WOW! CLOSING EVENT – PART 2
FRIDAY SEPTEMBER 8TH – DUBLIN

Interreg North-West Europe WOW!
EUROPEAN UNION
European Regional Development Fund

Elimination of pollutants using Biochar from cellulose in Constructed Wetlands

Dr. Silvia Venditti

Motivation

- Use large WWTPs as factories to boost **territorial cohesion** and **inclusive growth** (according to the Interreg NWE program) in rural areas.

- The NWE zone is composed of rural areas with a high percentage of small and medium WWTPs discharging in sensitive rivers where **pollution mitigation** is of utmost importance to achieve the good (chemical and) ecological conditions in surface water;

- The Wow Activated Biochar from Cellulose can be applied as **admixture in Nature-based Solutions (NBS)** for pollution mitigation in NWE's rural areas

Why Nature-Based Solutions (NBS)

- **Nature-based Solutions** are innovative approaches that regenerate areas affected by human activities, restoring key ecological functions that improve people's quality of life (EC, 2023).

Why micropollutants

- Micropollutants pose a possible risk to aquatic system;
- Conventional WWTPs are inefficient to remove most micropollutants;
- Mandatory for all EU member states to monitor 17 compounds, among them the antibiotics azithromycin, clarithromycin and erythromycin;
- **A solution for small/medium sized WWTPs is needed.**


JRC TECHNICAL REPORT

Development of the first Watch List under the Environmental Quality Standards Directive

Directive 2008/105/EC, as amended by Directive 2013/39/EU, in the field of water policy


EUROPEAN COMMISSION

Brussels, 26.10.2022
COM(2022) 541 final

2022/0345 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

concerning urban wastewater treatment (recast)


EUROPEAN COMMISSION

Brussels, 26.10.2022
COM(2022) 540 final

2022/0344 (COD)

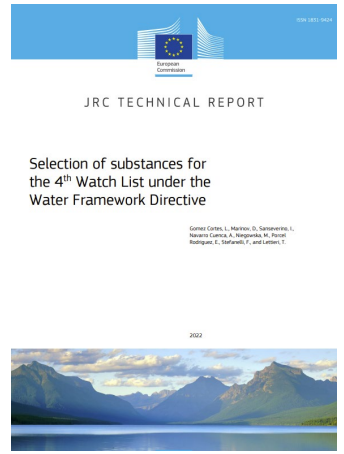
Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2000/60/EC establishing a framework for Community action in the field of water policy, Directive 2006/118/EC on the protection of groundwater against pollution and deterioration and Directive 2008/105/EC on environmental quality standards in the field of water policy

(Text with EEA relevance)

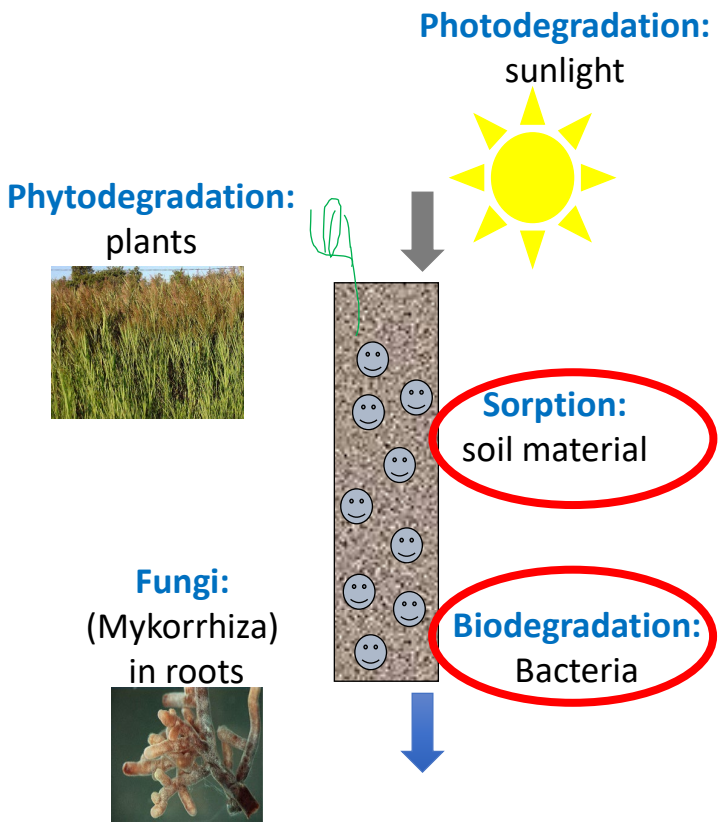
{SEC(2022) 540 final} - {SWD(2022) 540 final} - {SWD(2022) 543 final}

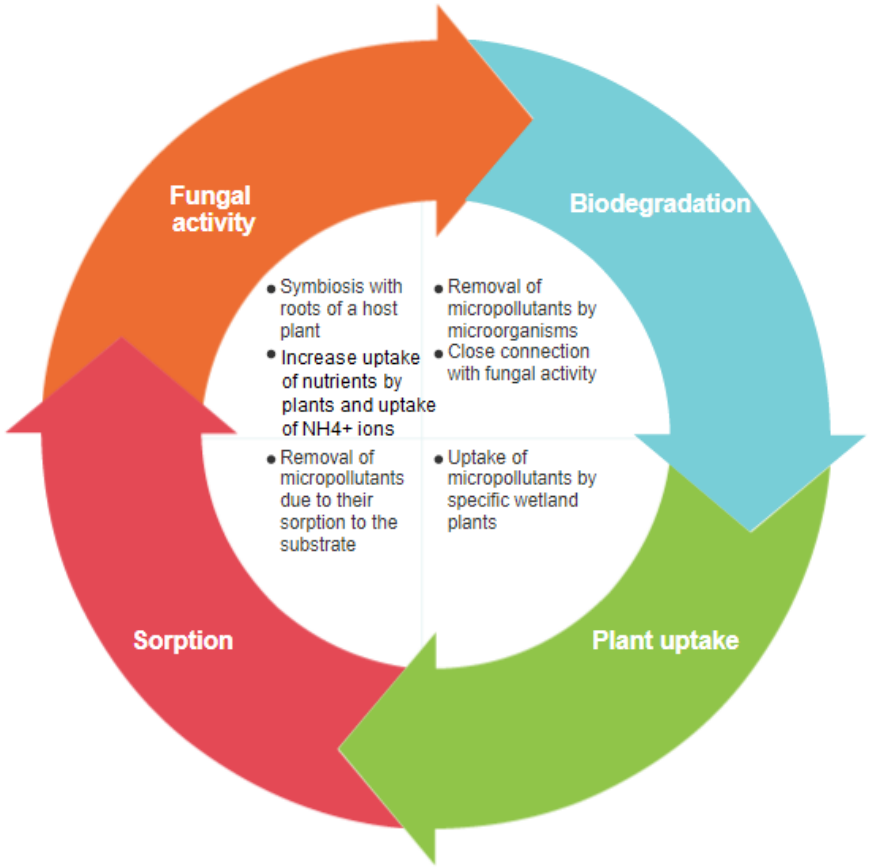

JRC TECHNICAL REPORT

Selection of substances for the 4th Watch List under the Water Framework Directive

2022

Removal Principles of a CW in a vertical flow configuration



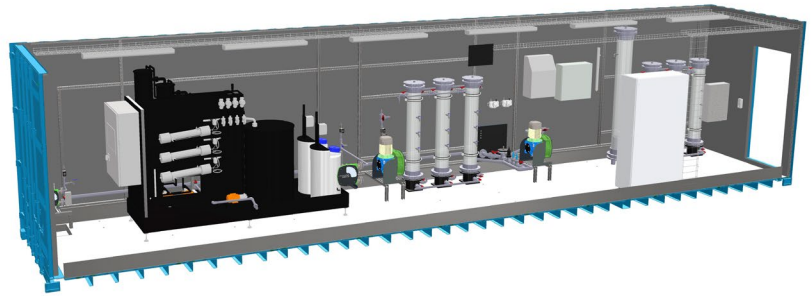


Which expertise we have since 2017

Interreg North-West Europe
WOW!
European Regional Development Fund

Interreg Grande Région | Großregion
EmiSûre
Fonds européen de développement régional | Europäischer Fonds für regionale Entwicklung

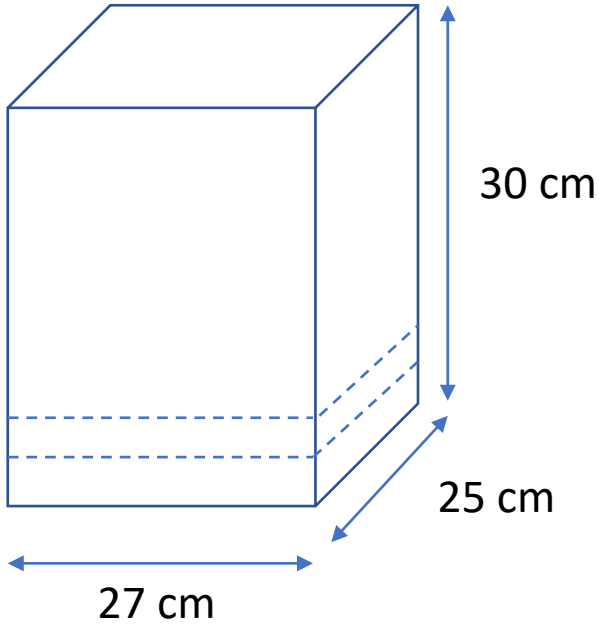
Interreg Grande Région | Großregion
CoMinGreat
Fonds européen de développement régional | Europäischer Fonds für regionale Entwicklung



CWs in Mesocosm scale (Lab design)

- They allow to conduct experiments under replicated, controlled and repeatable conditions at very low cost.

Phragmites australis
Iris pseudacorusm



20 cm
95 % Sand + 5 % Wow Activated Biochar (M2)
95 % Sand + 5 % EmiSûre Activated Biochar (M1)

10 cm gravel
6 cm of coarse 4-8 mm and 4 cm of fine 2-8 mm

Target contaminants (N#28)

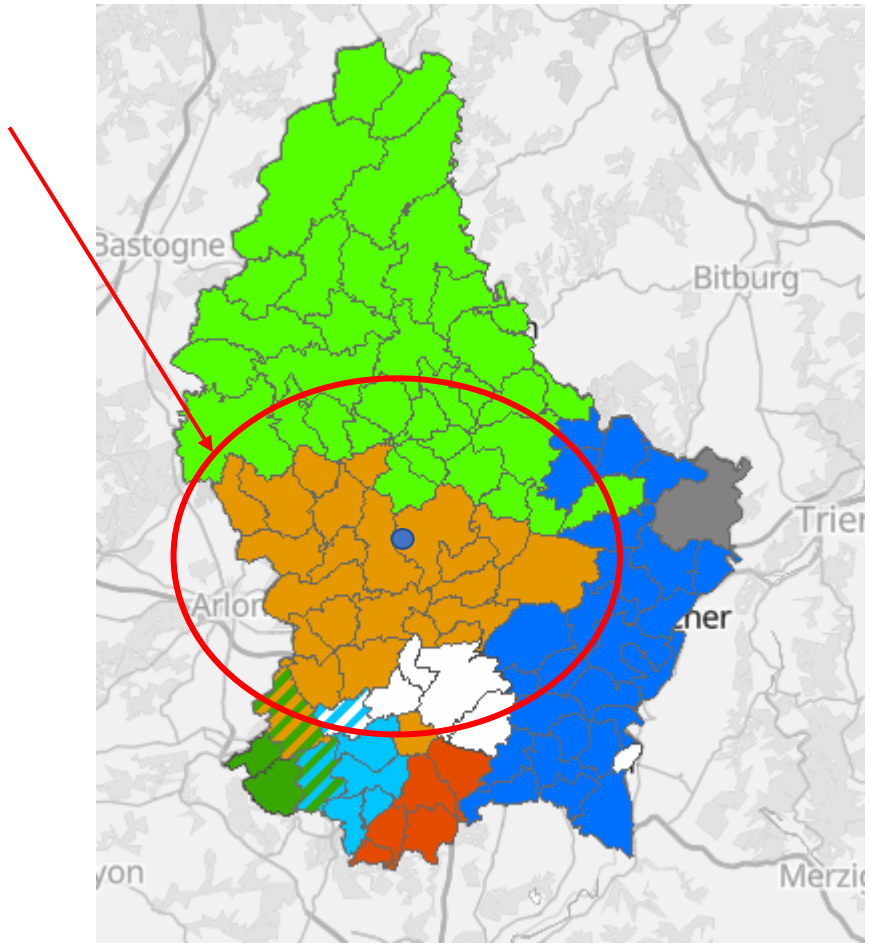
Group	Class	Substance	CAS number
P - Pharmacauticals (16)	Anti-inflammatories (2)	Diclofenac	15307-86-5
		Ibuprofene	15687-27-1
	Anaesthetics (1)	Lidocaine	137-58-6
	Antibiotics (4)	Ciprofloxacin	85721-33-1
		Clarithromycin	81103-11-9
		N4-acetylsulfamethoxazole	21312-10-7
		Sulfamethoxazole	723-46-6
	Beta-blockers (2)	Atenolol	29122-68-7
		Metoprolol	51384-51-1
	Contrast media (2)	Amidotrizoic acid	117-96-4
		Iomeprol	78649-41-9
	Hormones (3)	Estradiol-beta	50-28-2
		Estrone	53-16-7
		Ethinylestradiol	57-63-6
	Lipid regulators (1)	Bezafibrate	41859-67-0
	Psychiatric drug (1)	Carbamazepine	298-46-4
H - Herbicides (5)	Herbicides (5)	Deet	134-62-3
		Diuron	330-54-1
		Flufenacet	142459-58-3
		Isoproturon	34123-59-6
		Terbutryn	886-50-0
O-Others (7)	Antimycotic (1)	Carbendazim	10605-21-7
	Corrosion inhibitor (2)	Benzotriazole	95-14-7
		Tolyltriazole	29385-43-1
	Flame retardant (1)	Tris(2-chloroisopropyl)phosphate (TCPP)	115-96-8
	Fluorosurfactants (1)	Perfluorooctanesulfonic acid (PFOS)	1763-23-1
	Stimulants (1)	Caffeine	58-08-2
	Sweeteners (1)	Sucralose	56038-13-2

WWTP characteristics

SIDERO (Syndicat Intercommunal de dépollution des eaux résiduaires de l'Ouest)

WWTP of Beringen Mersch (70000 PE)

11373 m3/d (average 2022)



Relevance for the WWTP

Group	Class	Substance	CAS number
P - Pharmacauticals (16)	Anti-inflammatories (2)	Diclofenac	15307-86-5
		Ibuprofene	15687-27-1
	Anaesthetics (1)	Lidocaine	137-58-6
	Antibiotics (4)	Ciprofloxacin	85721-33-1
		Clarithromycin	81103-11-9
		N4-acetylsulfamethoxazole X	21312-10-7
		Sulfamethoxazole X	723-46-6
	Beta-blockers (2)	Atenolol	29122-68-7
		Metoprolol	51384-51-1
	Contrast media (2)	Amidotrizoic acid X	117-96-4
		Iomeprol	78649-41-9
	Hormones (3)	Estradiol-beta X	50-28-2
		Estrone X	53-16-7
		Ethinylestradiol X	57-63-6
	Lipid regulators (1)	Bezafibrate X	41859-67-0
	Psychiatric drug (1)	Carbamazepine	298-46-4
H - Herbicides (5)	Herbicides (5)	Deet	134-62-3
		Diuron X	330-54-1
		Flufenacet X	142459-58-3
		Isoproturon X	34123-59-6
		Terbutryn X	886-50-0
O-Others (7)	Antimycotic (1)	Carbendazim X	10605-21-7
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	Stimulants (1)	Caffeine	58-08-2
	Sweeteners (1)	Sucralose	56038-13-2

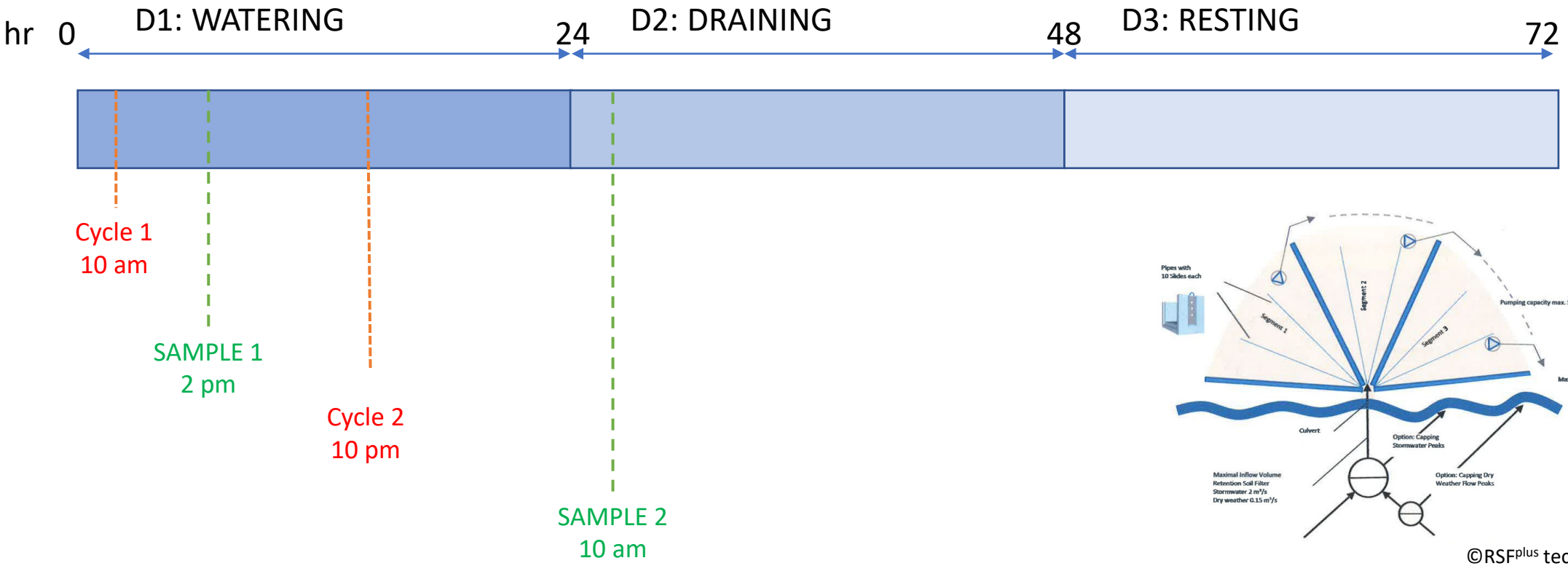
- 17 compounds out of 28 are relevant in the influent of the WWTP (>50 ng/L)
- 12 compounds out of 28 are relevant in the effluent of the WWTP (>50 ng/L)

Testing plan

Scenarios	Specifications	Hydraulic Load per irrigated surface (m3/m2d)	Hydraulic Load per irrigated volume of soil (m3/m3d)	Motivation
SCENARIO 1	Batch test	0.09*	426.9	0.1 m3/m2d EmiSûre/CoMinGreat surface hydraulic Load (45 to 90 cm dept)
SCENARIO 2	Continuos test	0.023	115.74*	110 m3/m3d EmiSûre/CoMinGreat surface hydraulic Load (45 to 90 cm dept)

Scenario 1: specifications

- Batch test of 3 days



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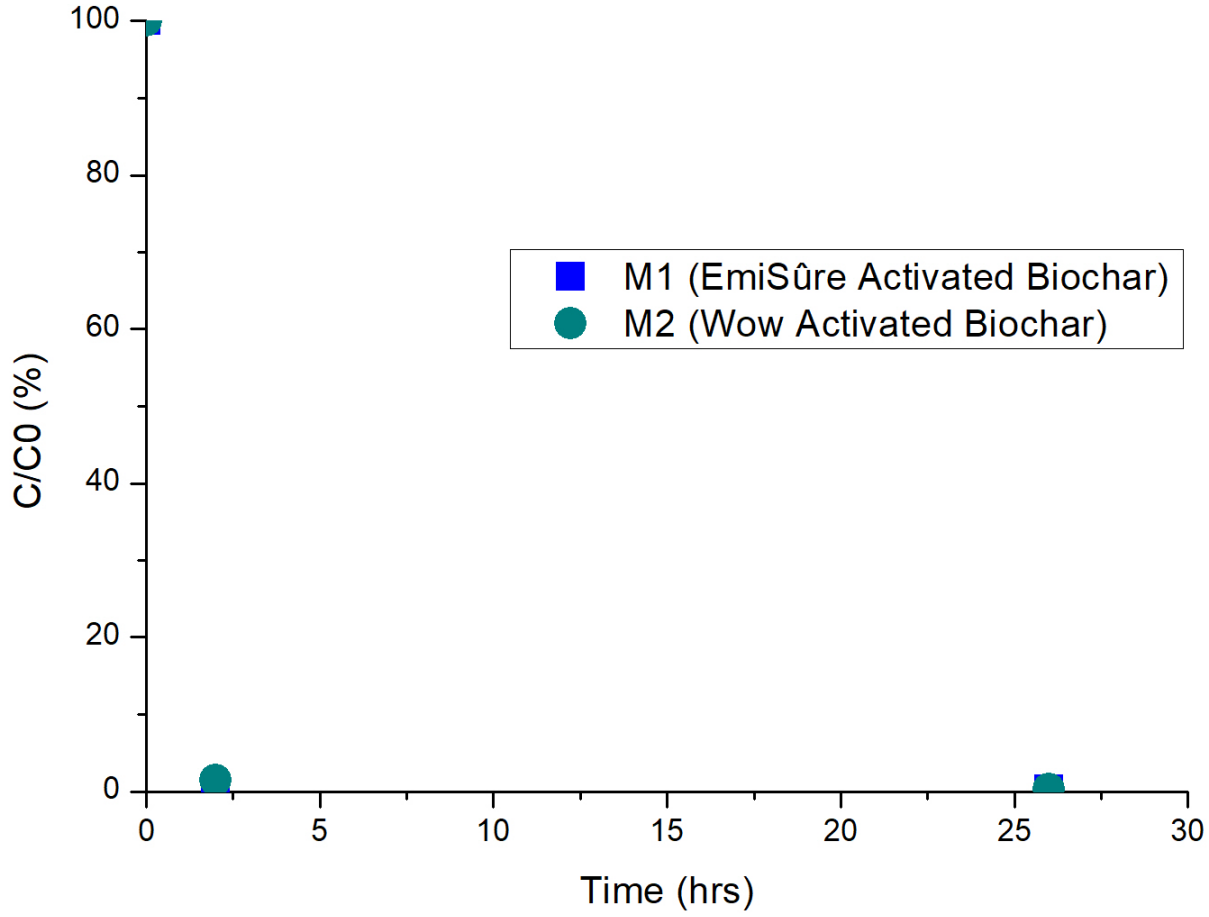
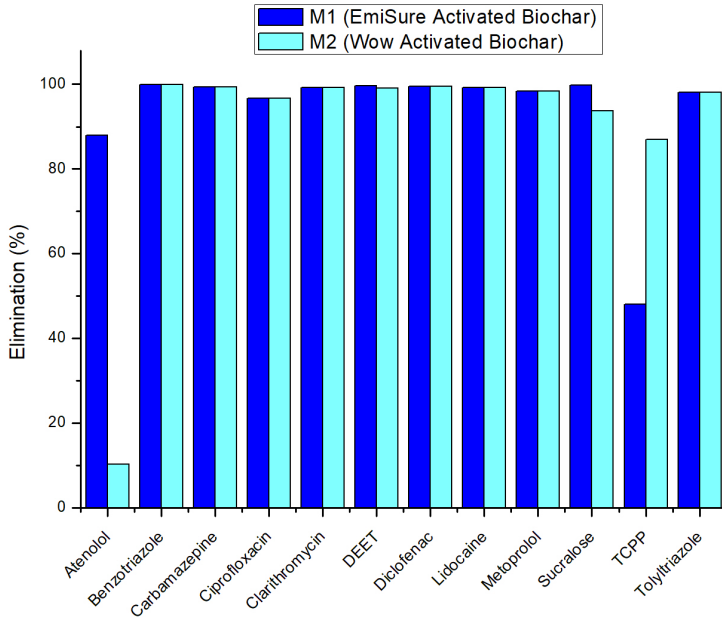
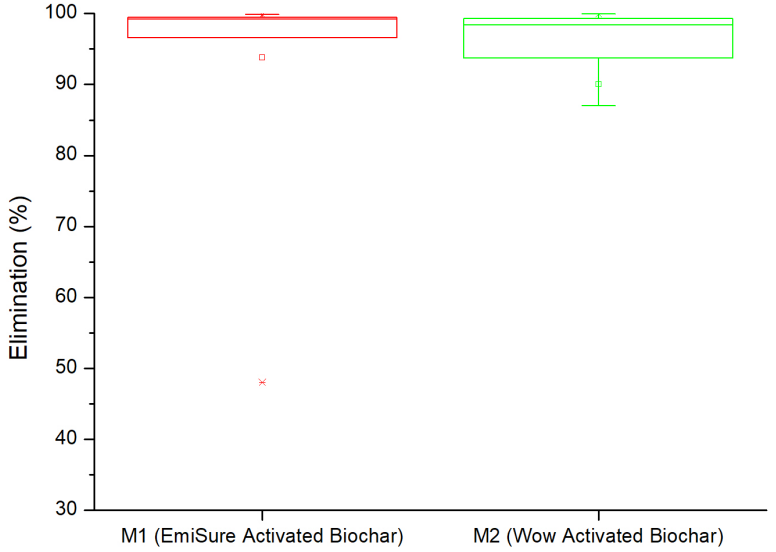
Scenario 1: results

- Full elimination occurs already with the first flush, after 4 hrs from the watering (Example **Diclofenac**)



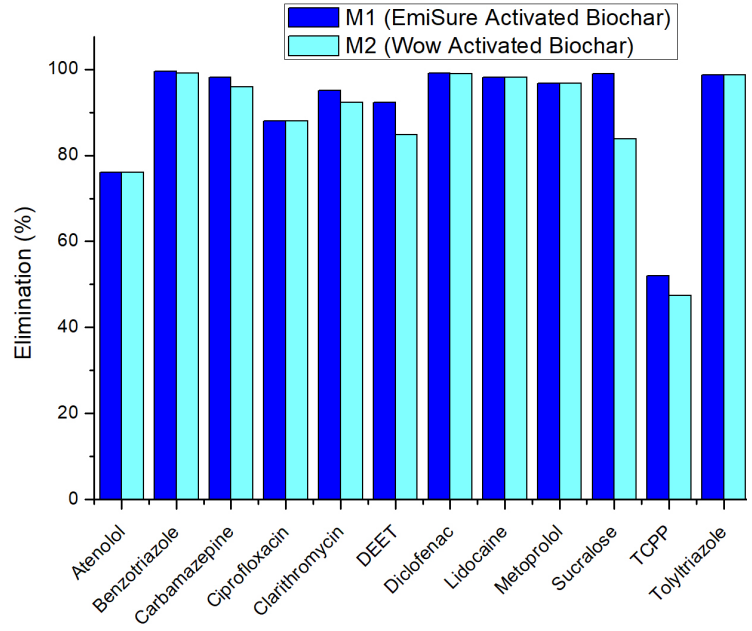
Scenario 1: results

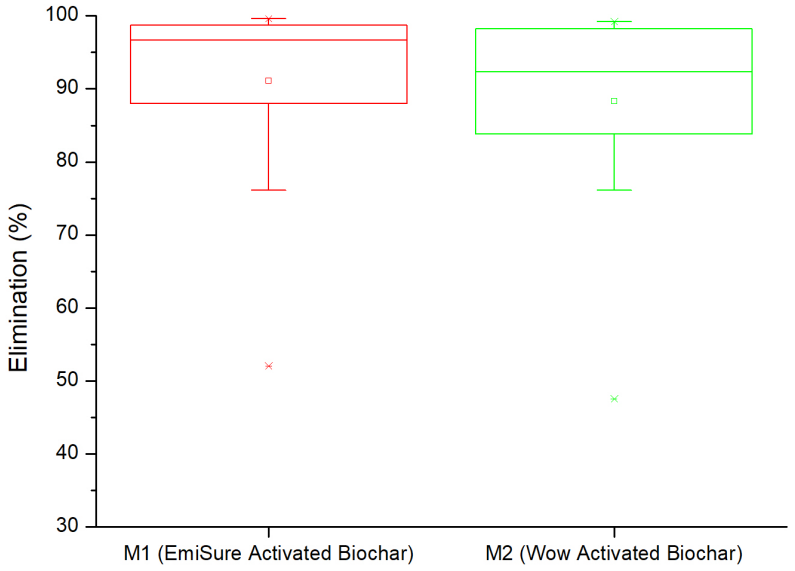




- There is not a significative difference in performance between M1 (EmiSure Activated Biochar) and M2 (Wow Activated Biochar) with the exception of Atenolol and TCPP
- Average elimination (12 compounds)= 94.5% (M1) and 91.5% (M2)

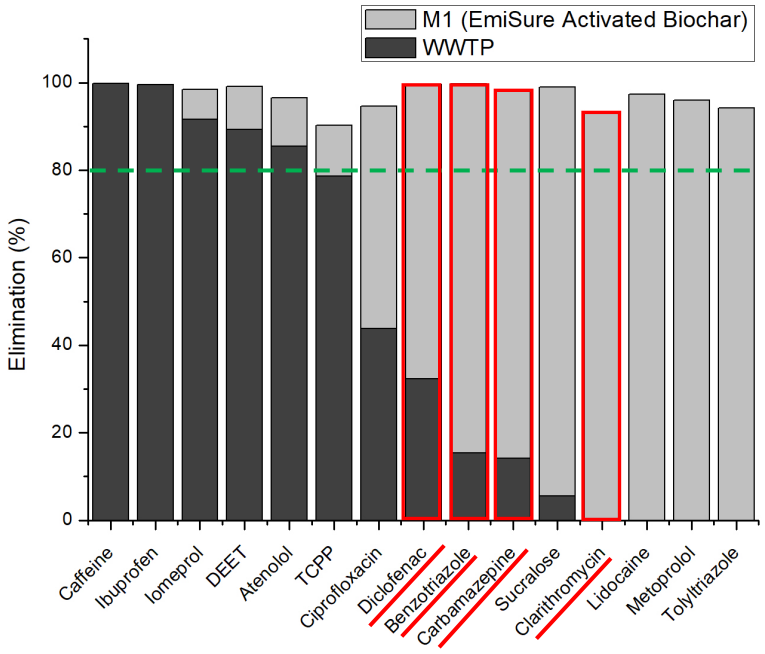
Scenario 2: results

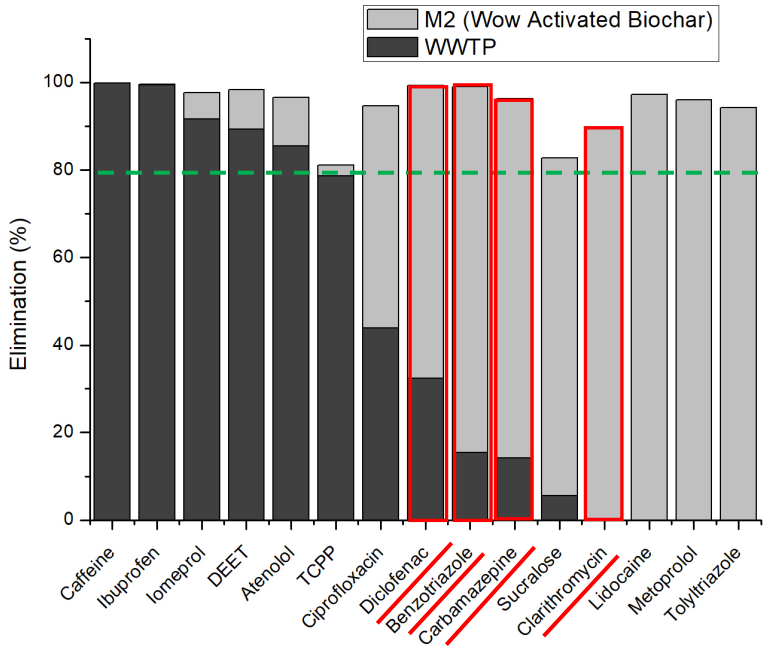




- There is not a significative difference in performance between M1 (EmiSure Activated Biochar) and M2 (Wow Activated Biochar)
- Average elimination (12 compounds)= 91.1% (M1) and 88.4% (M2)

Implementing policy





biologie sans charbon actif. En Suisse et en Bade-Wurtemberg, une élimination d'au moins 80 % dans toute la STEP est prescrite pour des micropolluants organiques sélectionnés. Similairement pour le Luxembourg, une élimination d'au moins 80 % dans la STEP est prescrite à ce stade pour les substances suivantes :

Substance	Application	Numéro CAS
Diclofénac	anti-inflammatoire	15307-86-5
Carbamazépine	anticonvulsivant	298-46-4
Clarithromycine	antibiotique	81103-11-9
Benzotriazole	anticorrosif	95-14-7

- Meeting the legislation restrictions with 80 % elimination for 4 mandatory compounds (Luxembourgish legislation)

Conclusions

- The Wow Activated Biochar from Cellulose proved to **be suitable** as admixture in CW for the removal of micropollutants (post-treatment step)

- The performance of Wow Activated Biochar from Cellulose is similar to those of previous Activated Biochar (produced from plants) with more than **80 % elimination** for most relevant micropollutants

- The implementation for a small catchment area in Saarland will be presented from Inka Hobus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