ULTIMATE

WATER SMART INDUSTRIAL SYMBIOSIS

Innovative sensors and alternative materials for the removal of organic matter and micropollutants by adsorption and AOP technologies in ARETUSA (CS3).

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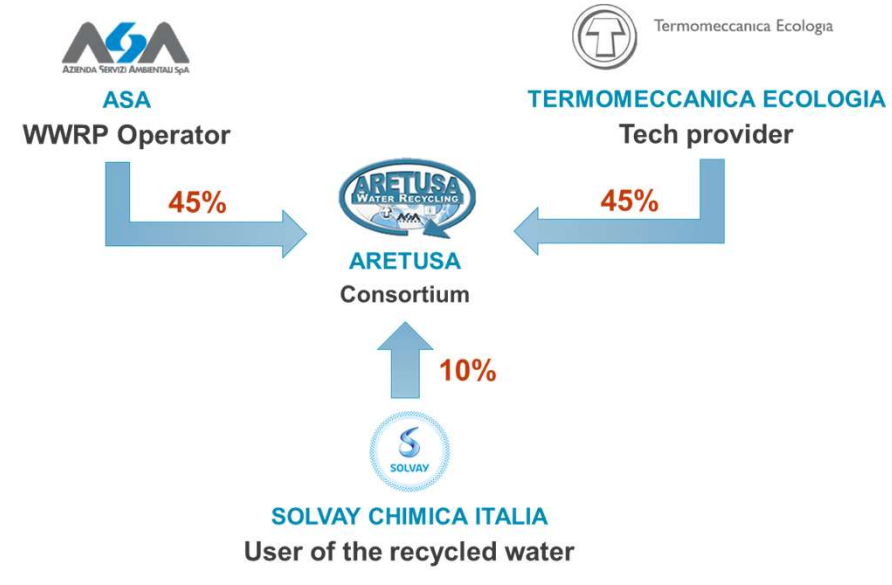
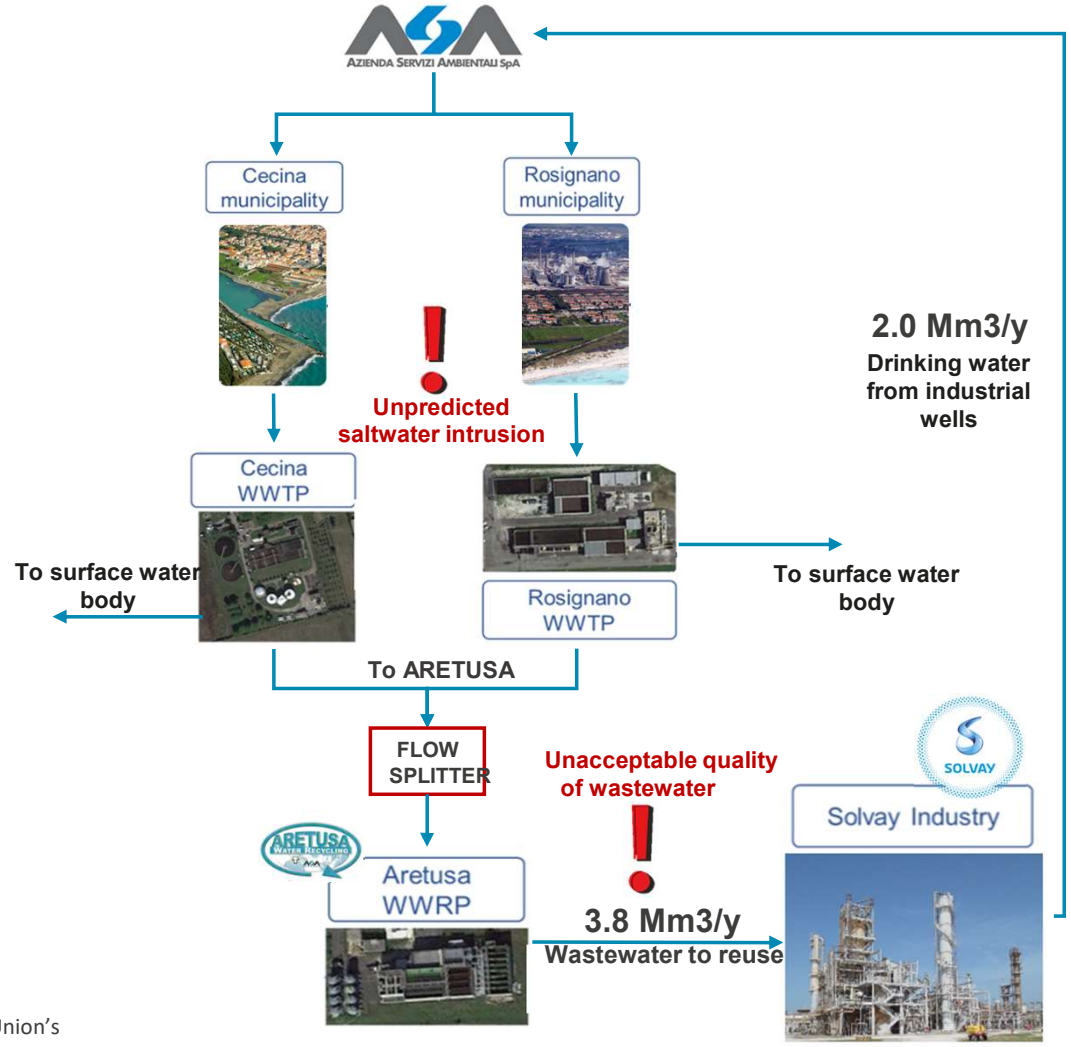
July, 10th 2023.

ARETUSA urban-industrial symbiotic system





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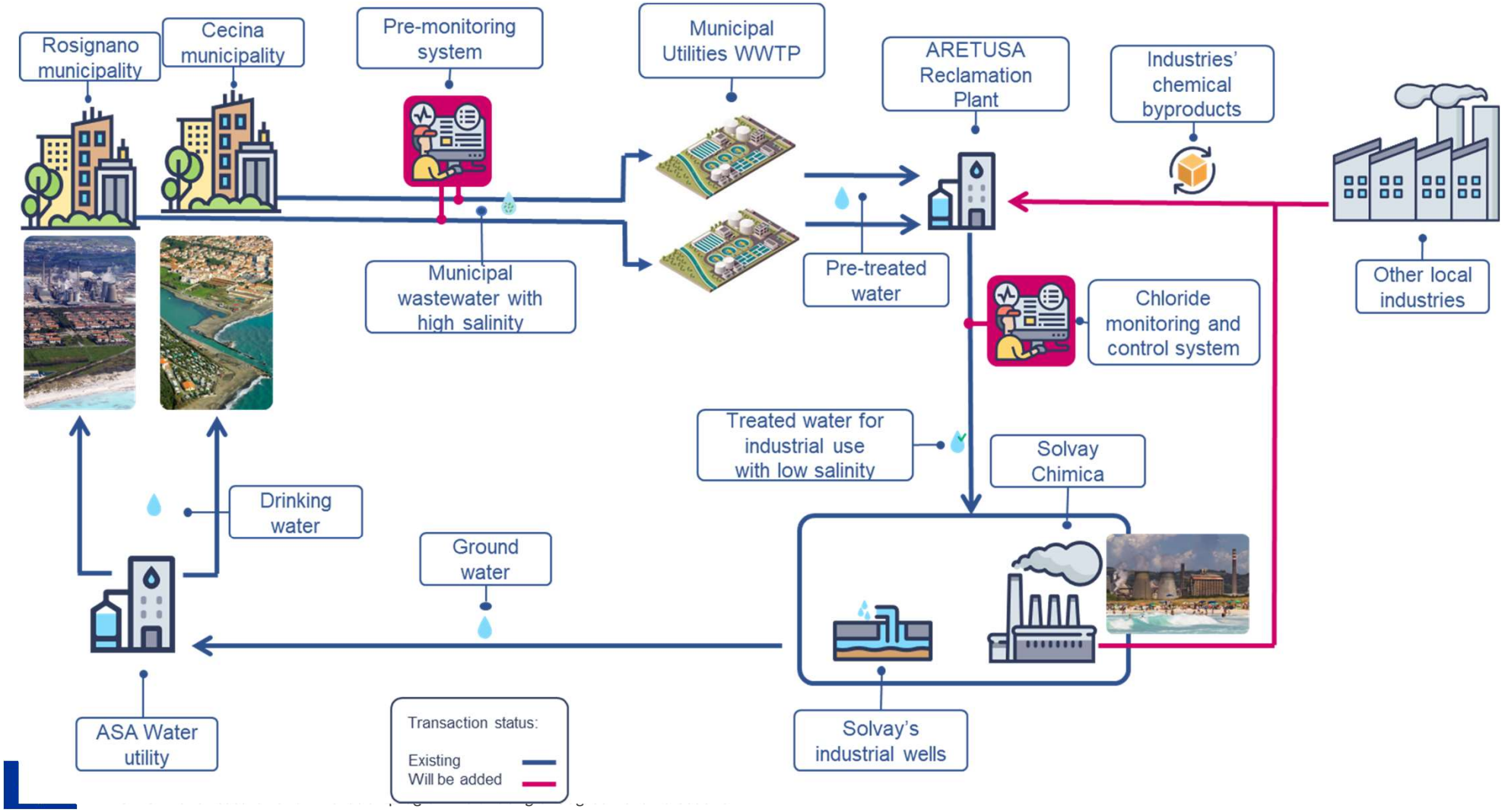
ARETUSA urban-industrial symbiotic system



Hydrochar for adsorption process

Hydrochar (HC) produced from sewadge sludge

	HC
F-	54.2
Cl-	44.4
Br-	< 0,1
NO3-	1.3
PO4---	38.5
SO4--	147.3
COD	4200

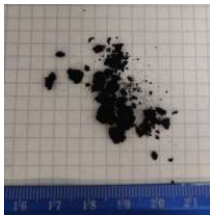
COD Leaching

Chemical activation

***Activation performed in CPTM laboratories**

- Mixing of char pellets with KOH in flakes (KOH to char ratio: 1:1).
- Heating up to 600°C (5°C/min), isotherm for 1 hr and cooling (5°C/min) with N2 purging.
- Washing with 5M HCl and demi water (up to pH 7).
- Drying at 105°C until constant weight.

AH
Activated Hydrochar



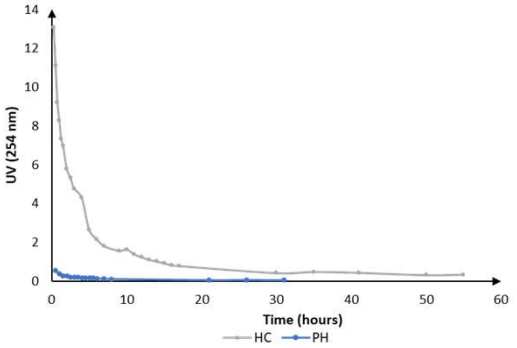
	AH
F-	< 0,1
Cl-	1.7
Br-	< 0,1
NO3-	< 0,1
PO4---	8.4
SO4--	103.4
COD	< 15

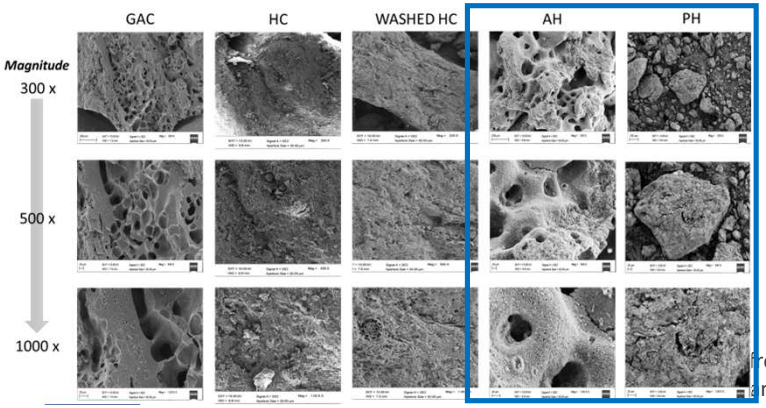
Optimal (chemical) activation of Hydrochar at pilot/demo scale is difficult → Pyrolysis was tested as more feasible alternative

Slow Pyrolysis

Material was produced by TGA under Nitrogen Flux (N2) at 450°C for 2 hours with a heating rate of 20°C/min.

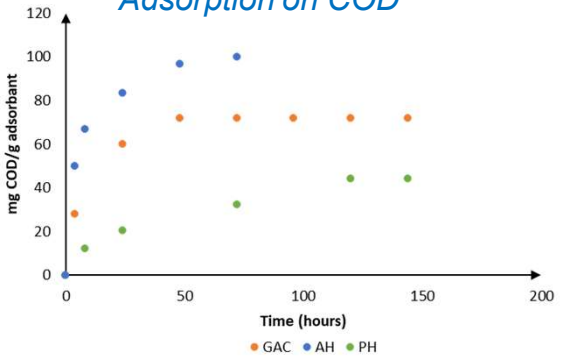
PH
Pyrolyzed Hydrochar





	BET Surface Area
	m²/g
HC	ND
AH	751.7
PH	100.42
GAC	1100-1150

Adsorption on COD



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Hydrochar for adsorption process

Process scale-up

Slow Pyrolysis of Hydrochar at Pilot scale

Temperature (°C)	450
Flowrate of hydrochar (kg/h)	40
Residence time (min)	90

100 kg

25-30 kg

Granular Activated Carbons

STANDARD SPECIFICATIONS - CSC5			
Specifications	Unit	Values	Methods
BET Surface area	m2/g	500 ± 50	BET N2
Ash content	%	< 10	CEFIC 1986
Bulk density	g/cm3	0,50-0,55	CEFIC 1986
Humidity	%	< 2	CEFIC 1986
Grain size:			Wet sieving
> 5 mm	%	0.5	
< 2 mm	%	1.5	

STANDARD SPECIFICATION - GBC 8x30			
Specifications	Units	Values	Method
Surface Area (BET)	m2/g	1000 ± 50	BET N2
Ash content	%	12 ± 2	CEFIC 1986
Bulk density	g/cm3	0,50 ± 0.05	CEFIC 1986
Moisture (as packed)	%	< 5	CEFIC 1986
Iodine index	mg/g	950 ± 50	CEFIC 1986
Hardness	%	> 95	On request
Half-length chlorination	cm	> 2.2	On request
Grain Size			Sieving
> 8 mesh (2.4 mm)	%	< 5	
< 30 mesh (0.6 mm)	%	< 5	

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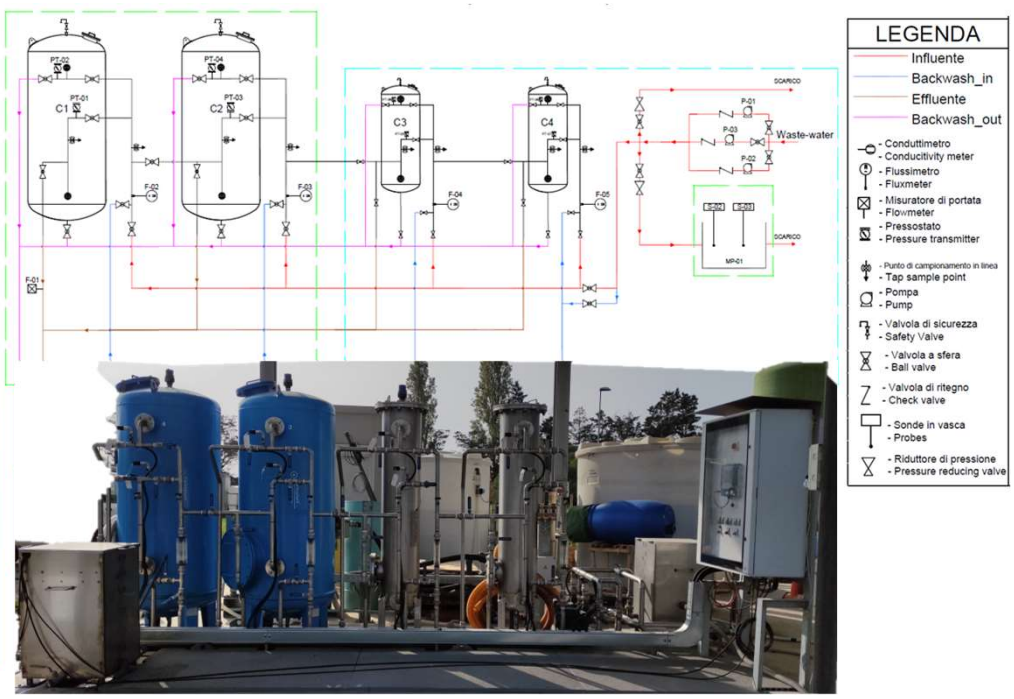
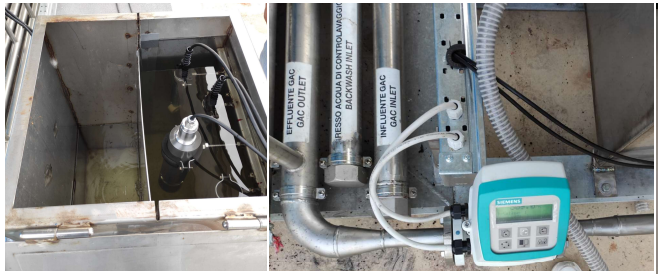
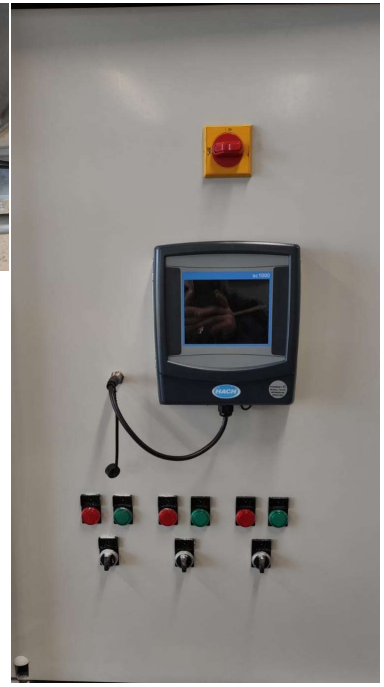
Pilot plant implementation – adsorption process



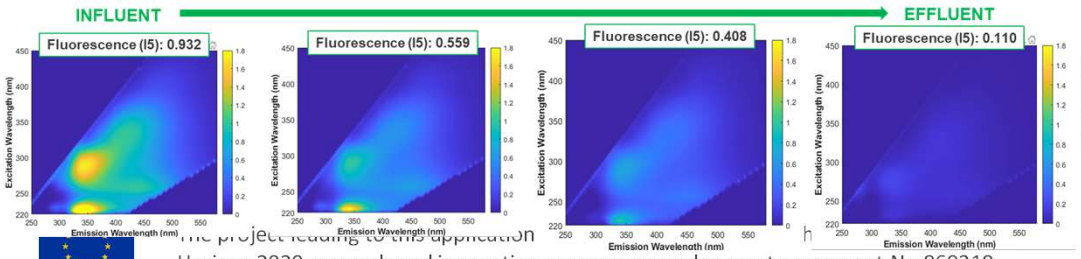
Monitoring system

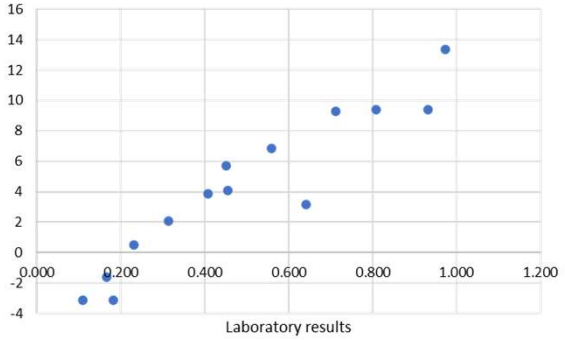
- ✓ Conductivity
- ✓ pH
- ✓ UV absorbance sensor reading at 254 nm
- ✓ Fluorescence sensor reading at the excitation/emission couple of 325/445 nm
- ✓ Flowmeter





Fluorescence sensor calibration





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Adsorption pilot plant

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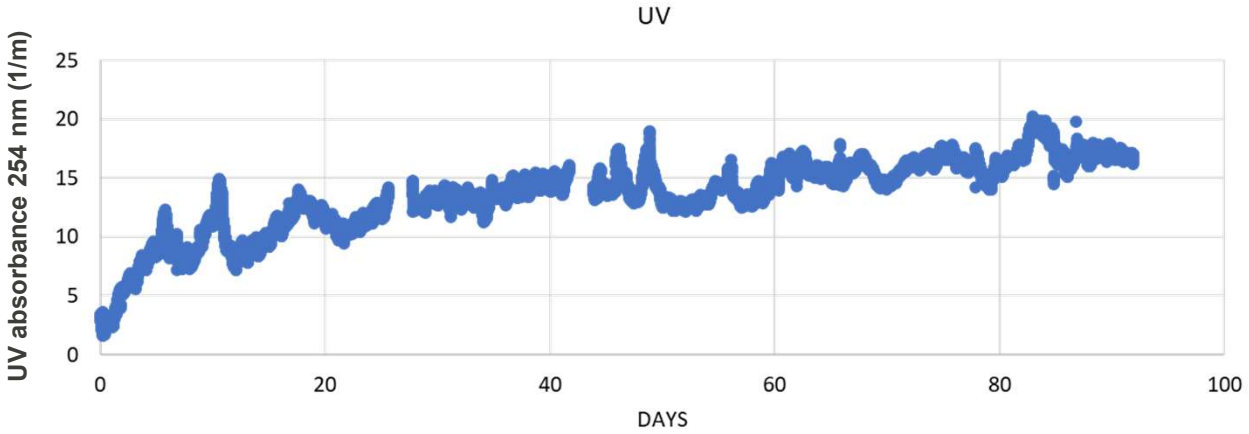
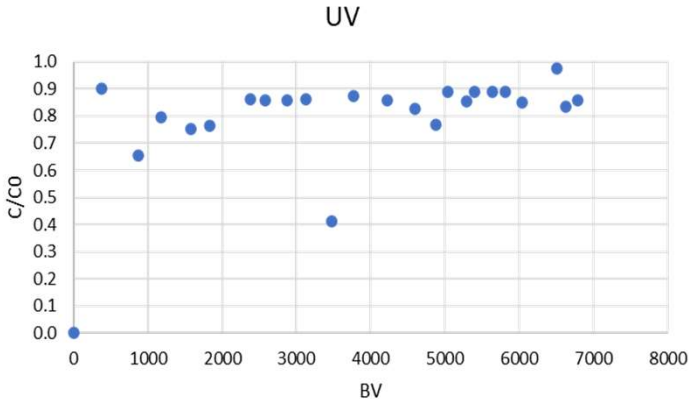
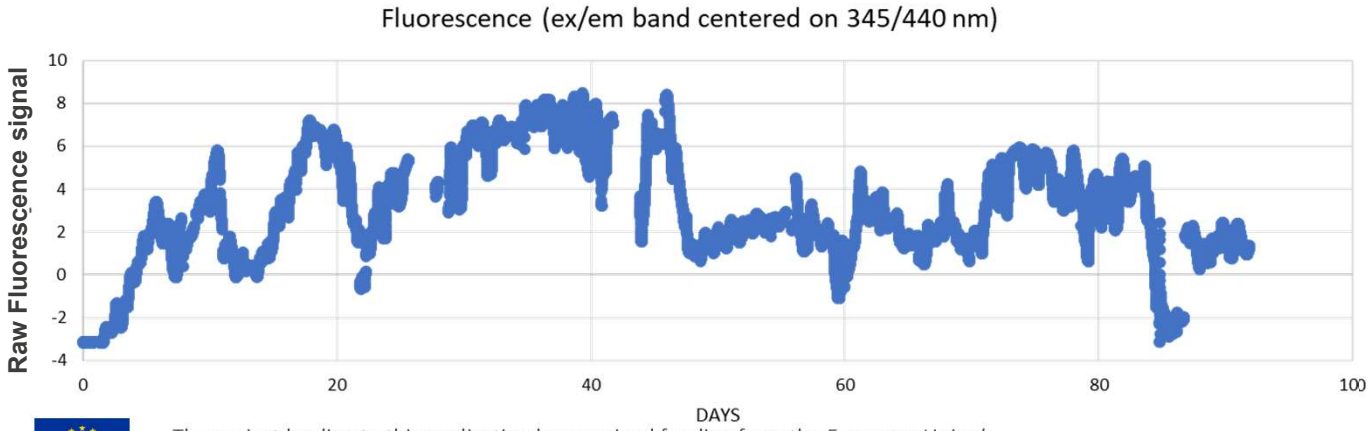
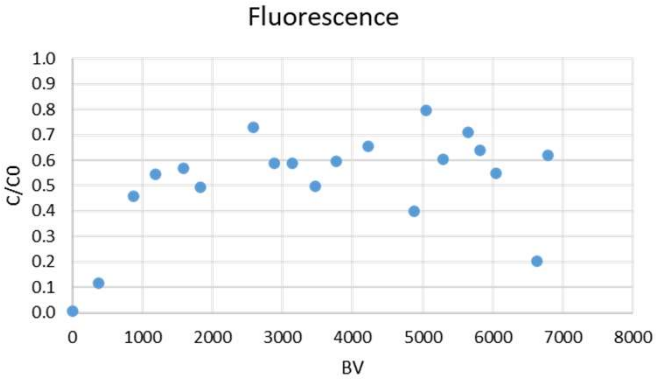
Pilot test: adsorption with GAC grain size 2-5 mm









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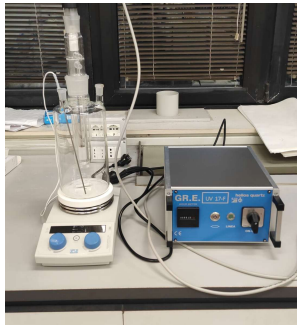
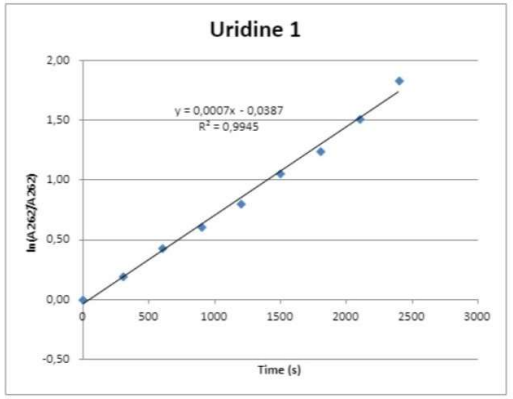
AOP Laboratory set-up and experimentation



Actinometry test



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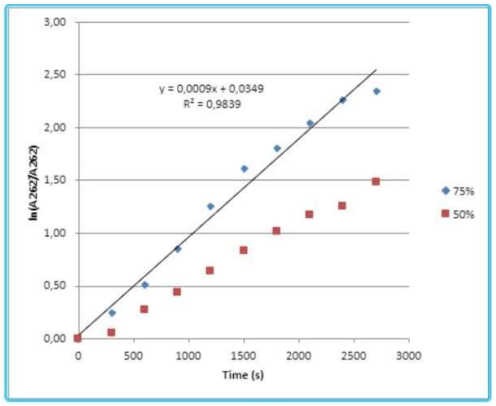
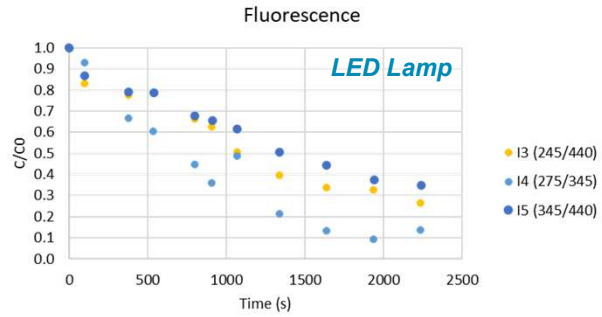
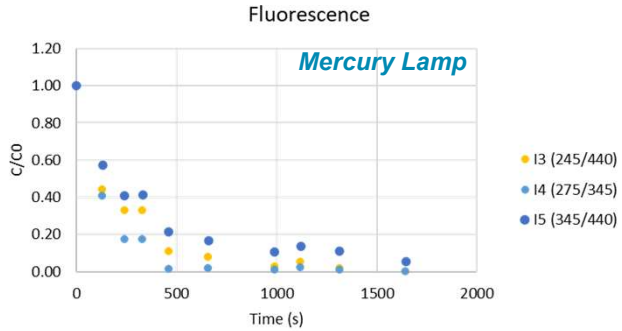
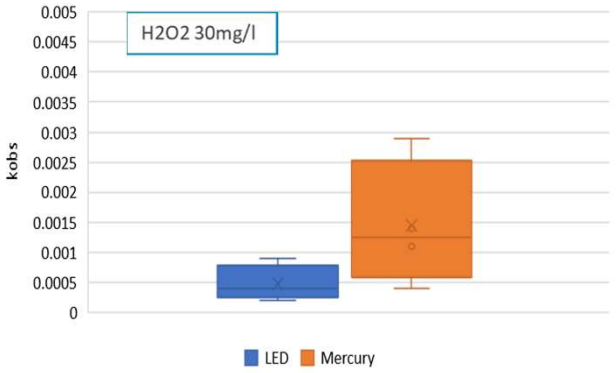
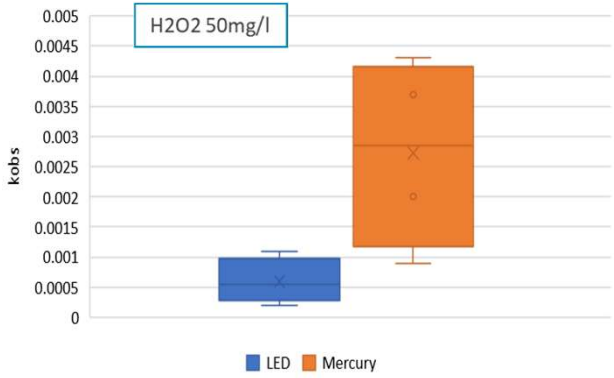


LED









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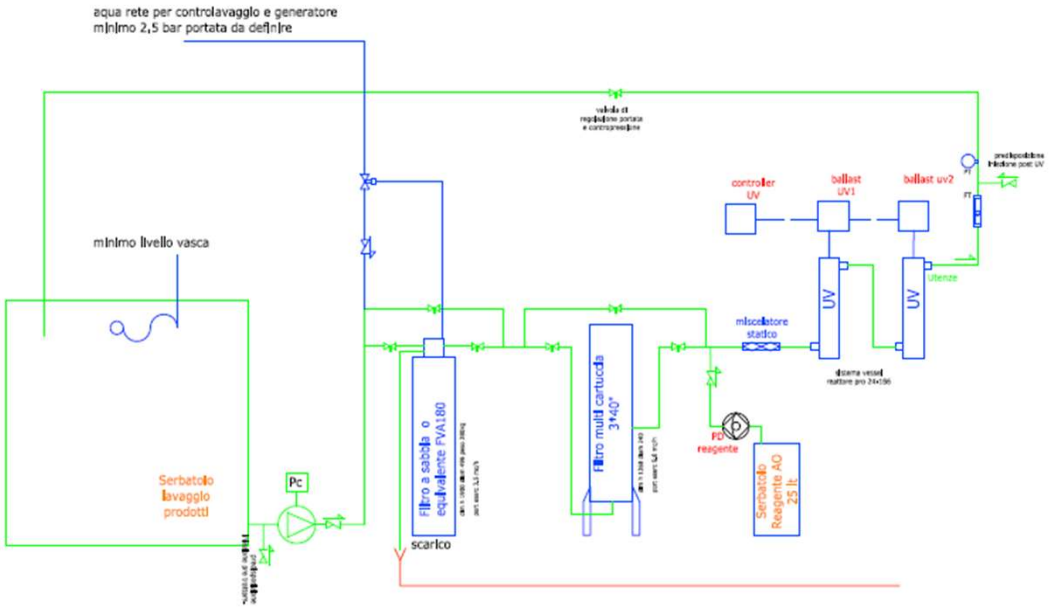
AOP Pilot plant



SKID EQUIPPED WITH:

- ✓ pressurization pump: 60 l/min, 1.9 bar
- ✓ sand filter: 3.5 mc/h 250 kg of sand
- ✓ multi-cartridge filter
- ✓ electromagnetic dosing pump
- ✓ static mixer
- ✓ Viqua PRO 24-180mJ UV system
- ✓ electrical panel

Fluorescence meter

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