GARDEN – Lake GARDa ENvironmental System
2nd International Scientific Workshop – Manerba del Garda, 10 May 2018

Wastewater and Combined Sewer Overflows in East Lake Garda catchment: the Horizon2020 INTCATCH demo and preliminary results

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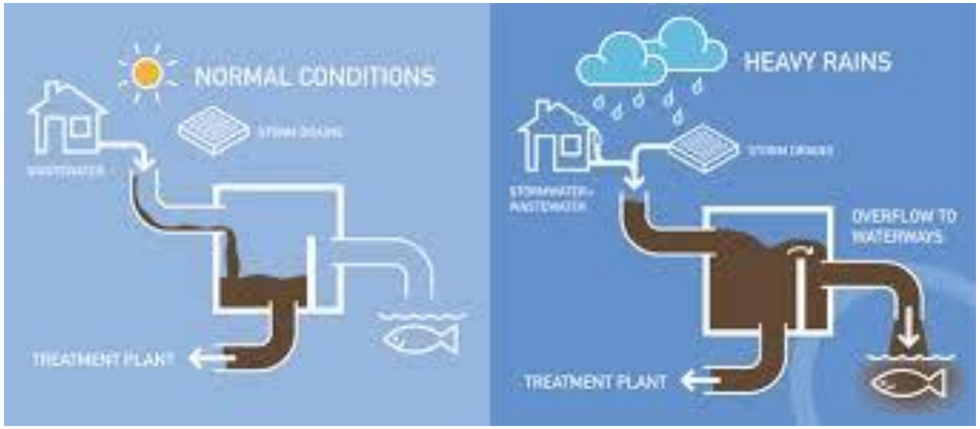
The problem of Combined Sewer Overflows

- Contain untreated human and industrial waste, toxic materials, and debris as well as stormwater
- One of the principal problems of the countries that have Combined Sewer System (CSS)
- Numbers:

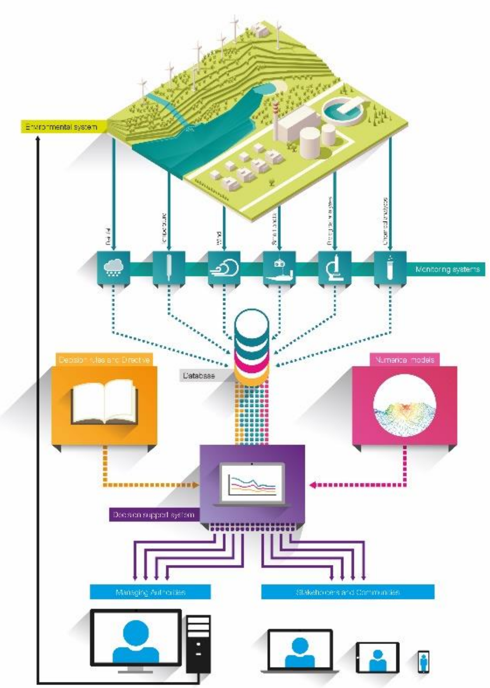
- **650.000** CSOs in Europe (EurEau)
- **20%** of surface water is at serious risk from pollution (EU Water Framework Directive, WFD)
- **11 CSOs** in the East side of Garda Lake



Aims of the INTCATCH Project

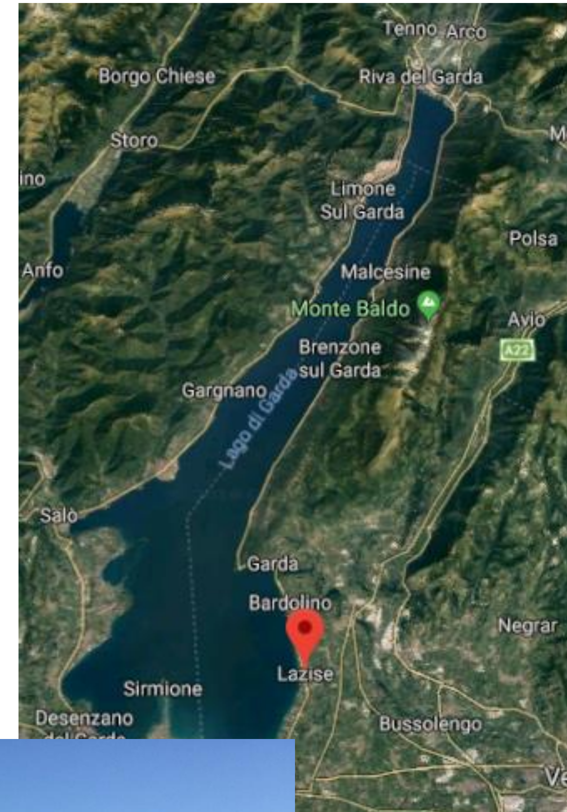
- Autonomous and radio controlled boats equipped with innovative sensors
- Next generation DNA test kits
- Innovative treatment systems for combined sewer overflows (CSOs)
- Cloud based geo referenced data management solutions to make data visible to the whole community
- Decision Support Systems (DSS) to optimize water quality monitoring strategies
- Make the CSO treatment technologies reproducible in real environment



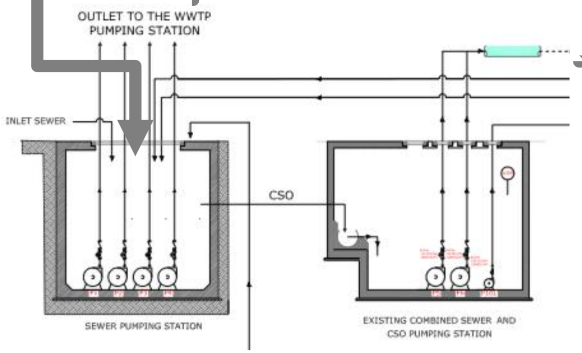
The Villa Bagatta Pumping Station

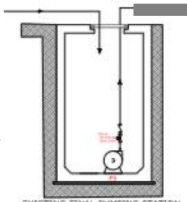
- The station pumps around 22,000 m^3/d
- Currently CSO is treated only by degritting
- The treated CSO is discharged far from the river by an underwater pipe
- In 2016-2017 only 36 CSO events with average dicharged volume of 1,800 m^3 and duration of 3.35 h



The Villa Bagatta Pumping Station

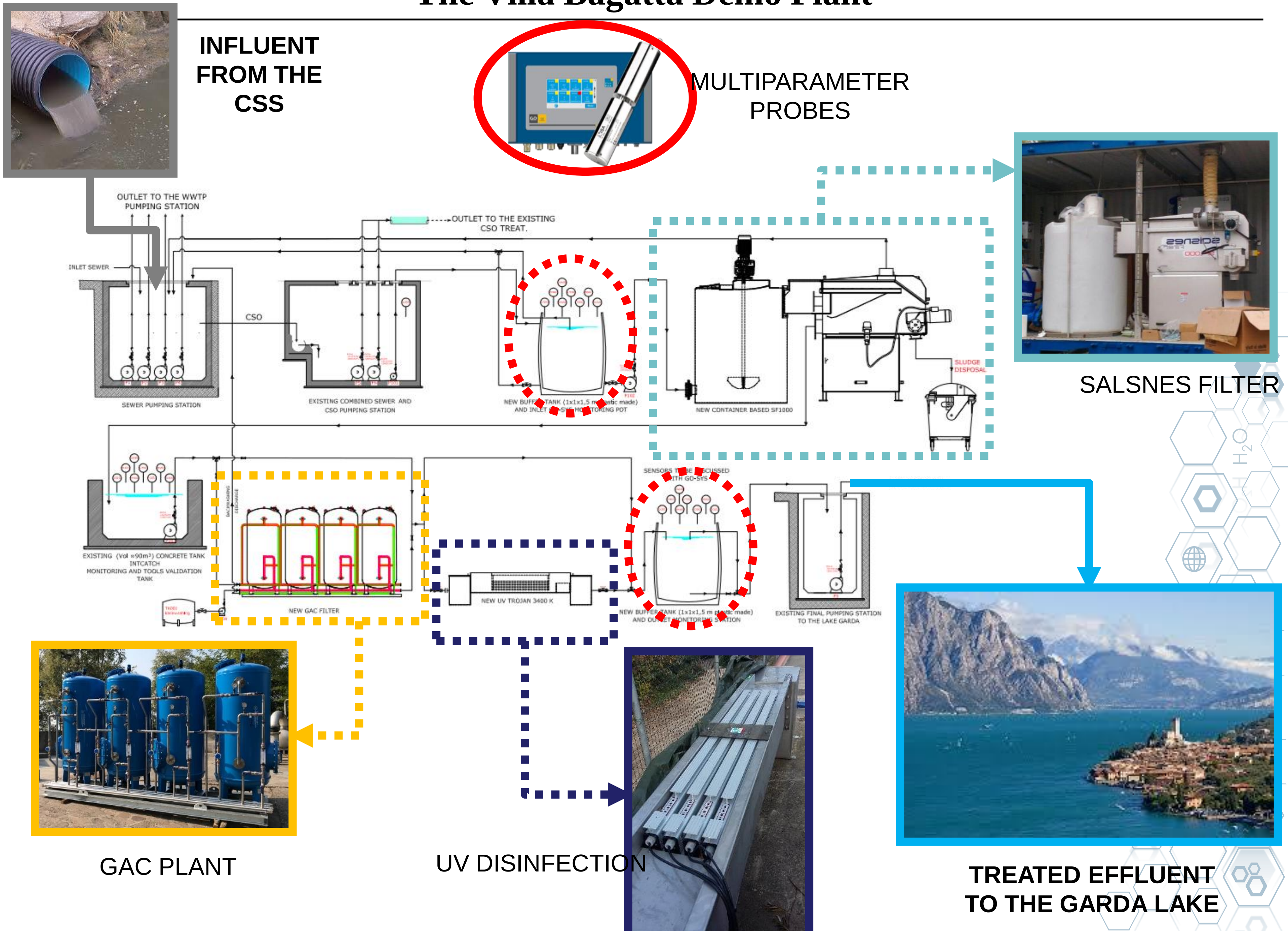
INFLUENT FROM THE CSS





TREATED EFFLUENT TO THE GARDA LAKE

The Villa Bagatta Demo Plant



Experimental activity: Villa Bagatta Demo Plant

- To test 3 different wastewater dilutions (1:3, 1:5, 1:10)
- To simulate CSO events by using Lake water for make the dilutions
- To analyse the most common parameters: COD, TSS, TP, TN, E. coli and coliform presence, PPCPs and other emerging contaminants such as microplastics
- To treat real CSO when the event occurs
- To validate the multiparameter probes installed in the plant

Wastewater characterization

Matrix	TSS	COD	TN	NH4-N	TP
	mg/L	mg/L	mg/L	mg/L	mg/L
Raw ww	270	464	78	65	7.2
Dil. 1:10	27	51	8	6	0.7
Dil. 1:5	54	97	16	13	1.5
Dil. 1:3	90	158	26	22	2.4

Material and methods: Salsnes Filter

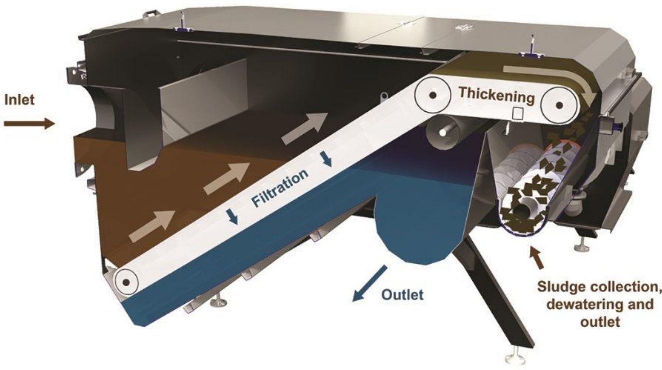
- Salsnes Filter system applies SOLIDS SEPARATION, SLUDGE THICKENING and DEWATERING in a single compact unit
- Setting parameters are regulated by PLC (maximum flow rate 54 m^3/h)
- The technology can offer:

→ Significantly lower lifecycle costs

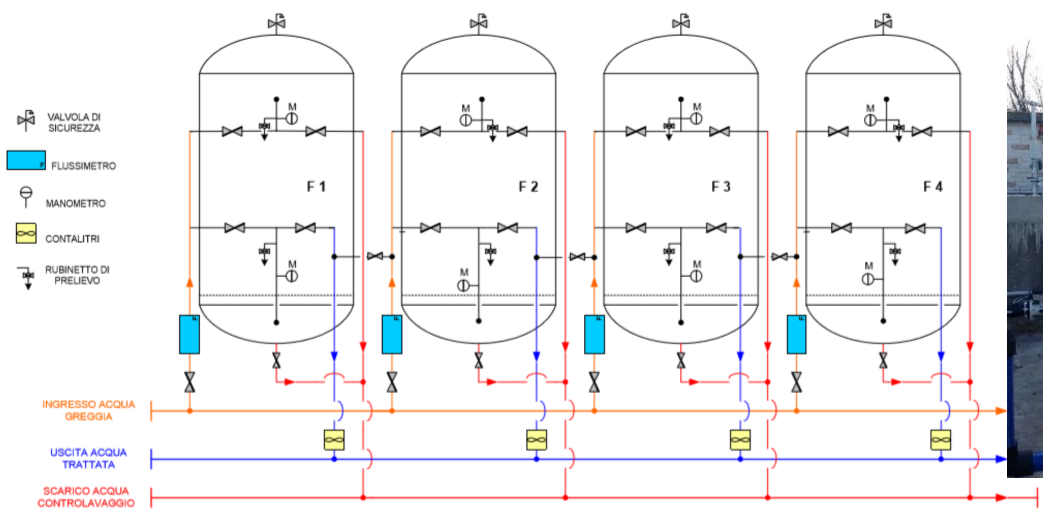
→ Smaller volume of drier sludge that reduce disposal costs

→ Less land requirements

→ Equal to or greater removal of TSS and COD (50% and 20% respectively)



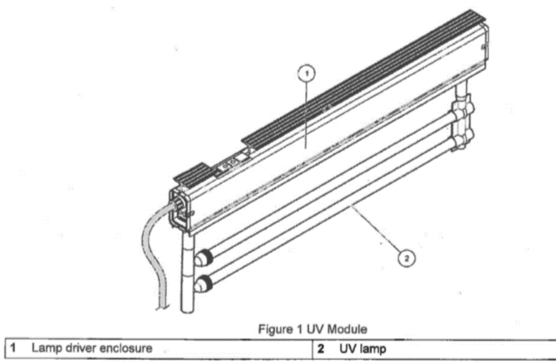
Material and methods: Granular Activated Carbon



- Suitable system for the removal of contaminating compounds such as VOCs, solvents, PCB, herbicides, pesticides and solids
- Relatively larger particle size
- Chosen the carbon type ST100 8X30, ST300 12X40 and Quartzite
- Filters volume of 0.3 m^3 each and flow rate of 1 L/s each
- Possible use in series or in parallel

Material and methods: UV lamps

- UV unit made by an open channel with 4 modules with 4 lamps each
- Lamps in fused quartz circular tubing
- Mechanical system which control the intensity ($\mu W/cm^2$)
- The UV technology is based on the inactivation of pathogenic microorganisms due to photooxidation of DNA

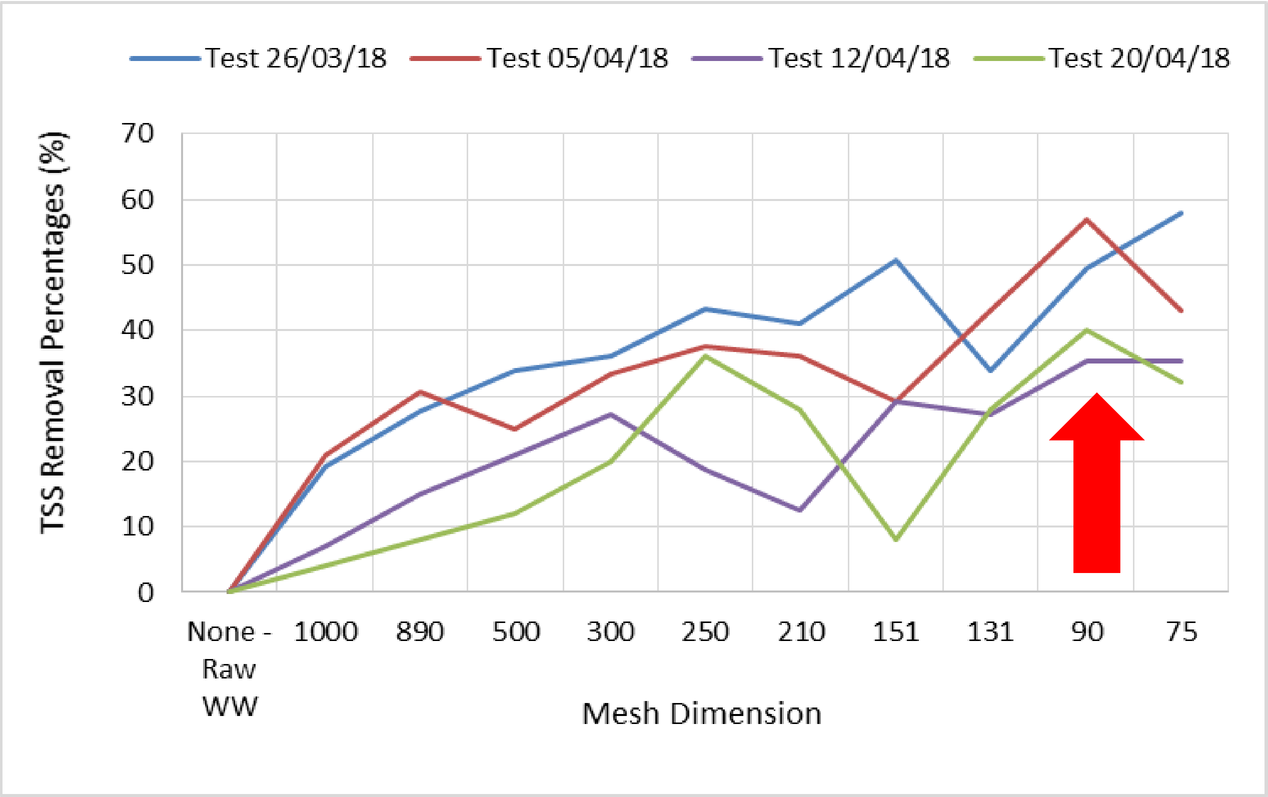


Examples of the most dangerous pathogens in drinking & waste water:

Group	Kind	Disease
• **BACTERIA**	▪ Coliforms ▪ Salmonella ▪ Vibrio ▪ Legionella ▪ E.coli	▪ Fever, intestinal disease ▪ Typhoid fever ▪ Cholera ▪ Pneumonia ▪ Fever, gastro enteral disease
• **VIRUSES**	▪ Hep A ▪ Polio	▪ Hepatitis ▪ Polio
• **PARASITES**	▪ Cryptosporidia ▪ Amoeba	▪ Intestinal disease ▪ Amebiasis

Results and discussion: Salsnes Filter

- Bench test done in order to evaluate the performance of each mesh provided by Salsnes
- Tested the mesh size in the range 75-500 micron
- Based on the data, we are going to test the mesh 90 micron in demo plant (up to 45% TSS removal)
- Tested different flow in the range 15-50 m^3/h



Results and discussion: Salsnes Filter

Mesh size	Flow rate	Dil. Factor	Filter belt speed	TSS effluent	Removal efficiency	Recovered Sludge
µm	m^3/h		Hz	mg/L	%	g/m^3 treated
350	50	4	6	21	10	n.a.
350	30	9	6	9	11	3.9
350	15	6	6	9	24	4.2
90	50	3	30	33	58	77
90	30	5	6	21	31	33
90	30	3	30	62	31	89
90	15	5	15	22	27	65
90	15	3	30	45	47	92

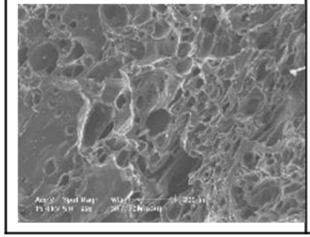
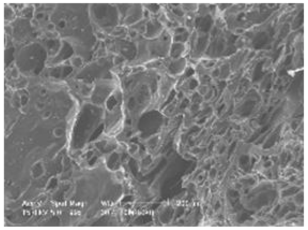
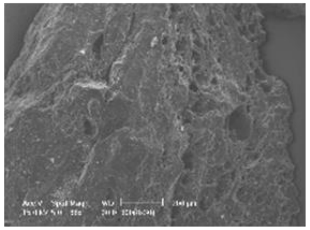
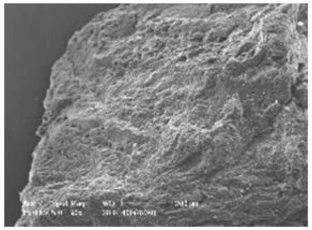
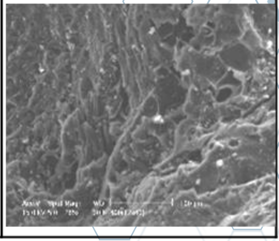
- Low TSS removal efficiency with mesh at 350 micron
- Better results with mesh at 90 micron

Results and discussion: GAC

- Identified the optimal GAC for demo plant throught batch test
- Analysis of three commercial GAC at two different porosity 8X30 and 12X40

Type	Size	BET Area	Methylene Blue Index (MBI)	Iodine index
	N°mesh/ sq in	m^2/g	ml/g	mg/g
1	8x30	>800	>150	>750
2 a	8x30	>950	>180	>950
2 b	12x40	>950	>180	>950
3 a	8x30	>1000	>190	>1000
3 b	12x40	>1000	>190	>1000

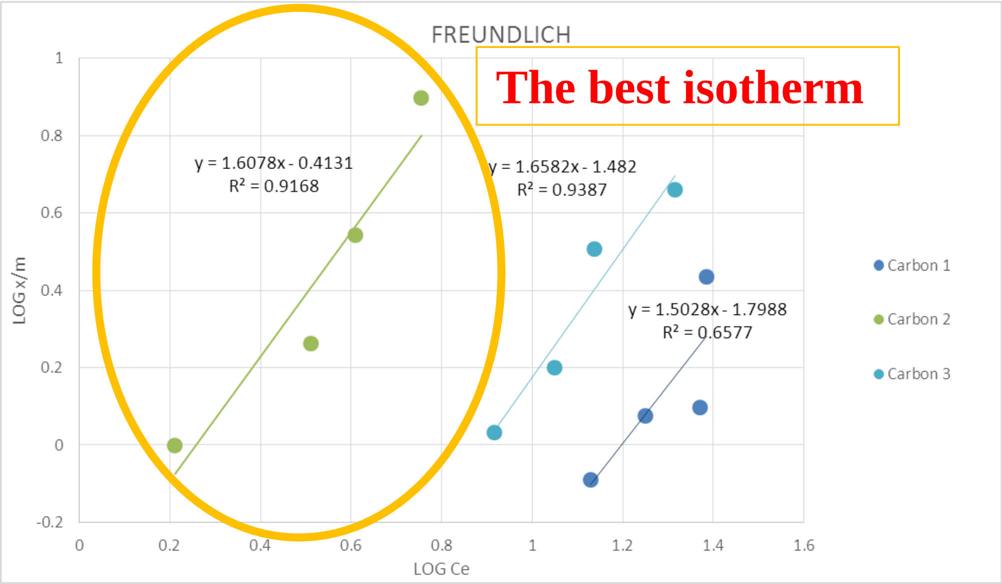
✓ **SEM analysis (Scanning Electron Microscope) granular activated carbon**

1	2 a	2 b	3 a	3 b
				

Results and discussion: GAC

- Test batch HRT from 10’ to 3h

- Column test HRT 10’



Carbon	1	2	3
Ni	29%	53%	56%
Mn	49%	58%	51%
Zn	30%	59%	61%
Fe	64%	64%	59%

Based on these data of sCOD and % metal removal, were chosen:

- 1 filter carbon type 1 (ST100 8X30)
- 2 filters carbon type 2b (ST300 12X40)

Results and discussion: GAC

- Tested GAC in series and in parallel in order to verify the best performance
- Tested 10 min and 5 min of contact time
- TSS and COD removal up to 60%
- On going: to analyse the emerging water pollutants which are listed in the «watch list»

Results and discussion: UV

- UV performance analyzed by coli and coliform selection with Brillance E. coli/coliform selective agar

Matrix	E. coli	Coliform
	UFC/ml	UFC/ml
IN UV	8,50E+03	3,58E+05
OUT UV	0-3	3-40

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Thank you!

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INTCATCH 2020