Innovative cost-effective multibarrier treatments for reusing water for agricultural irrigation

LIFE19 ENV/ES/000278

2nd Project workshop

Almería, 21st October 2024

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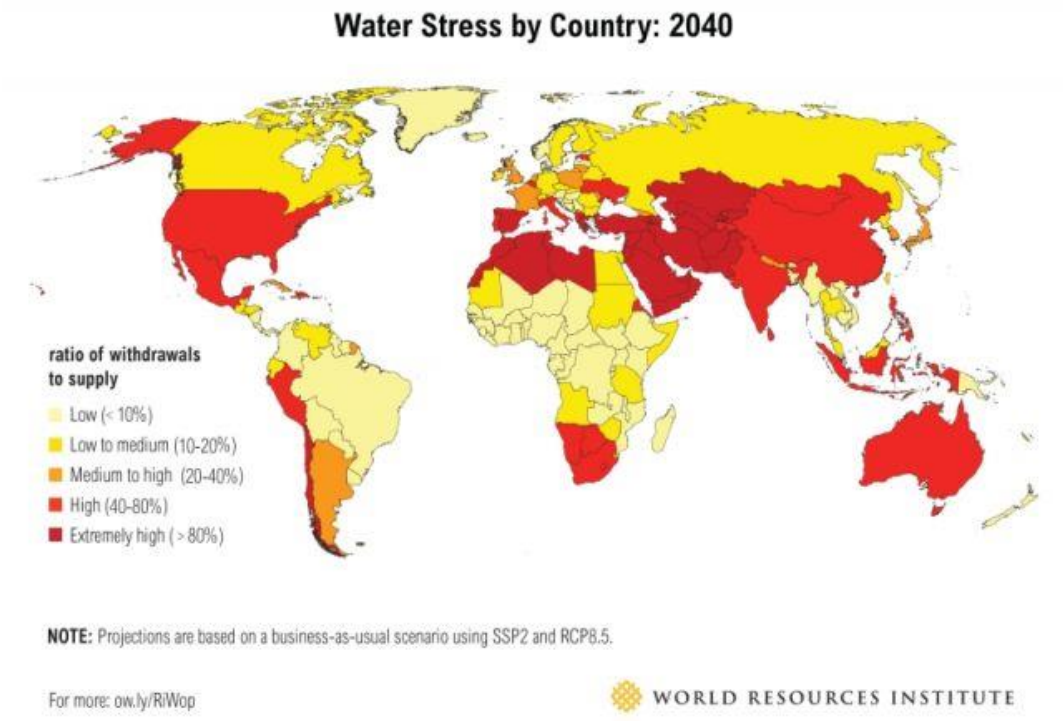
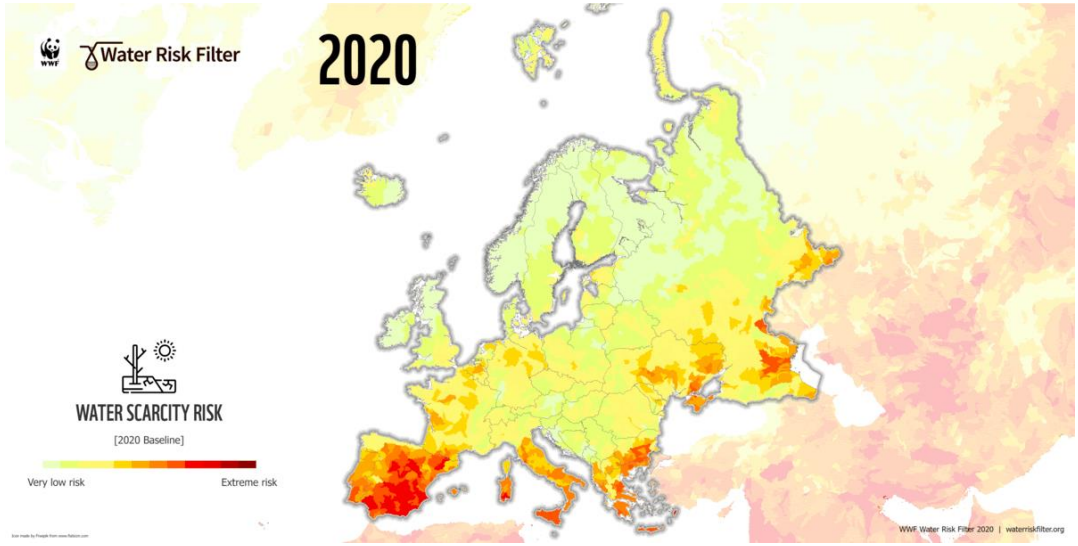
Challenges: Global water scarcity





Intensification of water scarcity in Europe caused by global warming is a reality:

- 30% of total UE population lives under water stress situation.
- This problem is exacerbated in the mediterranean countries (SP, IT, CY, GR)

2.6 billion people in the world suffer from water stress.

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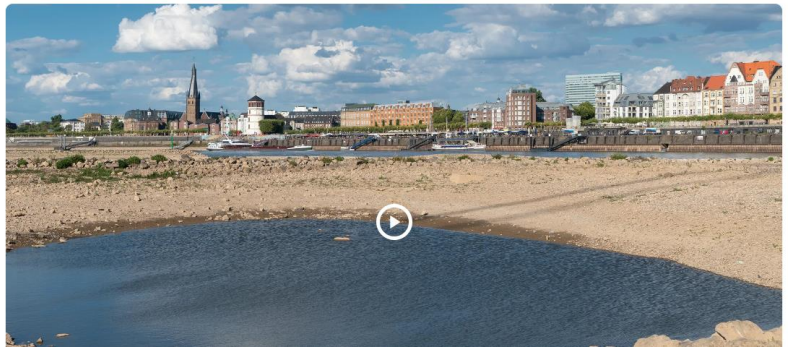
Challenges: Global water scarcity

Why is the UK facing water shortages despite record rainfall?

Climate breakdown, an increasing population and a lack of new infrastructure are factors contributing to water scarcity

UK at risk of summer water shortages and hosepipe bans

Study the alarming cause of water shortages in Germany



Water scarcity in the Netherlands August 2022

2022 | *Technical reports* | Energy and transport | Environment and climate change | Safety and security

Subtitle: GDO analytical report

Abstract: The Dutch government declared a "de facto water shortage (level 2)" on August 3rd, scaling up from a "threat of water shortage (level 1)". With this declaration, the management of the water distribution is delegated to a national commission (Management Team Water Scarcity) with the aim of following the development of the water scarcity more closely and being able to react faster if the need for more measures arises. Currently, mostly preventive measures are taken.

ENVIRONMENT · DROUGHT

Persistent drought in southern France: 'This time, it's brutal'

By Martine Valo (special correspondent in the French Pyrenees)

Published on April 29, 2024, at 5:30 am (Paris)

8 min read Lire en français

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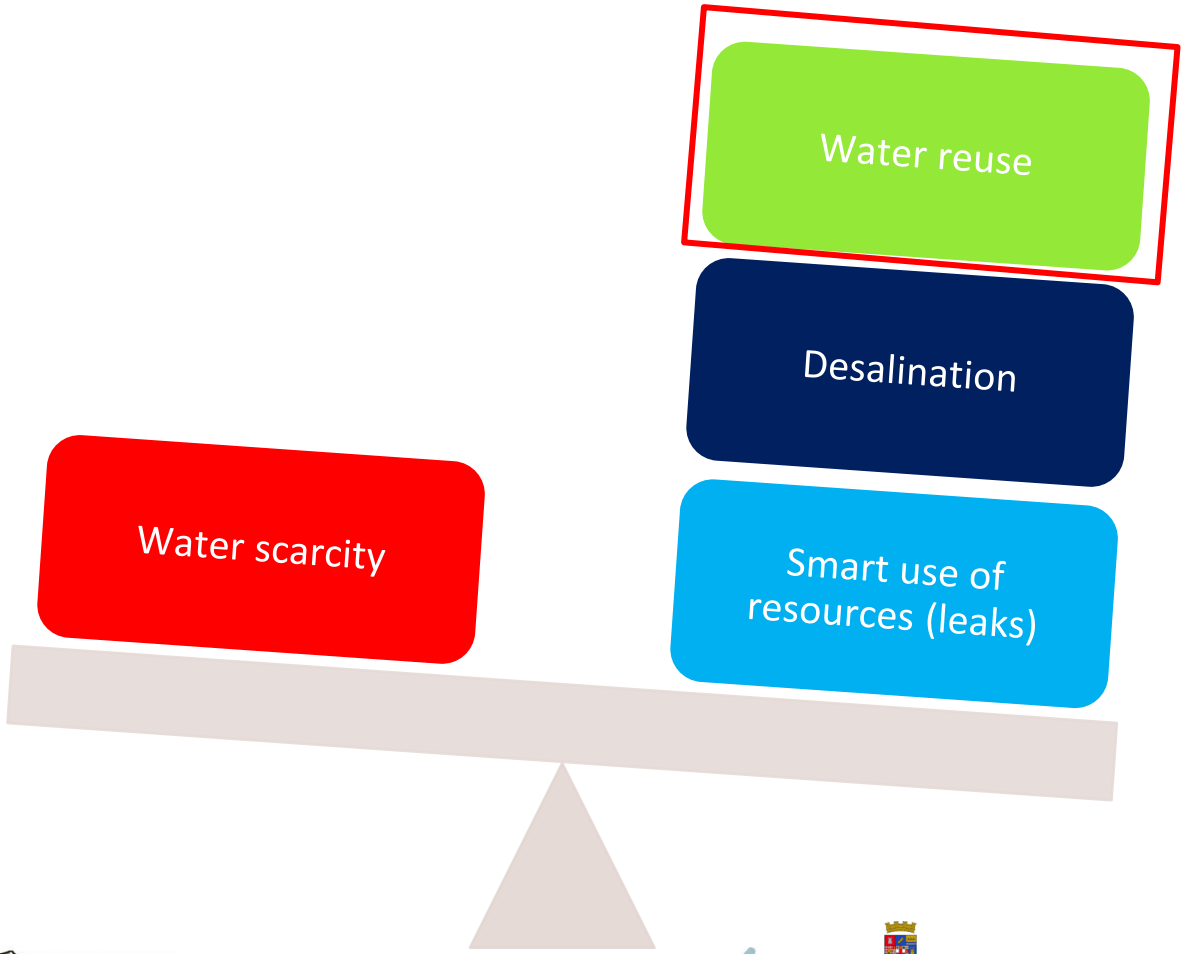
Challenges: fight against water scarcity



Not a waste!

In coastal areas, smart brine management

A quarter of non-revenue water is lost.
In Spain almost 1000Hm3/year

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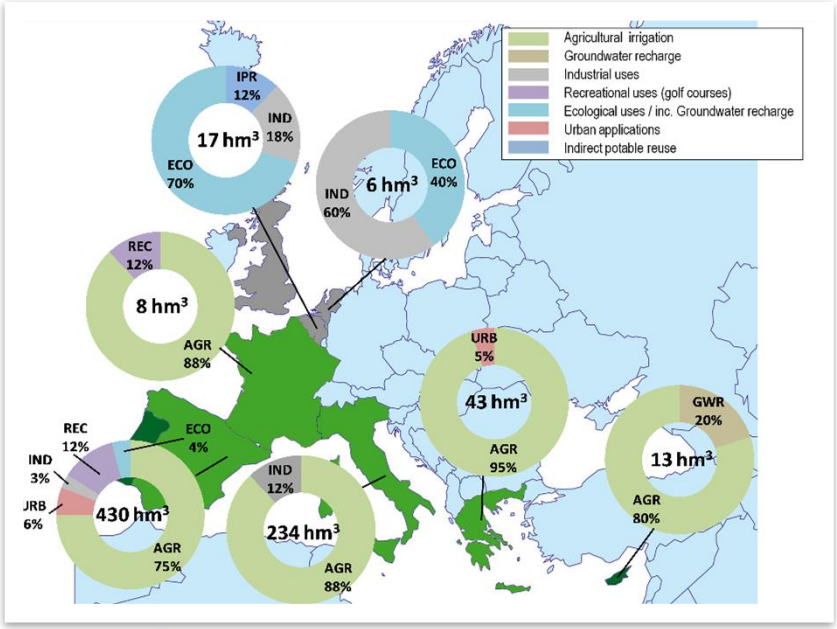
Challenges: Reuse, Reuse and finally reuse

EUROPE

more than 40,000 million m³ of waste water treated in EU every year

but only 964 million m³ of this treated wastewater is REUSED



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Challenges: Reuse, Reuse and finally reuse

Water uses in Europe:

-44% for energy production

-24% for agriculture up to 80% in the south of Europe

-21% for public supply

-11% for industry purposes

Accodind to FAO, By 2050, agriculture will have to produce almost 50% more food to satisfy the need

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Challenges: New EU Regulation 741/2020

Official Journal of the European Union

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Volume 63

English edition — Legislation — 5 June 2020

Contents

I *Legislative acts*

REGULATIONS

* Regulation (EU) 2020/740 of the European Parliament and of the Council of 25 May 2020 on the labelling of tyres with respect to fuel efficiency and other parameters, amending Regulation (EU) 2017/1369 and repealing Regulation (EC) No 1222/2009 1

* Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse (1) 32

II *Non-legislative acts*

INTERNATIONAL AGREEMENTS

* Council Decision (EU) 2020/742 of 29 May 2020 on the conclusion of the Agreement in the form of an Exchange of Letters between the European Union and the Islamic Republic of Mauritania concerning the extension of the Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania, expiring on 15 November 2019 56

- **Regulation focused to agricultural irrigation.**
  - ✓ Food farming and others
  - ✓ Regenerated water quality control
  - ✓ Production, distribution and storage
  - ✓ Risk management

Applicable 3 years after publication (**25th May 2020**)

More demanding requirements than the Spanish regulation

Table 2 – Reclaimed water quality requirements for agricultural irrigation

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
B	Secondary treatment, and disinfection	≤ 100	In accordance with Directive 91/271/EEC (Annex I, Table 1)	In accordance with Directive 91/271/EEC (Annex I, Table 1)	-	
C	Secondary treatment, and disinfection	≤ 1 000			-	
D	Secondary treatment, and disinfection	≤ 10 000			-	

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Challenges: New EU Regulation 741/2020 vs Spanish regulation

Real Decreto 1620/2007

USO DEL AGUA PREVISTO	VALOR MÁXIMO ADMISIBLE (VMA)				
	NEMATODOS INTESTINALES	*ESCHERICHIA COLI*	SÓLIDOS EN SUSPENSIÓN	TURBIDEZ	OTROS CRITERIOS
2.- USOS AGRÍCOLAS[1]					
CALIDAD 2.1[2] a) Riego de cultivos con sistema de aplicación del agua que permita el contacto directo del agua regenerada con las partes comestibles para alimentación humana en fresco.	1 huevo/10 L	100 UFC/100 mL Teniendo en cuenta un plan de muestreo a 3 clases[3] con los siguientes valores: n = 10 m = 100 UFC/100 mL M = 1.000 UFC/100 mL c = 3	20 mg/L	10 UNT	OTROS CONTAMINANTES contenidos en la autorización de vertido de aguas residuales: se deberá limitar la entrada de estos contaminantes al medio ambiente. En el caso de que se trate de sustancias peligrosas deberá asegurarse el respeto de las NCAs. *Legionella spp.* 1.000 UFC/L (si existe riesgo de aerosolización) Es obligatorio llevar a cabo la detección de patógenos Presencia/Ausencia (Salmonella, etc.) cuando se repita habitualmente que c=3 para M=1.000

REGLAMENTO (EU) 741/2020

Table 2 – Reclaimed water quality requirements for agricultural irrigation

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	NEW BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
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Challenges: New EU Regulation 741/2020 vs Spanish regulation

Table 4 – Validation monitoring of reclaimed water for agricultural irrigation

Reclaimed water quality class	Indicator microorganisms (*)	Performance targets for the treatment chain (log_{10} reduction)
A	*E. coli*	≥ 5,0
	Total coliphages/F-specific coliphages/somatic coliphages/coliphages (**)	≥ 6,0
	Clostridium perfringens spores/spore-forming sulfate-reducing bacteria (***)	≥ 4,0 (in case of *Clostridium perfringens* spores) ≥ 5,0 (in case of spore-forming sulfate-reducing bacteria)

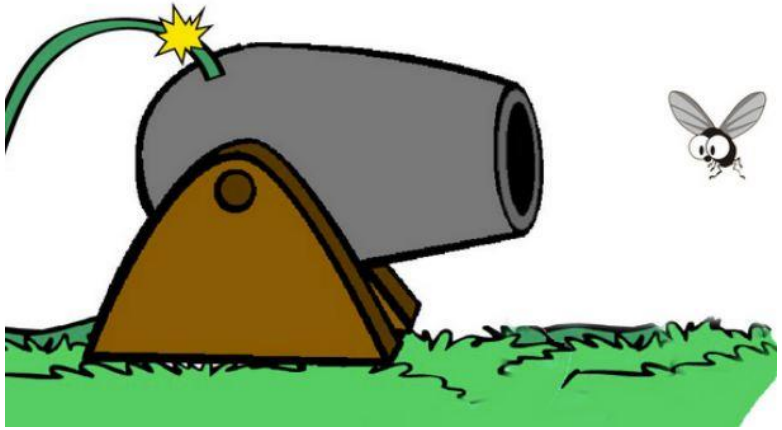
(*) The reference pathogens *Campylobacter*, Rotavirus and *Cryptosporidium* may also be used for validation monitoring purposes instead of the proposed indicator microorganisms. The following log_{10} reduction performance targets shall then apply: *Campylobacter* (≥ 5,0), Rotavirus (≥ 6,0) and *Cryptosporidium* (≥ 5,0).

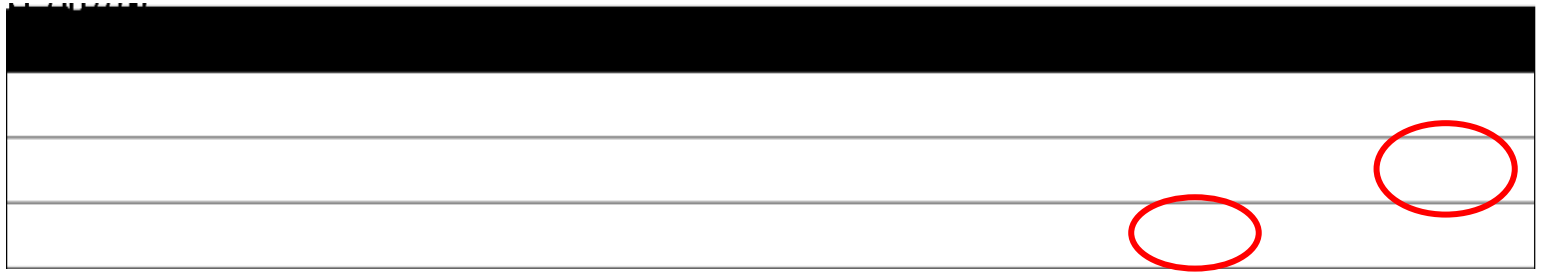
(**) Total coliphages is selected as the most appropriate viral indicator. However, if analysis of total coliphages is not feasible, at least one of them (F-specific or somatic coliphages) shall be analysed.

(***) *Clostridium perfringens* spores is selected as the most appropriate protozoa indicator. However, spore-forming sulfate-reducing bacteria are an alternative if the concentration of *Clostridium perfringens* spores does not make it possible to validate the requested log_{10} removal.

Virus indicator

Protozoa indicators





Affordable reclaimed water for agriculture is mandatory

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Objectives to reach

1

Obtaining reclaimed water meeting A quality (WWR-EU):

-Solutions for **large-medium** populations

-Solutions for **small** populations

2

Develop a **Decision Support System** (DSS) and a Sustainability Tool to ensure feasibility for each case & waste water.

3

Minimize environmental & health effects caused by reclaimed water use by reduction of:

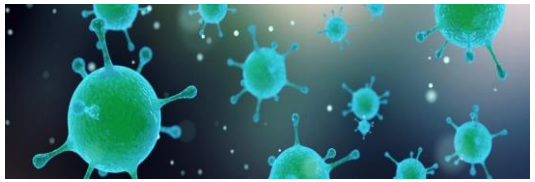
- Harmful disinfection/oxidation products & eco-toxicity (>80%)
- >90% Compounds of **Emergent Concern** (CECs) & **antibiotic resistant bacteria** (ARB)
- 97% **microplastics** (MPs)
- C footprint (50%)

4

Ensure water quality by:

-**Online monitoring**: toxics (UV-vis); pathogens (enzymatic activity).

-Offline analyses: MPs, eco-toxicity, ARB.



5

Recover more than 90% nutrients (N,P)

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Objectives to reach

6 **Test reclaimed water & recovered fertilizer** at experimental crop fields (500 m^2)

7 **Reduce to 0.10-0.15 €/m^3 OPEX of the 3ary treatment**:

-30% lower fouling membranes

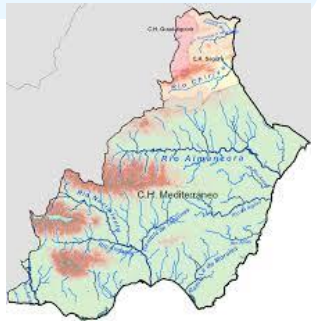
-Low energy UV-LED & Solar Photo-Fenton

-Residual O_3 reuse to advanced flotation (20%)

-Reduce size of disinfection due to efficient pretreatment

-Optimal technologies configuratio by DSS

8 **Study of WWR-EU incidence in existing WWRTPs-Almeria-ES inventory**



9 **Promote replication, transferability & market uptake** by a Stakeholder Panel

10 **Evaluation of environmental, social & economic impacts**

11 **Results Dissemination**

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Actions

WATER REUSE CASE STUDIES

DECISION SUPPORT SYSTEM

REPLICABILITY: ALMERIA CASE STUDY

Large-Medium WWTPs

PRETREATMENTS

Ballaste lamella clarification, high rate disolved ozoned flotation (DOF), disk filter, pre-ozonization…

DISINFECTION + AOPs

Ozone, UV, H2O2

Advanced Oxidation Systems (AOPs)

PATHOGEN ONLINE MONITORING

Small WWTPs

PRETREATMENTS

Microalgae HRAP + DAF

Innovative constructed wetlands

DISINFECTION + AOPs

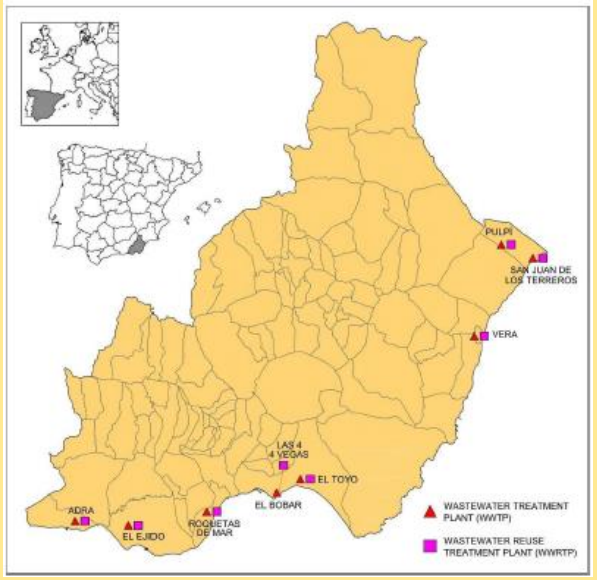
Solar driven AOPs, UV-LED

NUTRIENT RECOVERY BY ZEOLITE

PATHOGEN ONLINE MONITORING

TRANSFERABILITY AND MARKET UPTAKE

CROP FIELD TEST



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Actions: Solution large & Medium size plants

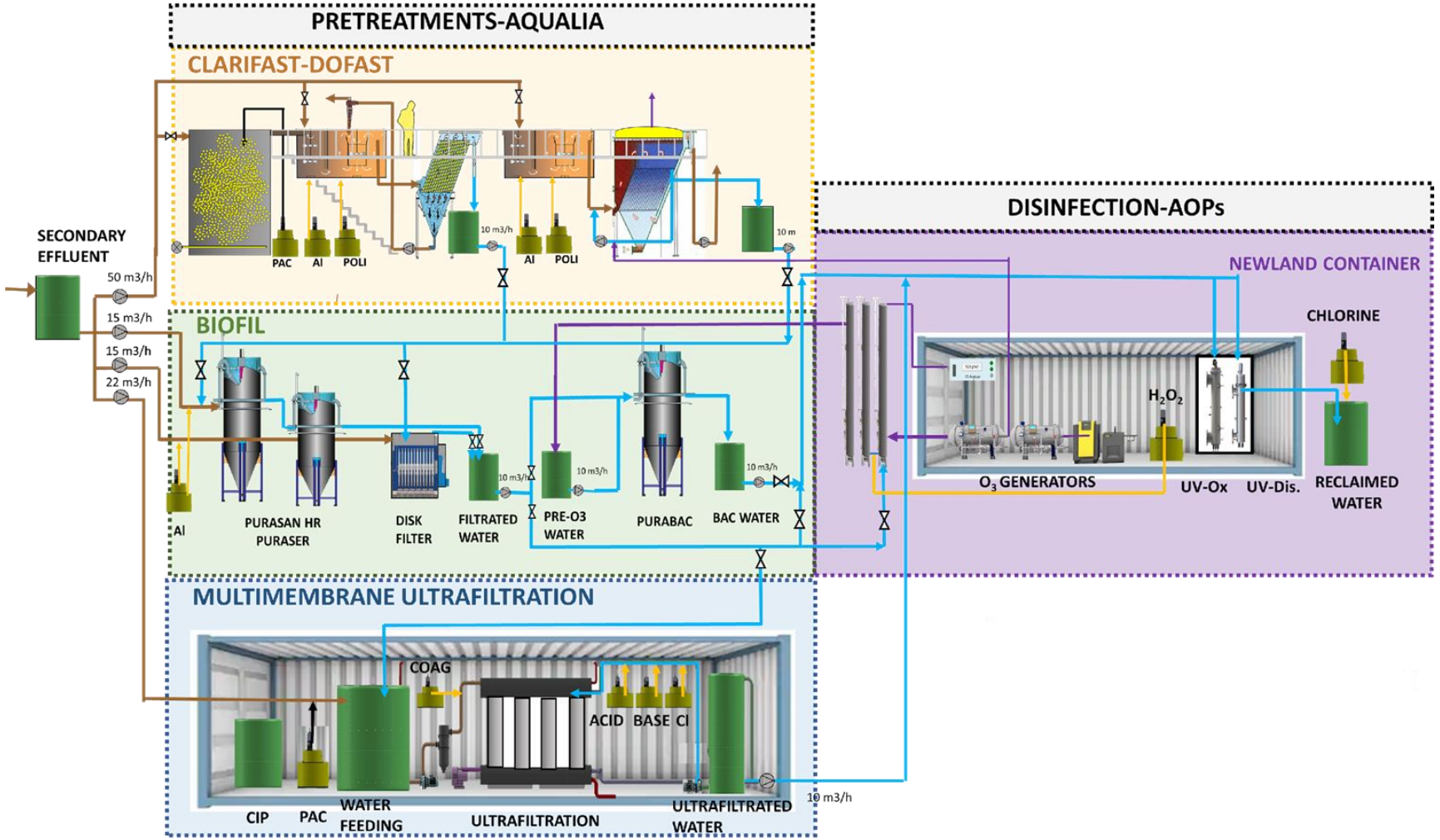
Large-Medium WWTPs

PRETREATMENTS
Ballaste lamella clarification, high rate disolved ozoned flotation (DOF), disk filter, pre-ozonization...

DISINFECTION + AOPs
Ozone, UV, H2O2
Advanced Oxidation Systems (AOPs)

PATHOGEN ONLINE MONITORING

TAYLOR MADE SOLUTIONS



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Actions: Solution large & Medium size plants

Large-Medium WWTPs

PRETREATMENTS

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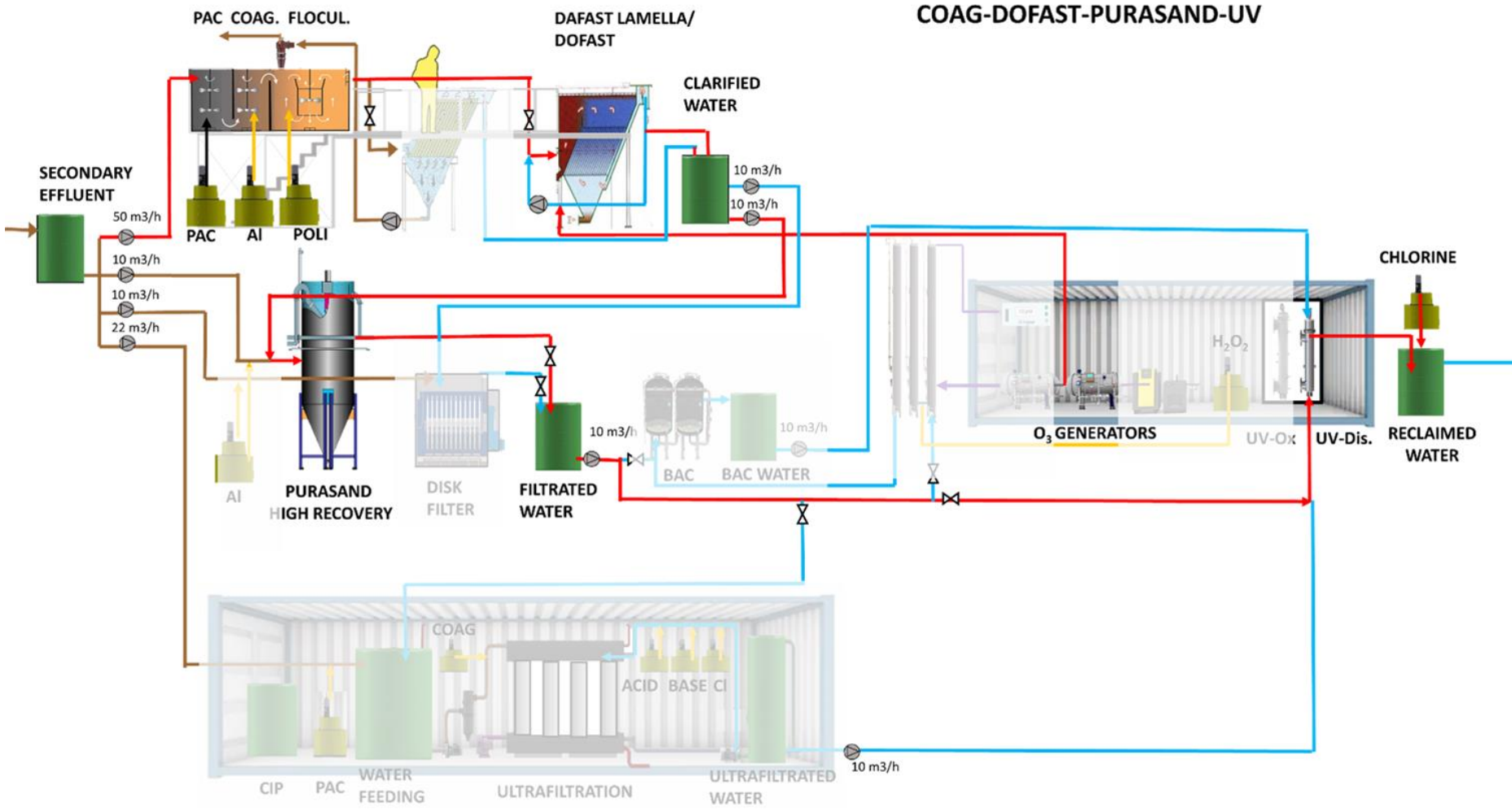
DISINFECTION + AOPs

Ozone, UV, H2O2

Advanced Oxidation Systems (AOPs)

PATHOGEN ONLINE MONITORING

TAYLOR MADE SOLUTIONS



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Actions: Solution large & Medium size plants

Large-Medium WWTPs

PRETREATMENTS

Ballaste lamella clarification, high rate disolved ozoned flotation (DOF), disk filter, pre-ozonization...

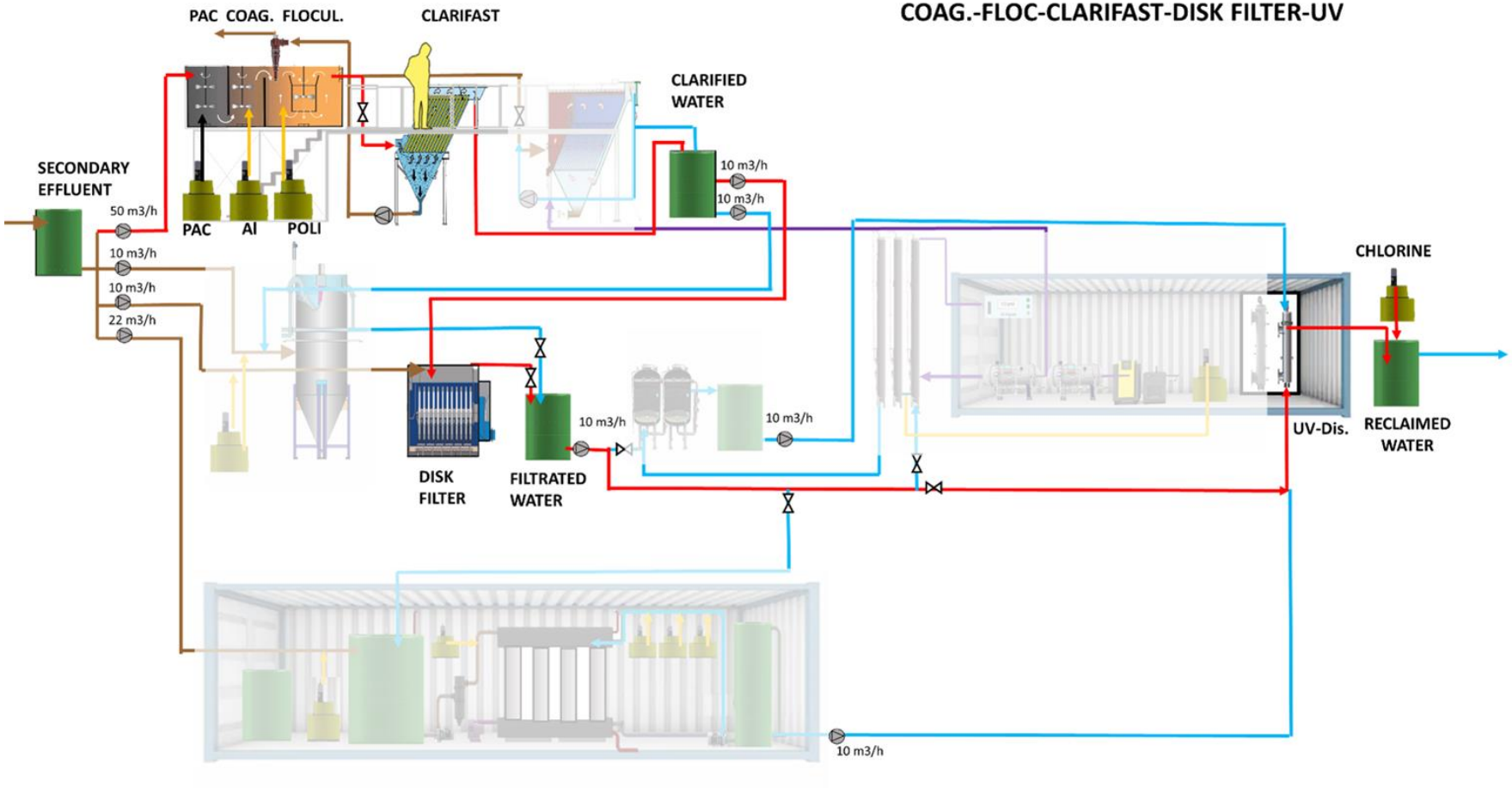
DISINFECTION + AOPs

Ozone, UV, H2O2

Advanced Oxidation Systems (AOPs)

PATHOGEN ONLINE MONITORING

COAG.-FLOC-CLARIFAST-DISK FILTER-UV



TAYLOR MADE SOLUTIONS

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#REUSEHUB

Large & médium size

Small Size

El ToyoWWTP

Innovative cost-effective multibarrier treatments for reusing water for agricultural irrigation
+ 16 technologies
6000m2 de innovation

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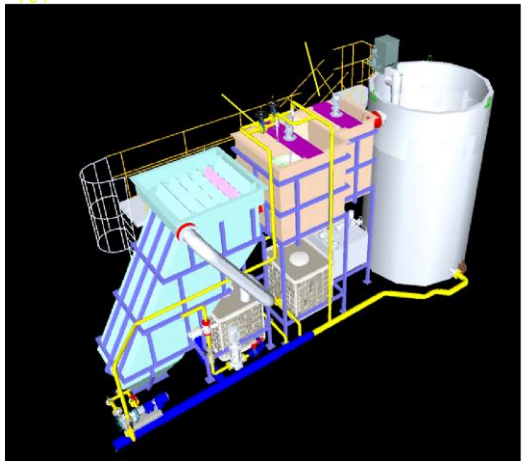
#REUSEHUB

Large and Medium size solutions



+ 16 technologies
6000m2 de innovation

Beyond the state of the art

- **New hydraulic lamella distribution system (50m/h)**
- **New ballasted media to test (adsorption) PAC/GAC.**
- **EC removal**

CLARIFAST: BALLASTED FLOCULATION

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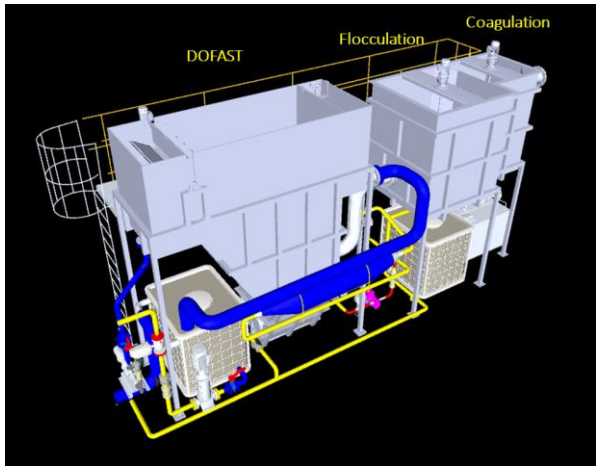
Large and Medium size solutions



+ 16 technologies
6000m2 de innovation

Beyond the state of the art

- **Downflow velocity up to 50 m/h**
- **Innovative lamella distribution system**
- **No compressor/pressurized vessel**
- **DOF system.**

DOFAST: Dissolved air/Ozone Flotation

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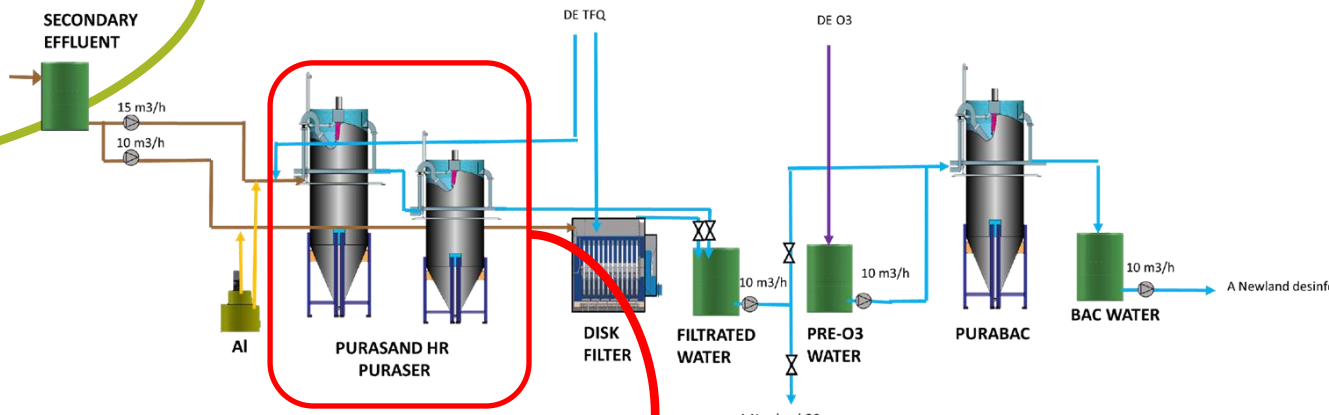
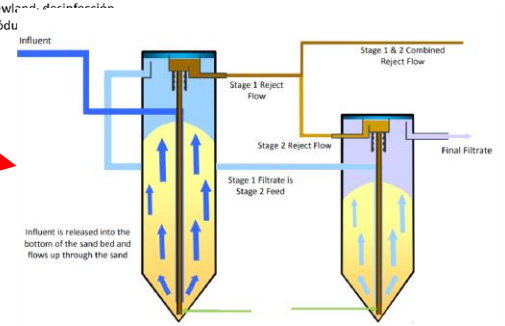
Large and Medium size solutions



Continuous backwash sand filter

Beyond the state of the art

- **90% WASH WATER REDUCTION**
- **90% COMPRESSED AIR REDUCTION**
- **50% SUSPENDED SOLIDS AND TURBIDITY EFFLUENT REDUCCTION**



+ 16 technologies
6000m2 de innovation

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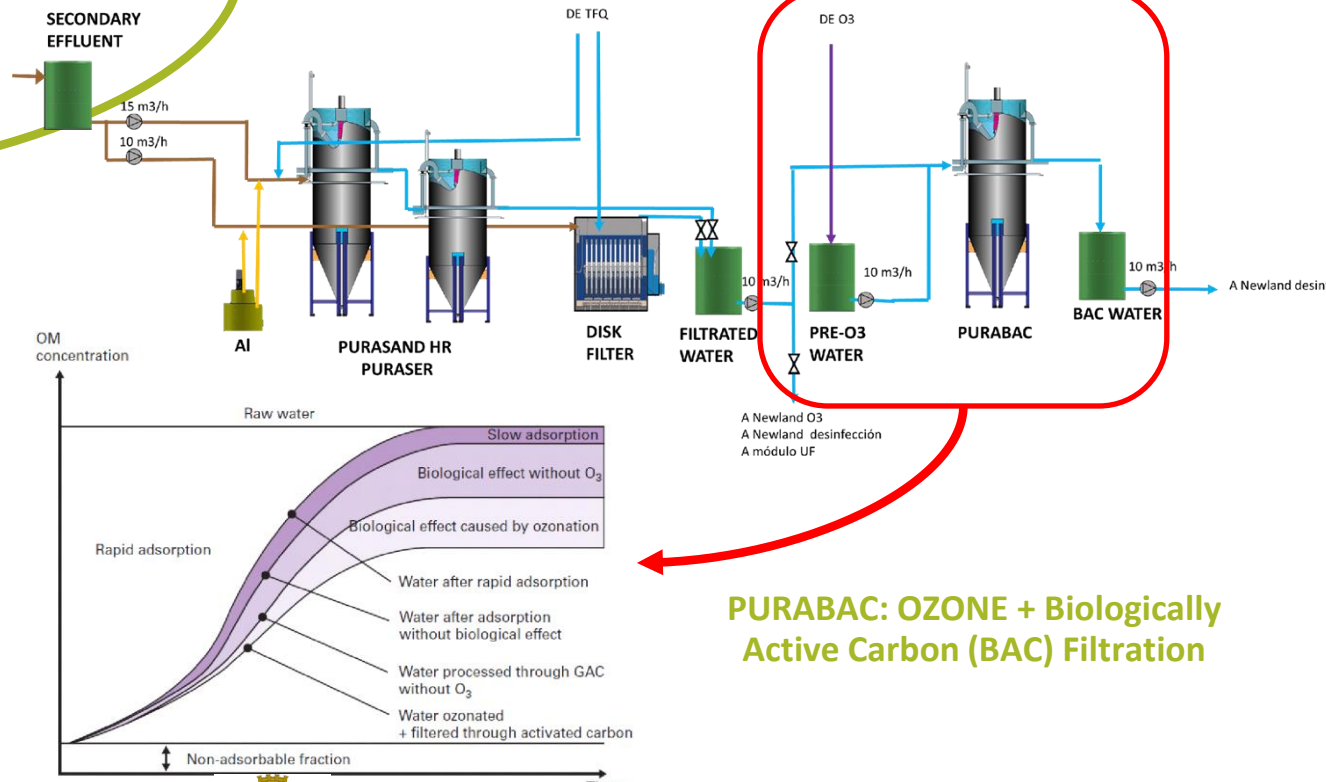
#REUSEHUB

Large and Medium size solutions



PURABAC: OZONE + Biologically Active Carbon (BAC) Filtration

+ 16 technologies
6000m2 de innovation

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#REUSEHUB

Large and Medium size solutions

UF 0,02 micras

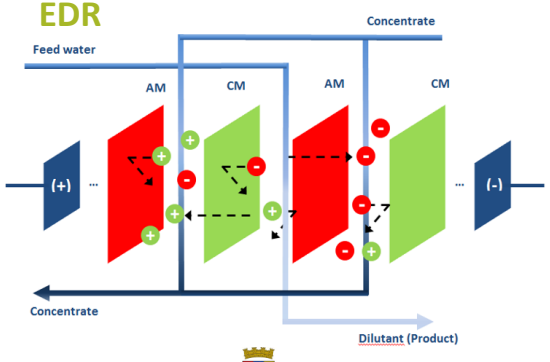
Lower salinity.

Membrane platform

Nanofiltración

RO

EDR



+ 16 technologies
6000m2 de innovation

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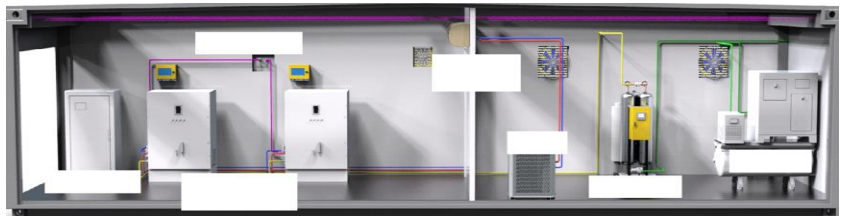
Large and Medium size solutions



+ 16 technologies
6000m2 de innovation

Advanced Oxidation tech

OZONE
-2 O3 generators 200 gr O3/h
-3 contact towers

+

UV
-Validated doce MS2 RED: 20-100 mJ/cm2
2 Uds: Newland y Trojan
-Oxidación 800 mJ/cm2

+ H_2O_2 +

AOP combination
- Ozonoe + H_2O_2
- Ozone + UV
- H_2O_2 + UV
- Ozone + H_2O_2 + UV

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Small size solutions

5X50 Clarifying wetlands

3000m2 raceway pond

UV LED

Solar photo-Fenton

Fresnel system

+ 16 technologies
6000m2 de innovation

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RESULTS & MONITORING

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RESULTS & MONITORING

Samples Analysis

Treatments

Physical-Chemical analysis

- **Analytical Laboratory**: AQUALIA
- **Parameters**: pH, T^a, Electrical conductivity, Turbidity, Color, ORP, DO, Solids, BOD5, COD, T, NH_4^+, NO_3^-, TP, PO_4^{3-}

Microbiological

- **Analytical Laboratory**: CIESOL and EXTERNAL LABORATORY
- **Parameters**: E. Coli, Total Coliphages, Clostridium perfringens spore, Intestinal nematodes (helminth eggs), Legionella spp.

CECs and Pesticides

- **Analytical Laboratory**: UAL
- **Parameters**: 4-AA, 4-AAA, 4-FAA, 9-Acridinecarboxilic_acid, Amisulpride, Atenolol, Benzotriazole, Caffeine, Cetirizine, Citalopram, Cotinine, Dextromethorphan, Diphenhydramine, EDDP, Eprosartan, Fenofibric_acid, Flecainide, Gabapentin, Iomeprol, Irbesartan, Lamotrigine, Lidocaine, Mepivacaine, Nicotine2, O-Desmethyltramadol, O-Desmethylvenlafaxine, Oxypurinole, Sotalol, Sulpiride, Telmisartan, Theophylline, Trazodone, Trigonelline, Valsartan, Venlafaxine, Clindamycin, Levofloxacin, Sulfapyridine, Acetamiprid, Azoxystrobin, Carbendazim, Pirimicarb, Terbutryn, Thiabendazole

MP

- **Analytical Laboratory**: CETIM
- **Parameters**: MP (fibers and fragments)

ARB

- **Analytical Laboratory**: CETIM
- **Parameters**: Total ARB, RB Gentamycin, RB Chloranfeinicol and RB Ceftazidime

Ecotoxicity

- **Analytical Laboratory**: CETIM
- **Parameters**: Standard Daphnia magna test

Phoenix

LIFE PHOENIX is a project co-funded by the European Union under the LIFE Programme Grant Agreement no. LIFE19 ENV/ES/000278

RESULTS & MONITORING

CLARIFAST (Weighted lamellar settling)

Physical-Chemical analysis

Operating conditions		
Q input	m^3/h	20.0
Coagulant	mg/l	110
Floculant	mg/l	3.5

Results

Physico-chemical analysis

Parameters	Sampling point	Units	Results: Average value	Results: Standard deviation	Reclaimed water quality requirements R.741_A Class
Turbidity	Input	NTU	5.7	7.6	5
	Output		**2.8**	0.3	
	Reduction	%	50	--	
Transmitance (254 nm)	Input	%	63.1	0.7	Not applicable
	Output		70.3	0.5	
	Increase		11	--	
Total suspended solids	Input	mg/L	12.2	4.3	10
	Output		**7.0**	1.3	
	Reduction	%	42	--	
DBO_5	Input	mg/L	3.3	0.6	10
	Output		**2.5**	0.7	
	Reduction	%	25	--	

Removal:

- Turbidity: > 50%
- TSS: > 40%
- BOD5 > 25%

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

Phoenix

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RESULTS & MONITORING

CLARIFAST (Weighted lamellar settling)

Microbiological analysis

Operation conditions				
Q input	m3/h	20,1	±	5,3
Transmitance	%	68,5	±	3,8
UV Dose	mJ/cm2	52,39	±	6,3

Results

Microbiologycal analysis

Parameters	Sampling point	Units	Results Average	Standard deviation	Legal limit	R.741_A Class	
E. coli	Input to WWTP	UFC/100 ml	3,6E+06	6,4E+05	≥ 5	log10	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	1			
	WWTP Red.	u. log	2,50	0,18			
	Equipment Red.	u. log	1,15	0,50			
	UV Red.	u. log	2,90	0,35			
	Total Red.	u. log	6,56	0,08			n 3
Total Coliphagues	Input to WWTP	UFC/100 ml	9,8E+02	2,2E+02	≥ 6	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	0,00	0,00			
	WWTP Red.	u. log	0,17	0,08			
	Equipment Red.	u. log	0,85	0,05			
	UV Red.	u. log	1,96	0,02			
	Total Red.	u. log	2,98	0,11			n 4
Clostridium perfringens spores	Input to WWTP	UFC/100 ml	3,2E+05	1,0E+05	≥ 4	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	37	22			
	WWTP Red.	u. log	2,45	0,48			
	Equipment Red.	u. log	1,03	0,40			
	UV Red.	u. log	0,86	0,40			
	Total Red.	u. log	4,34	1,09			n 3

ACHIEVE QUALITY
CLASS A

Achieve minimum requirements
for agricultural irrigation
Regulation (EU) 2020/741

Phoenix

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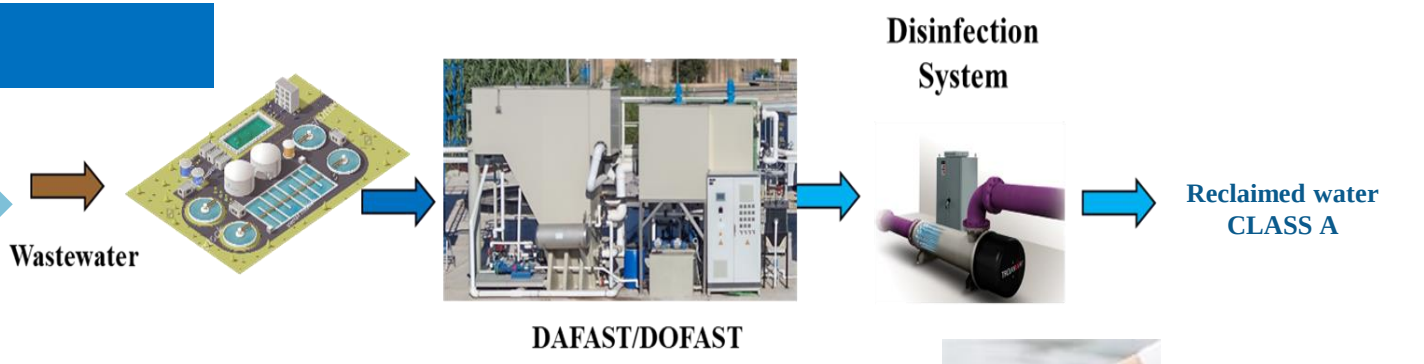
RESULTS & MONITORING

DAFAST (High-speed dissolved air/ozone flotation)



Physical-Chemical analysis

Operating conditions		
Q input	m^3/h	20.0
Coagulant	mg/l	110
Floculant	mg/l	3.48

Results

Physico-chemical analysis

Parameters	Sampling point	Units	Results: Average value	Results: Standard deviation	Legal Limit R.741_A Class
Turbidity	Input	NTU	9.4	5.2	5
	Output		**3.3**	1.0	
	Reduction	%	65	--	
Transmitance (254 nm)	Input	%	63.9	2.2	Not applicable
	Output		70.9	1.4	
	Increase		11	--	
Total suspended solids	Input	mg/L	13.5	4.4	10
	Output		**7.3**	3.6	
	Reduction	%	46	--	
DBO_5	Input	mg/L	8.2	4.7	10
	Output		**5.6**	1.6	
	Reduction	%	32	--	

Removal:
- Turbidity: > 60%
- TSS: > 45%
- BOD5 > 30%

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

Phoenix

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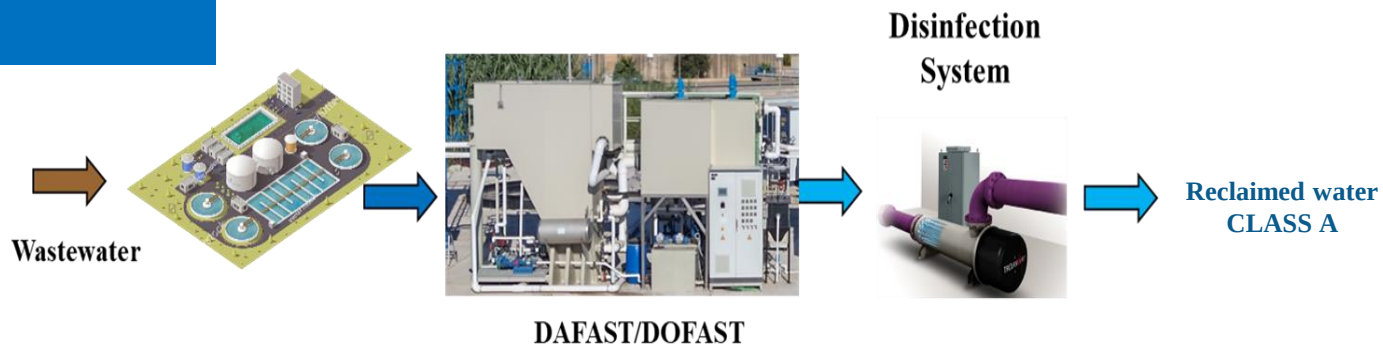
RESULTS & MONITORING

DAFAST (High-speed dissolved air/ozone flotation)



Microbiological analysis

Operation conditions				
Q input	m3/h	20,4	±	1,0
Transmitance	%	70,2	±	1,8
UV Dose	mJ/cm2	42,86	±	6,6

Results

Microbiologycal analysis

Parameters	Sampling point	Units	Results Average	Standard deviation	Legal limit	R.741_A Class	
E. coli	Input to WWTP	UFC/100 ml	2,0E+06	1,8E+06	≥ 5	log10	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	0			
	WWTP Red.	u. log	0,91	1,09			
	Equipment Red.	u. log	1,90	0,57			
	UV Red.	u. log	2,97	0,43			
	Total Red.	u. log	5,79	0,62			n 6
Total Coliphagues	Input to WWTP	UFC/100 ml	5,0E+03	2,8E+03	≥ 6	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	0,00	0,00			
	WWTP Red.	u. log	0,08	0,05			
	Equipment Red.	u. log	1,24	0,59			
	UV Red.	u. log	2,37	0,45			
	Total Red.	u. log	3,69	0,96			n 4
Clostridium perfringens spores	Input to WWTP	UFC/100 ml	2,3E+04	1,6E+04	≥ 4	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	0	0			
	WWTP Red.	u. log	0,40	0,65			
	Equipment Red.	u. log	1,95	0,52			
	UV Red.	u. log	2,42	0,42			
	Total Red.	u. log	4,77	0,79			n 5

ACHIEVE QUALITY CLASS A

Achieve minimum requirements
for agricultural irrigation
Regulation (EU) 2020/741

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RESULTS & MONITORING

UF

Reclaimed water CLASS A

Physical-Chemical analysis

Operating conditions				
Q input	m^3/h	6,6	±	0,8
Coagulant	mg/l	--	±	--
Floculant	mg/l	--	±	--

Results

Physico-chemical analysis

Parameters	Sampling point	Units	Results: Average value	Results: Standard desviation	Reclaimed water quality requirements R.741_A Class
Turbidity	Input	NTU	19,0	14,8	**5**
	Output		**<1**	0,1	
	Reduction	%	94	--	n 4
Transmitance (254 nm)	Input	%	48,5	13,1	**Not applicable**
	Output		63,0	1,1	
	Reduction		12	--	n 3
Total suspended solids	Input	mg/L	20,2	11,0	**10**
	Output		**0,6**	0,5	
	Reduction	%	95	--	n 3
DBO_5	Input	mg/L	21,5	12,0	**10**
	Output		**4,5**	0,7	
	Reduction	%	76	--	n 2

Removal:
- Turbidity: > 90%
- TSS: > 90%
- BOD5: 75%

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

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RESULTS & MONITORING

UF

Reclaimed water CLASS A

Microbiological analysis

Operation conditions						
Q input	m3/h	6,6	±	0,8		
Transmitance	%	58,0	±	7,0		
UV Dose	mJ/cm2	0,00	±	0,0		

Results

Microbiologycal analysis

Parameters	Sampling point	Units	Results Average	Standard deviation	Legal limit	R.741_A Class	
E. coli	Input to WWTP	UFC/100 ml	3,8E+06	1,0E+06	≥ 5	log10	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	< 1			
	WWTP Red.	u. log	1,40	0,62			
	Equipment Red.	u. log	5,18	0,66			
	UV Red.	u. log	0,00	0,00			
	Total Red.	u. log	6,57	0,11			n 9
Total Coliphagues	Input to WWTP	UFC/100 ml	3,7E+03	1,7E+03	≥ 6	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	0,00			
	WWTP Red.	u. log	0,15	0,05			
	Equipment Red.	u. log	1,65	0,42			
	UV Red.	u. log	0,00	0,00			
	Total Red.	u. log	1,81	0,47			n 3
Clostridium perfringens spores	Input to WWTP	UFC/100 ml	6,0E+05	4,5E+05	≥ 4	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	< 1			
	WWTP Red.	u. log	1,91	0,72			
	Equipment Red.	u. log	3,94	0,73			
	UV Red.	u. log	0,00	0,00			
	Total Red.	u. log	5,40	0,80			n 9

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

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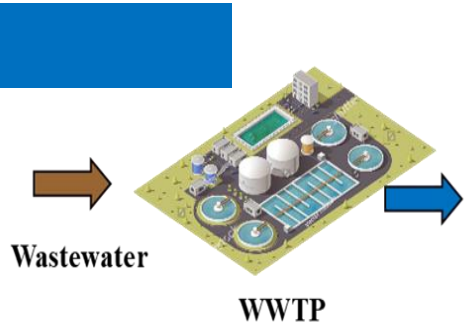
RESULTS & MONITORING

PURASER (Two sand filtration with continuous washing)



Physical-Chemical analysis

Operation conditions				
Q input	m^3/h	**10,4**	±	**0,4**
Coagulant	mg/l	**110**	±	**0,5**
Floculant	mg/l	**0,0**	±	**0,0**

Results

Physico-chemical analysis

Parameter	Sampling point	Units	Resultado Average	Resultado Standard deviation	Legal limit R.741_A Class	
Turbidity	Input	UNT	8,6	6,4	**5**	
	Output		**1,4**	0,4		
	Reduction	%	84	--		n 9
Transmitance (254 nm)	Input	%	66,2	4,0	**No aplica**	
	Output		73,9	1,7		
	Reduction		12	--		n 8
Total suspend solids	Input	mg/L	12,1	4,5	**10**	
	Output		**3,0**	1,4		
	Reduction	%	75	--		n 8
DBO_5	Input	mg/L	9,1	3,6	**10**	
	Output		**6,0**	2,5		
	Reduction	%	34	--		n 8

Removal:

- Turbidity: > 80%
- TSS: > 70%
- BOD5: > 30%

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

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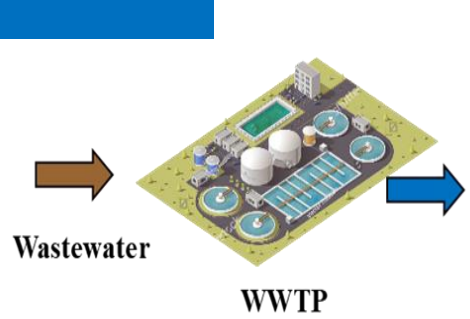
RESULTS & MONITORING

PURASER (Two sand filtration with continuous washing)



PURASER

Disinfection System

Reclaimed water CLASS A

Microbiological analysis

Operation conditions				
Q input	m3/h	10,3	±	0,5
Transmitance	%	72,4	±	2,3
UV Dose	mJ/cm2	63,81	±	10,4

Results

Microbiologycal analysis

Parameters	Sampling point	Units	Results Average	Standard deviation	Legal limit	R.741_A Class	
E. coli	Input to WWTP	UFC/100 ml	2,5E+06	1,4E+06	≥ 5	log10	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	1			
	WWTP Red.	u. log	2,03	0,88			
	Equipment Red.	u. log	1,81	0,63			
	UV Red.	u. log	2,67	0,39			
	Total Red.	u. log	6,51	0,47			n 4
Total Coliphagues	Input to WWTP	UFC/100 ml	2,7E+03	2,0E+03	≥ 6	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	0,00			
	WWTP Red.	u. log	0,48	0,36			
	Equipment Red.	u. log	1,96	0,33			
	UV Red.	u. log	1,73	0,69			
	Total Red.	u. log	4,17	1,08			n 3
Clostridium perfringens spores	Input to WWTP	UFC/100 ml	2,8E+03	1,6E+03	≥ 4	log_{10}	
	Output WWTP + PHOENIX+UV	UFC/100 ml	< 1	0			
	WWTP Red.	u. log	1,10	0,58			
	Equipment Red.	u. log	1,89	0,49			
	UV Red.	u. log	1,82	0,35			
	Total Red.	u. log	4,81	0,72			n 3

ACHIEVE QUALITY CLASS A

Achieve minimum requirements for agricultural irrigation Regulation (EU) 2020/741

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RESULTS & MONITORING

CONCLUTIONS

- Results

Treatments

What effluent is obtained for our technologies by Regulation 741/2020

CLASS	PURASER	DISC FILTER	CLARIFAST	DAFAST	UF
A	*UV	*UV	*UV	*UV	*
B					
C	*		*		
D		*		*	

A CLASS



Table 1 – Classes of reclaimed water quality and permitted agricultural use and irrigation method

Minimum reclaimed water quality class	Crop category (*)	Irrigation method
A	All food crops consumed raw where the edible part is in direct contact with reclaimed water and root crops consumed raw	All irrigation methods
B	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	All irrigation methods
C	Food crops consumed raw where the edible part is produced above ground and is not in direct contact with reclaimed water, processed food crops and non-food crops including crops used to feed milk- or meat-producing animals	Drip irrigation (**) or other irrigation method that avoids direct contact with the edible part of the crop
D	Industrial, energy and seeded crops	All irrigation methods (***)

Table 2 – Reclaimed water quality requirements for agricultural irrigation

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (number/100 ml)	BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤ 10	≤ 10	≤ 10	≤ 5	*Legionella* spp.: < 1 000 cfu/l where there is a risk of aerosolisation Intestinal nematodes (helminth eggs): ≤ 1 egg/l for irrigation of pastures or forage
B	Secondary treatment, and disinfection	≤ 100	In accordance with Directive 91/271/EEC (Annex I, Table 1)	In accordance with Directive 91/271/EEC (Annex I, Table 1)	-	
C	Secondary treatment, and disinfection	≤ 1 000			-	
D	Secondary treatment, and disinfection	≤ 10 000			-	

D CLASS



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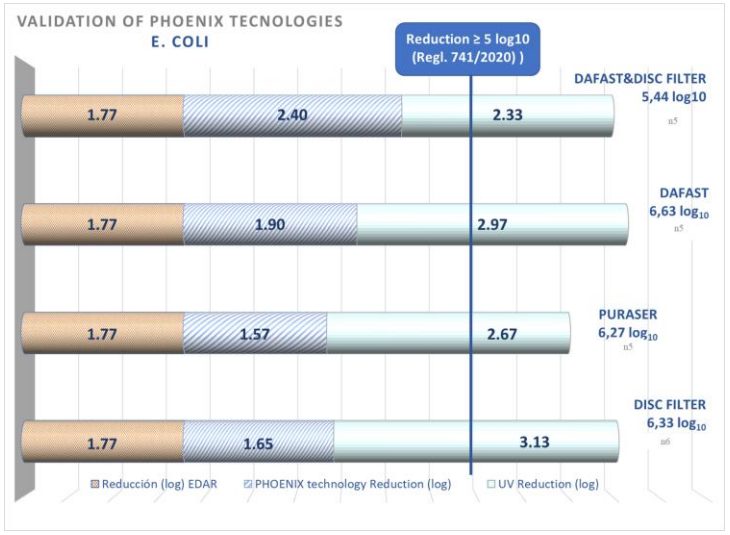
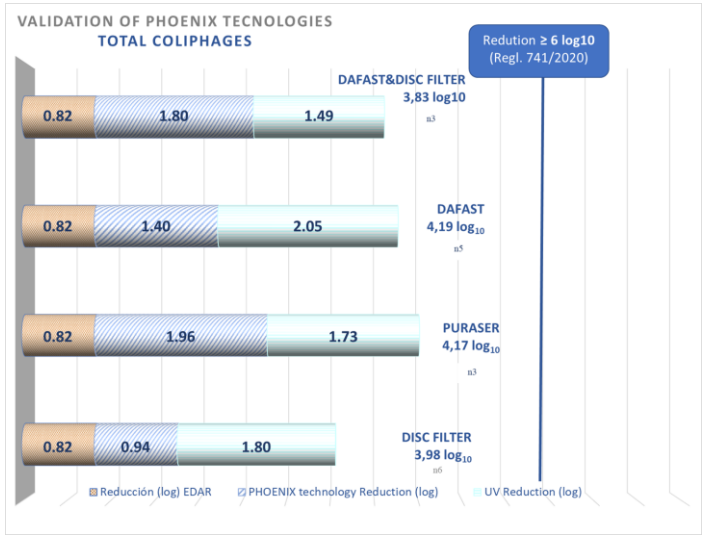
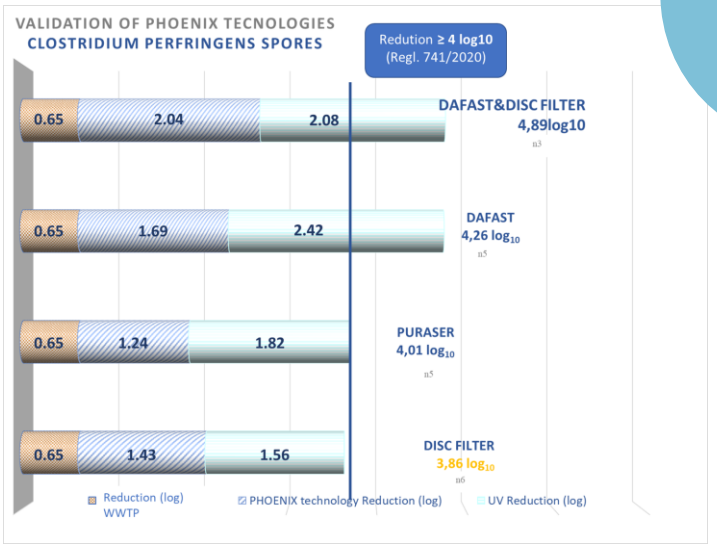
RESULTS & MONITORING

CONCLUTIONS

➢ Results







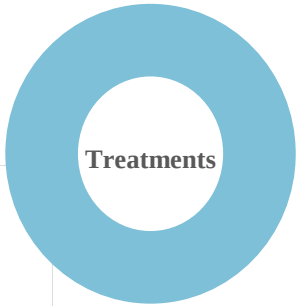


Table 4 – Validation monitoring of reclaimed water for agricultural irrigation

Reclaimed water quality class	Indicator microorganisms (*)	Per
A	*E. coli*	≥ 5,0
	Total coliphages/F-specific coliphages/somatic coliphages/coliphages (**)	≥ 6,0
	Clostridium perfringens spores/spore-forming sulfate-reducing bacteria (***)	≥ 4,0 (in case of *Clostridium perfringens* spores) ≥ 5,0 (in case of spore-forming sulfate-reducing bacteria)

The best validation results have been achieved with DAFAST

VALIDATION TECHNOLOGIES

…not present in sufficient quantity in raw waste water to achieve the $\log_{10}$ reduction, the …ndicator in reclaimed water shall mean that the validation requirements are complied with. …rformance target may be established by analytical control, by addition of the performance …ment steps based on scientific evidence for standard well-established processes, such as …ports or case studies, or tested in a laboratory under controlled conditions for innovative treatment.

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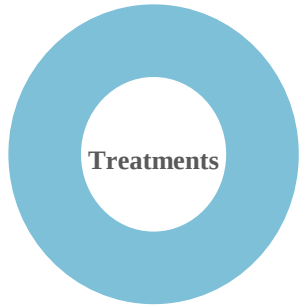
RESULTS & MONITORING

CONCLUTIONS



➢ Results

The most concentrated and difficult to eliminate so far have been:

- **Caffeine**
- **Oxypurinole**
- **4-AAA**

CECs

Part of these CEC have been successfully removed with **PHOENIX serial technologies** (DAFAST+DF)

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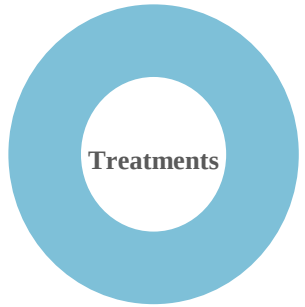
RESULTS & MONITORING

CONCLUTIONS



➢ Results

CECs

The results are being **processed**

Microplastics

Some **PHOENIX technologies removed > 50%**

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RESULTS & MONITORING

CONCLUTIONS

Treatments

➢ Results

CECs

Microplastics

WORK IN PROGRESS

Ceftazidime has been **t**he most difficult ARB to remove

Antibiotic resistant bacterias analysis

Chloramphenicol has been the most eliminated.

More results will be shared in the immediate future

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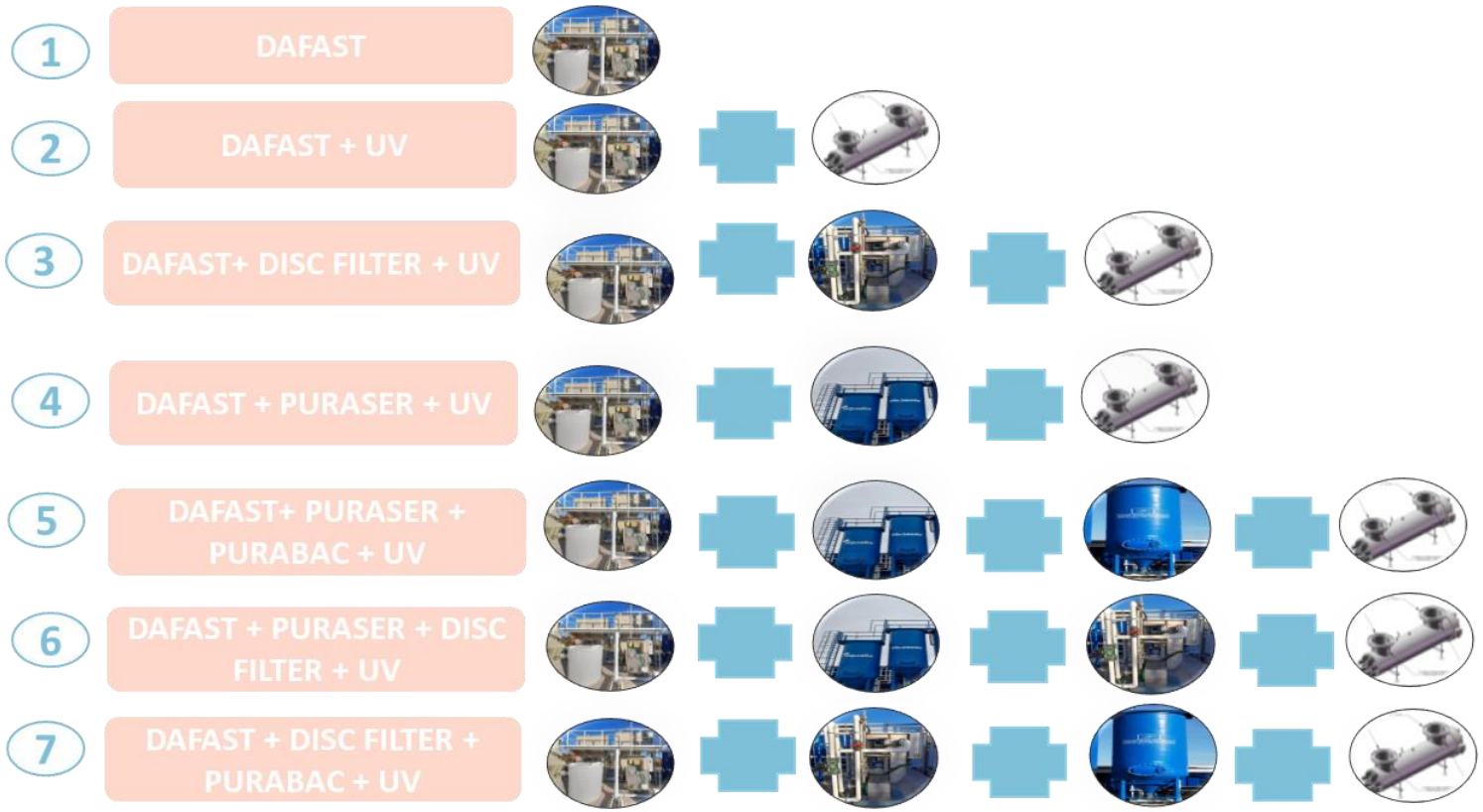
RESULTS & MONITORING

CONCLUTIONS

➢ Results



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#REUSEHUB

Innovative cost-effective multibarrier treatments for reusing water for agricultural irrigation

LIFE19 ENV/ES/000278

2nd Project workshop

Almería, 21st October 2024

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