWET

2007 Start of the experiments to better evaluate the performance and the potentiality of the first Biomassbed installed at Pusterla farm (Italy)





The steps during ArtWET

2007, a new prototype was installed at the Campus of Piacenza University as pilot plant

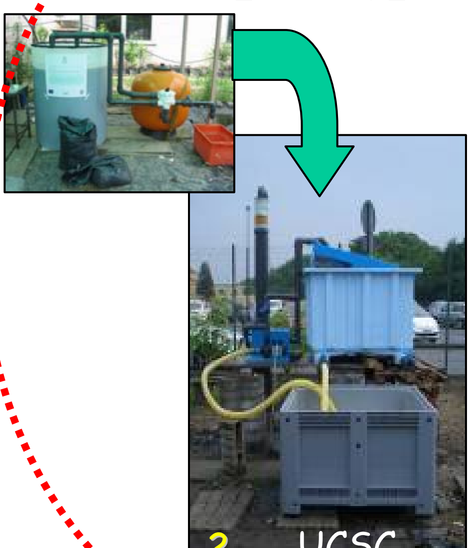
2008: The first Biomassbed was upgraded with a new versatile modules

2008: The pilot plant at the University Campus was improved with new modules.

A new plant with the same characteristics was set at the Rosati farm, experimental site of Ancona University

Bioreactors in Italy

Pilot prototype



Demonstration site

Demonstration site

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Biomassbed at Pusterla farm

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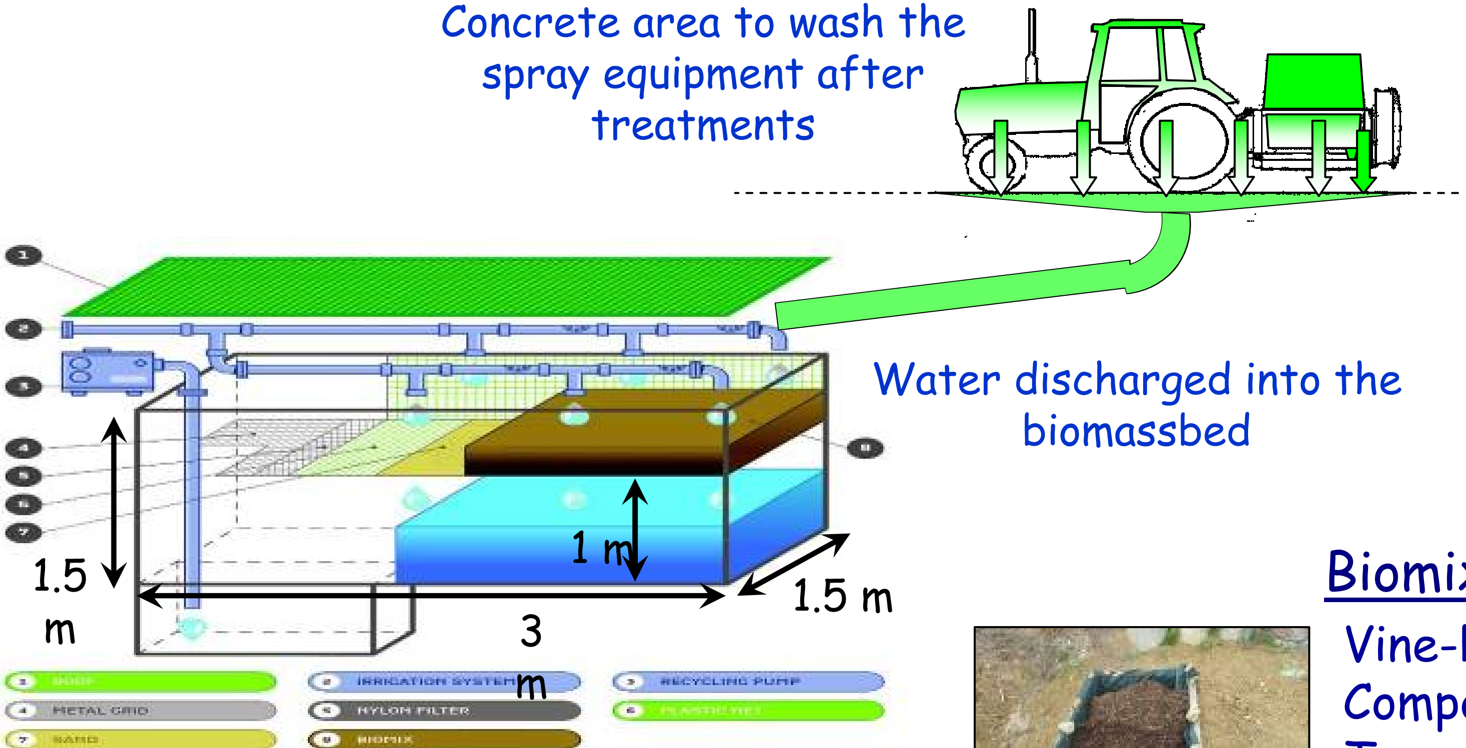
Biomassbed at Pusterla farm

The design during experiments since 2003 to 2007



Biomassbed scheme

Biomix

Vine-branch	40%
Compost	40%
Topsoil	20%
C/N	28,7
Bulk dens.	525 g/l

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The results during experiments since 2003 to 2007

	Maximum and mitigated concentrations of a.i. in the water (mg/L)					Pesticide toxicological end-points			
Pesticide	*2003*	*2004*	*2005*	*2006*	*2007*	*EC 50 Daphnia magna (mg/L)*	*LC 50 fish (mg/L)*	*EC 50 Algae (mg/L)*	*EC 50 Aquatic plants (mg/L)*
Mancozeb	16.50 (2.30)	-	-	-	-	0.073	0.46	1.1	-
Metalaxyl	6.17 (0.02)	1.93 (0.17)	0.02* (nd)	13.57 (0.14)	0.31* (0.10)	28	100	33	85
Penconazole	0.28 (nd)	3.44 (nd)	0.04* (0.01)	0.43 (nd)	0.08* (0.05)	6.75	1.3	2	0.11
Chlorpyrifos	-	3.91 (nd)	0.01* (nd)	0.13 (nd)	0.005* (nd)	0.0017	0.007	0.48	-

**sampling 20 days after treatment*

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Biomassbed at Pusterla farm

The results during experiments since 2003 to 2007

The mitigation does not appear of high efficiency for some compound, mainly the most water soluble

↓

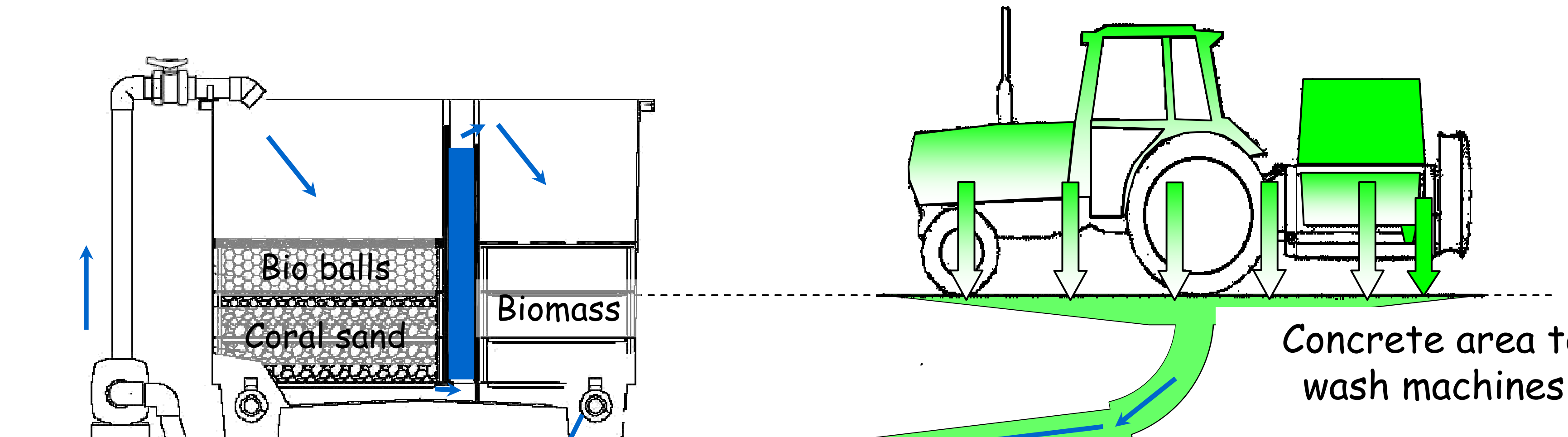
Necessity to improve the system in Pusterla farm: how?

Decreasing the high water content of copper and sulphur

Minimising anaerobic conditions

Easily removal and replacement of the biomass

The design during experiments from 2008



Results 2008

a.i.	% in the water	% in the biomass	% in the suspended solids	% dissipated / adsorbed
Chlorpyriphos	0.00	0.59	0.00	99.41
Cyprodinil	0.14	0.09	0.02	99.75
Fludioxonil	0.06	0.41	0.01	99.52
Metalaxyl	0.09	0.01	0.00	99.91
Penconazole	0.18	2.01	0.20	97.61

In years 2003-2007, with the old system, for a.i. penconazole, maximum percentage of dissipation / adsorption was 62% ;

for a.i. chlorpyriphos, maximum percentage of dissipation / adsorption was 92%

An example of pesticide trend

	Concentrations of a.i. discharged and mitigated in the biobed (mg/L)		
Pesticide	*2006*	*2007*	*2008*
Metalaxyl	13.57 0.14	0.31 0.10	3.93 0.009
Penconazole	0.43 <0.001	0.08 0.05	0.49 <0.001
Chlorpyrifos	0.13 <0.001	0.005 <0.001	0.01 <0.001

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The experiments in 2009

- The same design of the prototype
- Biomass used during 2008 was recycled during 2009 with the addition of new biomass of the same kind (20% to reach the correct volume)
- The prototype accumulated waste water until last treatment (mid august) and run (from 1° September) for two following months.

Biomassbed at Pusterla farm

Results 2009

PENCONAZOLE	a.i. applied	a.i. discharged in the biobed	Water conc. at 1° September	Water conc. after the biobed	Conc. in the biomass at the end	Estimation of dissipation-degradation
	Kg	g in 2200L	µg/L in 2000L	µ g/L in 1600L	mg/kg	%
Dimetomorph	3.42	7.95	4.8	0.86	0.27	82.8
Thiametoxam	0.92	1.08	2.1	1.8	0.02	30.1
Metalaxyl	8.63	13.36	214.8	1.3	0.02	99.5
Penconazole	0.17	0.27	6.2	1.5	0.29	77.7
Chlorpyrifos-methyl	7.29	36.4	2.3	0.1	n.d.	96.2

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Conclusion on Pusterla Biomassbed

- The system developed for 2008 during the project seems to be more efficient than the old one.
- It loose efficiency for some a.i. if old biomass is not accurately replaced.
- It requires low quantities of biomass (< 60 kg), reducing the exhausted biomass eventually to discharge.
- Waste water can be accumulated during the applications period (summer) and processed afterwards

Prototype at Piacenza University

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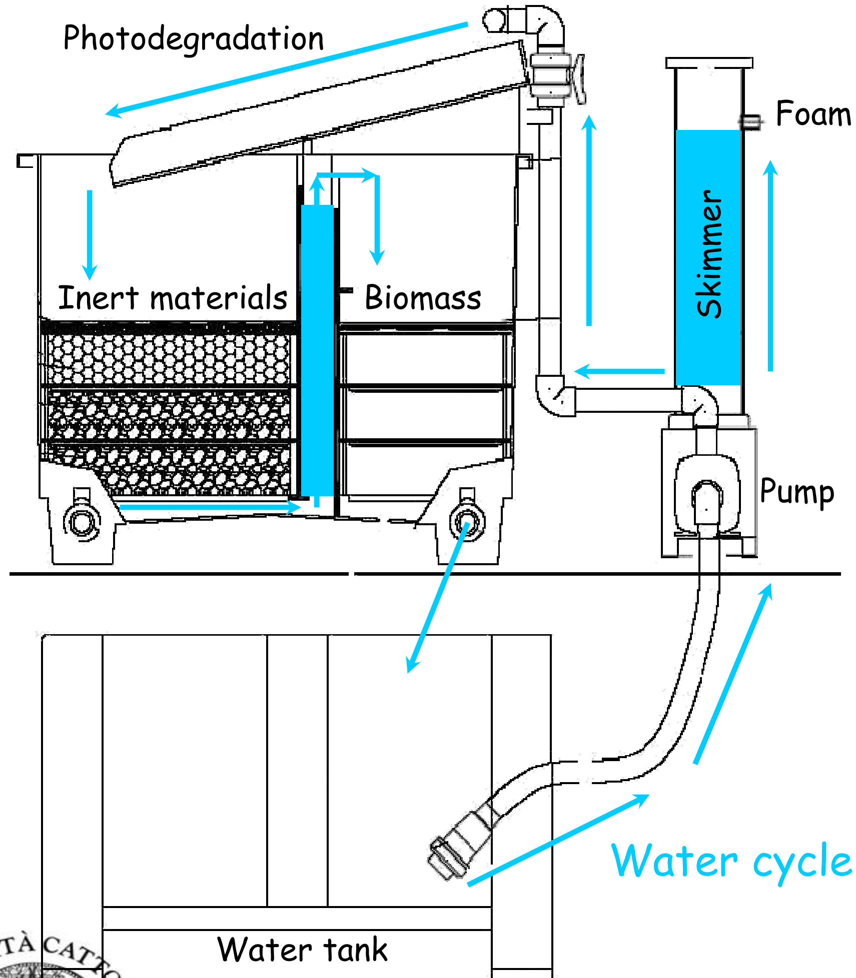
The design during experiments since 2008



The system was tested using a "step by step" procedure. In the last experiment, all the mitigation processes were tested at the same time: separation through the skimmer, photodegradation, adsorption on inert materials, degradation on the biomass.

Ten active ingredients were added:

acetochlor, achlonifen, linuron, metolachlor, pendimethalin, terbutylazine (herbicides)

chlorpyrifos, ethoprophos (insecticides)

metalaxyl, tricyclazole (fungicides)

Sampling and analysis of water, biomass, foam

System 9 days working,
4 cycles/day,
all modules activated

Prototype at Piacenza University

The results during experiments since 2008

a.i.	% in the water	% in the biomass	% in the foam	% dissipated*
Acetochlor	11.82	0.52	0.74	86.92
Achlonifen	0.00	0.86	0.00	99.14
Chlorpyrifos	0.00	6.03	3.70	90.27
Ethoprophos	0.00	0.75	0.37	98.88
Linuron	28.09	4.57	1.69	65.65
Metalaxyl	2.74	0.05	1.29	95.93
Metolachlor	44.68	1.78	3.20	50.33
Pendimethalin	0.00	5.22	3.65	91.13
Terbuthylazine	55.17	7.55	6.90	30.38
Tricyclazole	44.34	8.10	2.01	45.55

* **% dissipated**: % no more found in the system, due also to volatilization, adsorption not on the biomass, degradation **after 9 days of experiments**.

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Conclusion on Piacenza Prototype

The results of the trials conducted in 2008 put on evidence the different fate of several a.i. in relation to their physical-chemical characteristics.

After the conduction of trials with and without biomix placed into the prototype, it results that the biomix activity (adsorption and degradation), in aerobic condition, is fundamental for the concentration reduction in water of the higher water soluble a.i.

The prototype working with all the modules activated, is able to mitigate water concentration of the major part of organic chemicals in a short time, increasing the mitigated water volume per year

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General conclusion

- The new plants are efficient and are able to reduce the water concentration until the analytic 100 % for some chemicals only if designed and utilised properly.
- The chose of the correct assembly must be focused upon demonstrated efficiency on-site.

Anyway, the diffusion of such tools should tacking care of:

- It is necessary to plan transparent procedures approved by national and local authorities.
- Avoid the Home-made systems, and the re-production of foreigner tools not validated at local conditions.
- The installation costs should be, at least, partially sustained by public founding

Thank you

F. Ferrari. M. Trevisan, A. Merli, E. Capri.