Innovative Treatment of Combined Sewer Overflow and perspective of Hydrochar reuse for pollutants adsorption

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INTCATCH 2020

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Combined Sewer Overflows: pressure and impacts

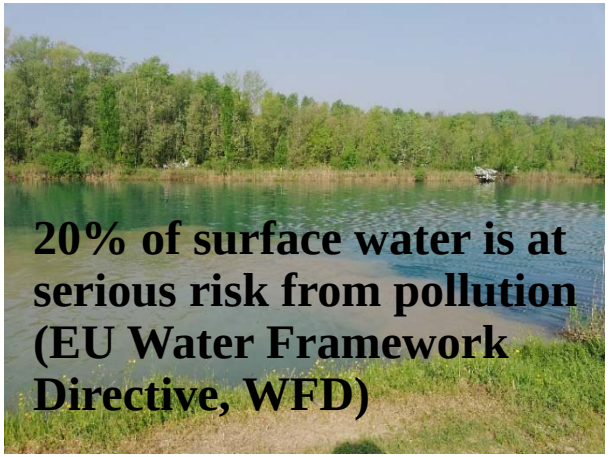
- ORGANIC MATTER
- SOLID MATTERS SUCH AS MACRO AND MICRO PARTICLES
- CHEMICALS (N, P, HEAVY METALS…)
- PATHOGENS

- Bathing and Recreational water use
- Water and food consumption
- Water uses for agricultural activities
- Eutrophication
- Biodiversity
- Morphology

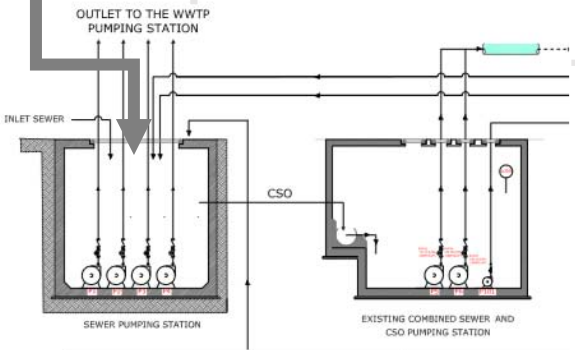
Land **Urban area**

Runoff **Combined Sewer System** → 650,000 CSOs stations in Europe (EurEau)

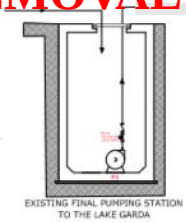
CHANGE OF QUALITY OF THE RECEIVING WATER BODY



Typical CSOs treatment



PRELIMINARY DEGRITTING FOR SOLIDS REMOVAL



The INTCATCH Project

Granular activated carbon adsorption to remove solids and contaminants

UV disinfection to remove pathogens

Dynamic rotating filtration to remove solids

Advanced treatment: Granular Activated Carbon (GAC) Filtration

- The most applied adsorption technique for the treatment of wastewater
- No real information about CSO water treatment
- Used to absorb natural organic compounds and chemicals by both chemical and physical absorption
- From organic materials with high carbon contents (wood, lignite, coal)
- Diameter ranging between 0.5-1.5 mm

Hydrochar: production and uses

400 g digested-dewaterd sludge
+
350 g digested sludge

T=190°, 250°

P=140 bar

HYDROCHAR:

- **Fuel**
- **Soil amendment**
- **Absorbent for activated carbon production**

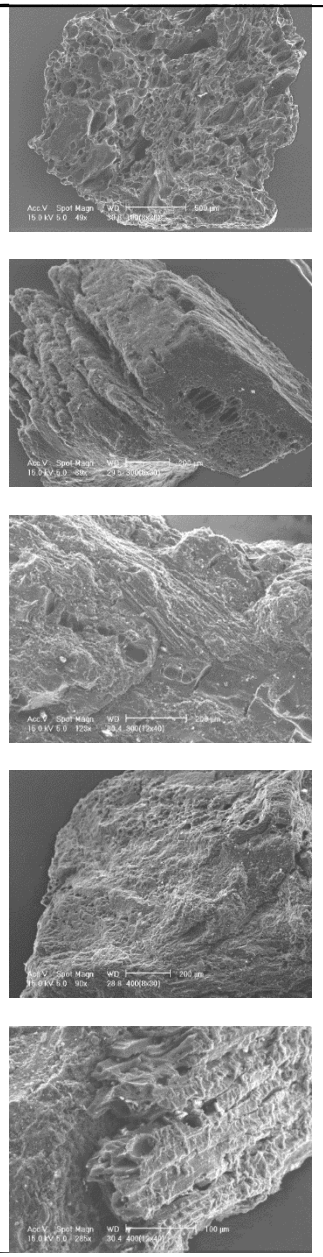
Characteristics of GAC tested

NAME	ST 300	ST 300	STW 400	STW 400	ST 100
TYPE	Mineral GAC	Mineral GAC	Mineral GAC	Mineral GAC	Mineral GAC
SIZE DISTRIBUTION [U.S. mesh]	8x30	12x40	8x30	12x40	8x30
DENSITY [g/L]	500±20	500±20	500±20	500±20	520±20
UMIDITY [%]	<2	<2	<2	<2	<2
IODINE NUMBER [mg/L]	>950	>950	>1000	>1000	>750
METHYLENE BLUE INDEX [mg/L]	>180	>180	>190	>190	>150
ABRASION NUMBER [%]	> 80	> 80	> 80	> 80	> 80
HARDNESS [%]	> 90	> 90	> 90	> 90	> 90
ASH LEVEL [%]	< 15	< 15	< 15	< 15	< 15
SURFACE AREA [m^2/g]	> 950	> 950	> 1000	> 1000	> 800

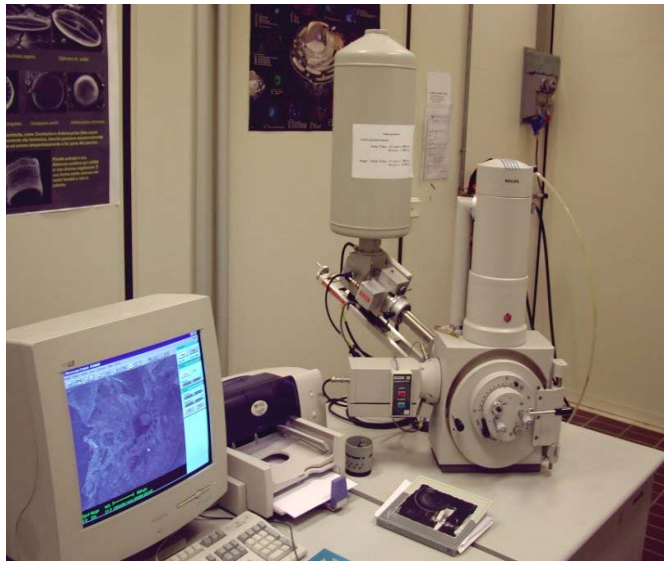
Granulometric and spectroscopy analysis

GAC type	C_u
ST100 8X30	1.4
ST300 8X30	1.5
ST300 12X40	1.6
STW400 8X30	1.5
STW400 12X40	1.7

1-2 mm in diameter



Scanning Electron Microscope



Results: GAC perforance

Test GAC

- Wastewater (30 mg sCOD/L)
- Absorbent: commercial GAC
- Quantity: 2, 5, 10, 20 g/L

ST100 8x30

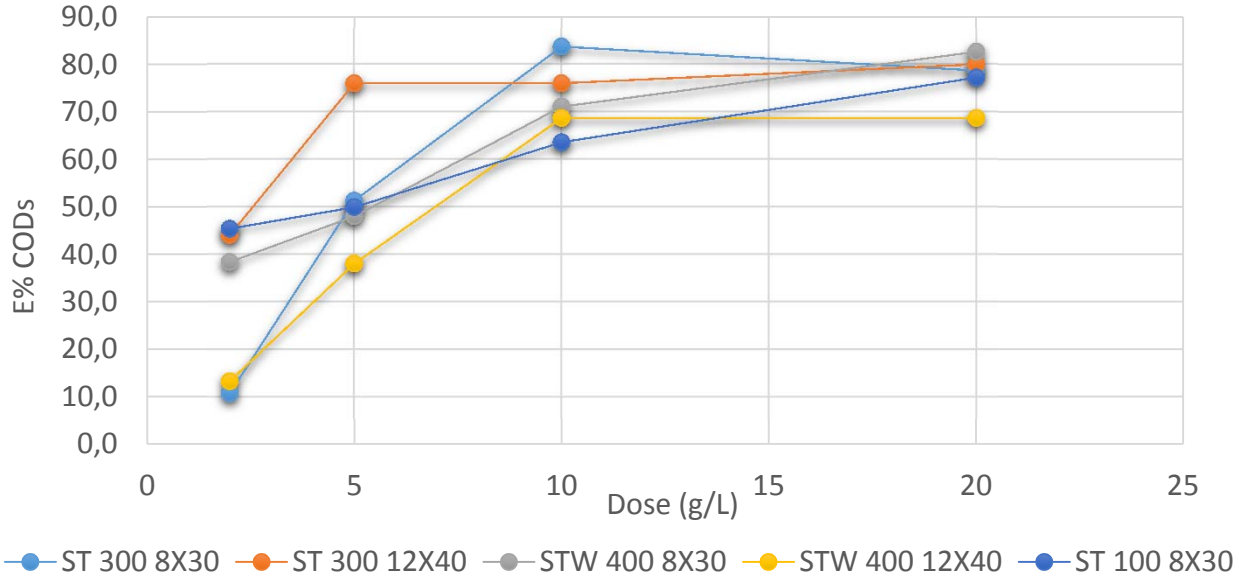
Best performance in sCOD removal

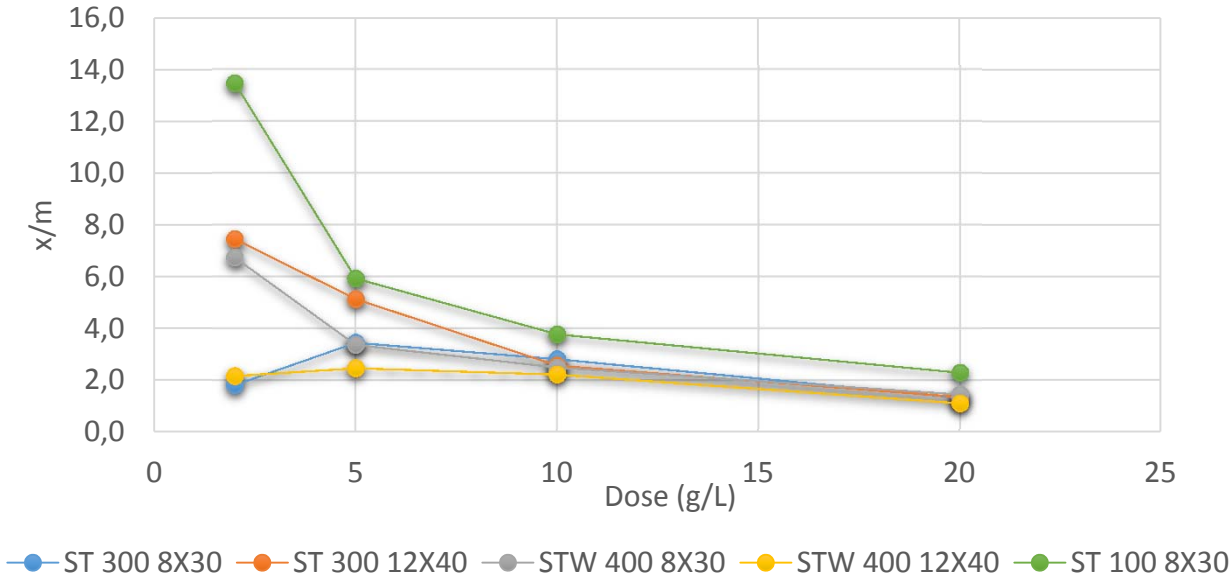
ST300 8x30

Best performance observed in the removal of Mn and Cd (80%) and Cr (40%)

ST100 8x30, ST300 8x30

used in CSOs Pilot Plant in real environment





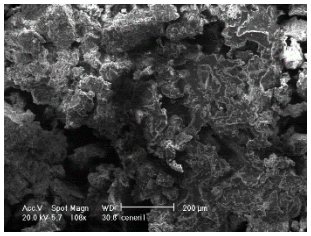
Hydrochar analysis

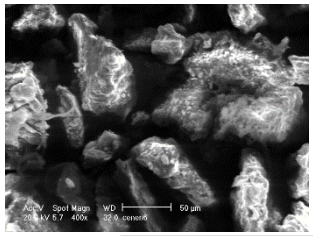
190° → **0.85** g HC/g feedstock

250° → **0.67** g HC/g feedstock

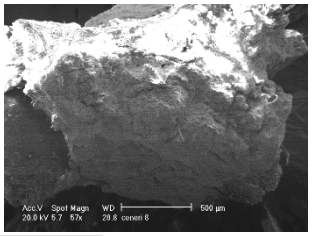
	EDS microanalysis (wt%)									
	Zn	Mn	Na	Al	Si	P	S	K	Ca	Fe
Raw HC190°	1.2	0.9	3.7	7.5	6.6	18.1	8.2	1.1	17.6	31.4
Raw HC250°	-	-	-	8.6	7.4	20.7	7.9	0.9	20.4	31.0
Washed HC190°	0.9	0.6	3.9	9.6	8.8	21.3	7.1	0.9	17.9	24.3
Washed HC250°	-	-	-	10.2	8.7	23.5	8.2	0.8	19.1	25.8

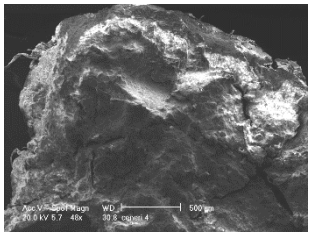
HC 250°





HC 190°



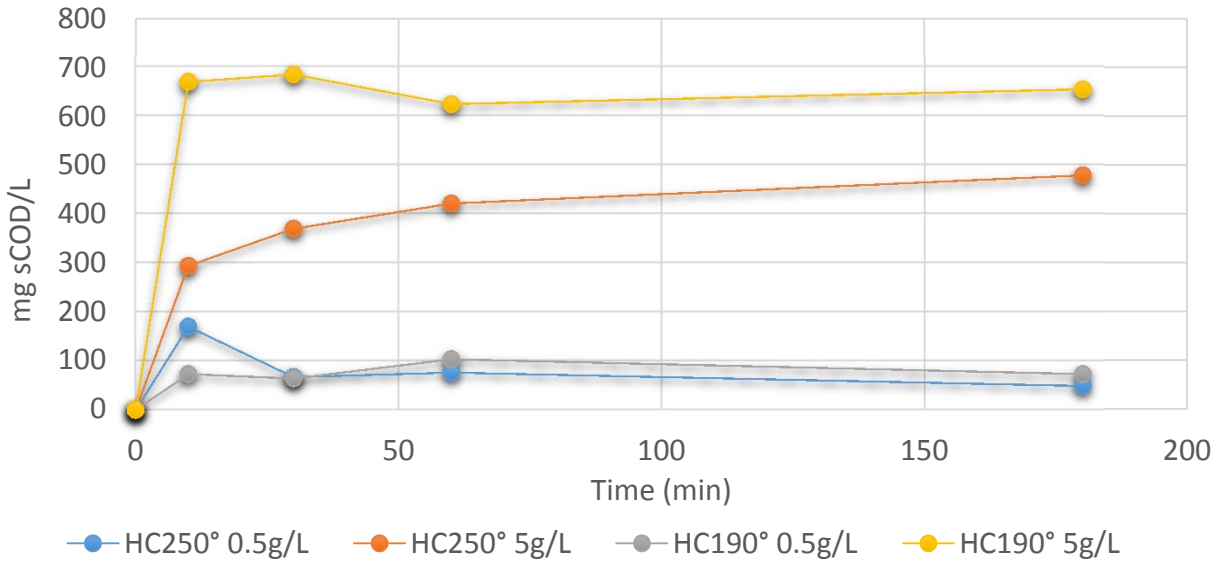


50-500 micron in diameter

Preliminary results: raw and washed HC

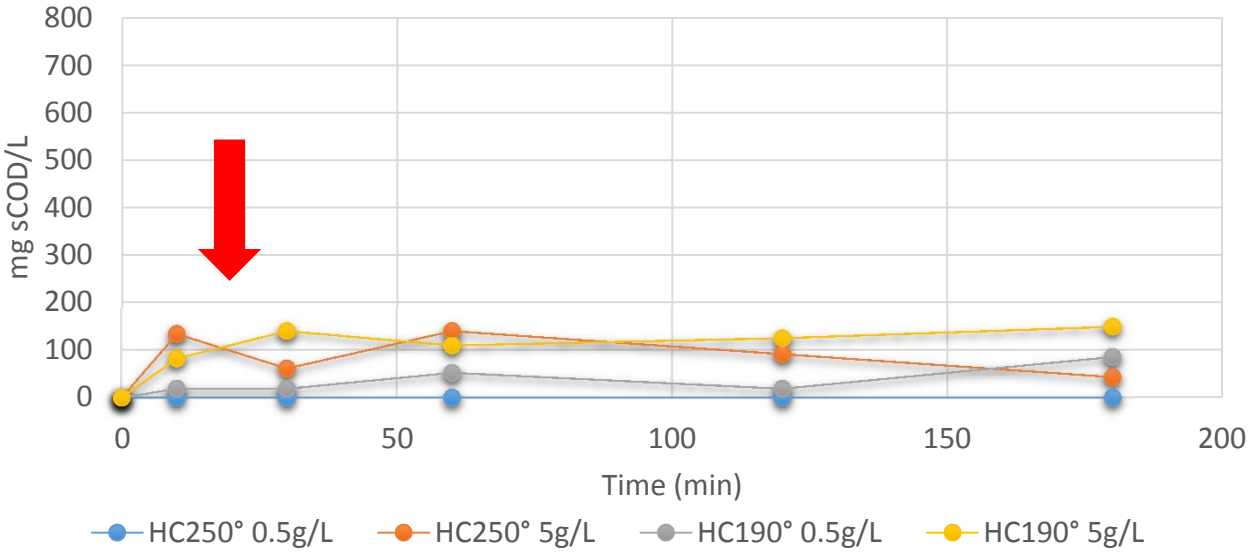
Test 0_A_HC

- Distilled water
- Absorbent: raw HC
- Quantity: 5 and 0.5 g/L
- Analysis: sCOD profile



Test 0_B_HC

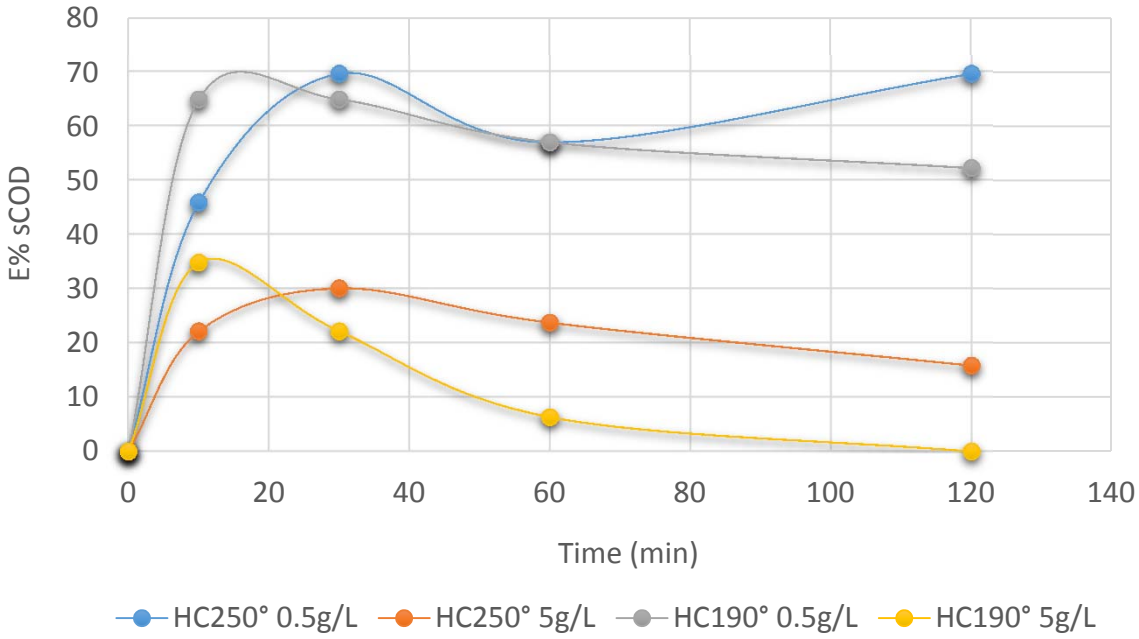
- Distilled water
- Absorbent: washed HC
- Quantity: 5 and 0.5 g/L
- Analysis: sCOD profile



sCOD removal efficiency of washed HC

Test 1_HC

- Wastewater (200 mg sCOD/L)
- Absorbent: washed HC
- Quantity: 5 and 0.5 g/L



Test 2_HC

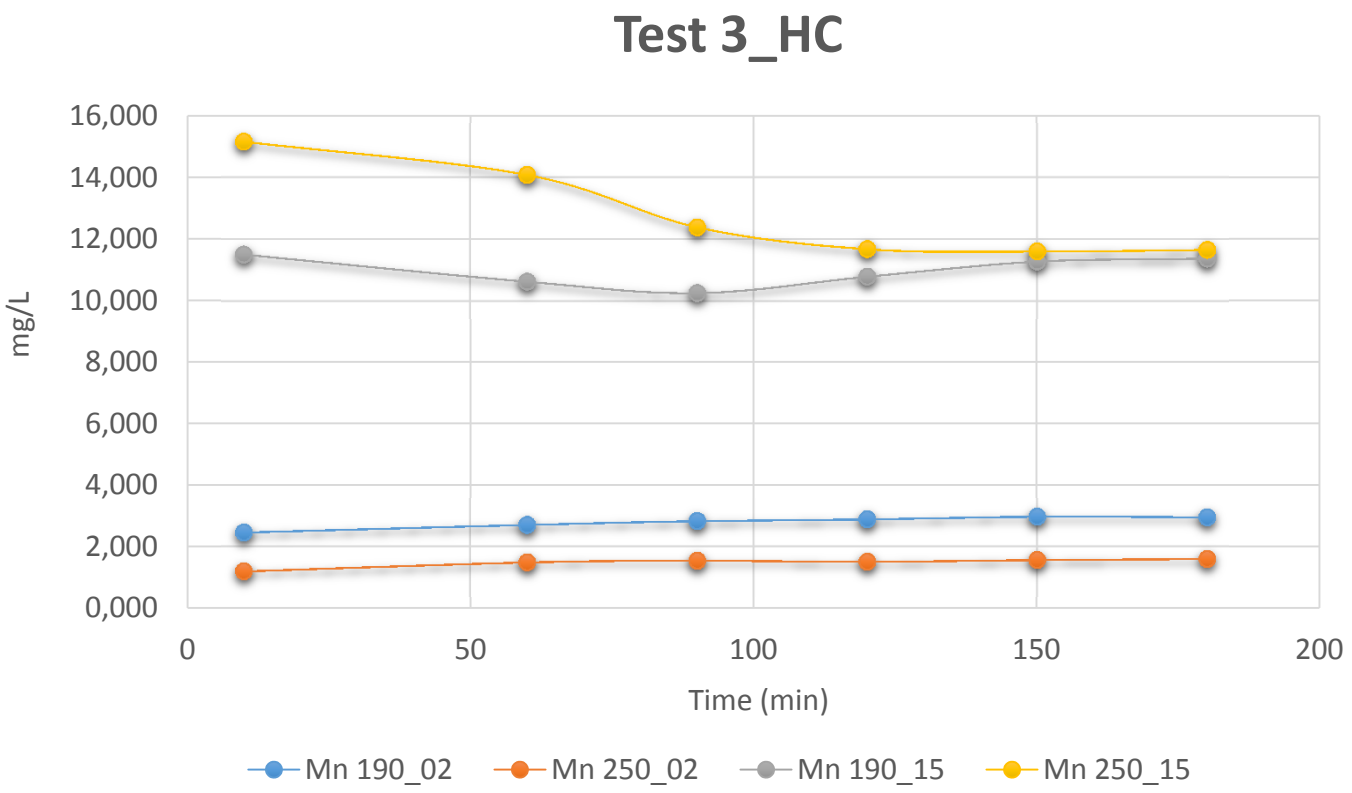
- CSO water (30 mg sCOD/L)
- Absorbent: washed HC
- Quantity: 5 and 0.5 g/L

NO LEVEL OF ABSORPTION IN TERMS OF sCOD

Metals profile with washed HC

Test 3_HC

- Distilled water
- Absorbent: washed HC
- Quantity: 0.5 g/L
- Metal added: Mn 2 and 15 mg/L



Conclusion and future outlook

- Higher sCOD removal efficiency observed at lower concentration of HC (0.5 g/L) and higher concentration of sCOD/metals
- Optimal washing ratio of 0.5 g of absorbent for each L of washing water
- Slight removal of Mn detected

- Further experiments are need to investigate more in detail the activated and non-activated HC

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Thank you

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