Distillation of post-processing water derived from the hydrothermal carbonization process of sewage sludge

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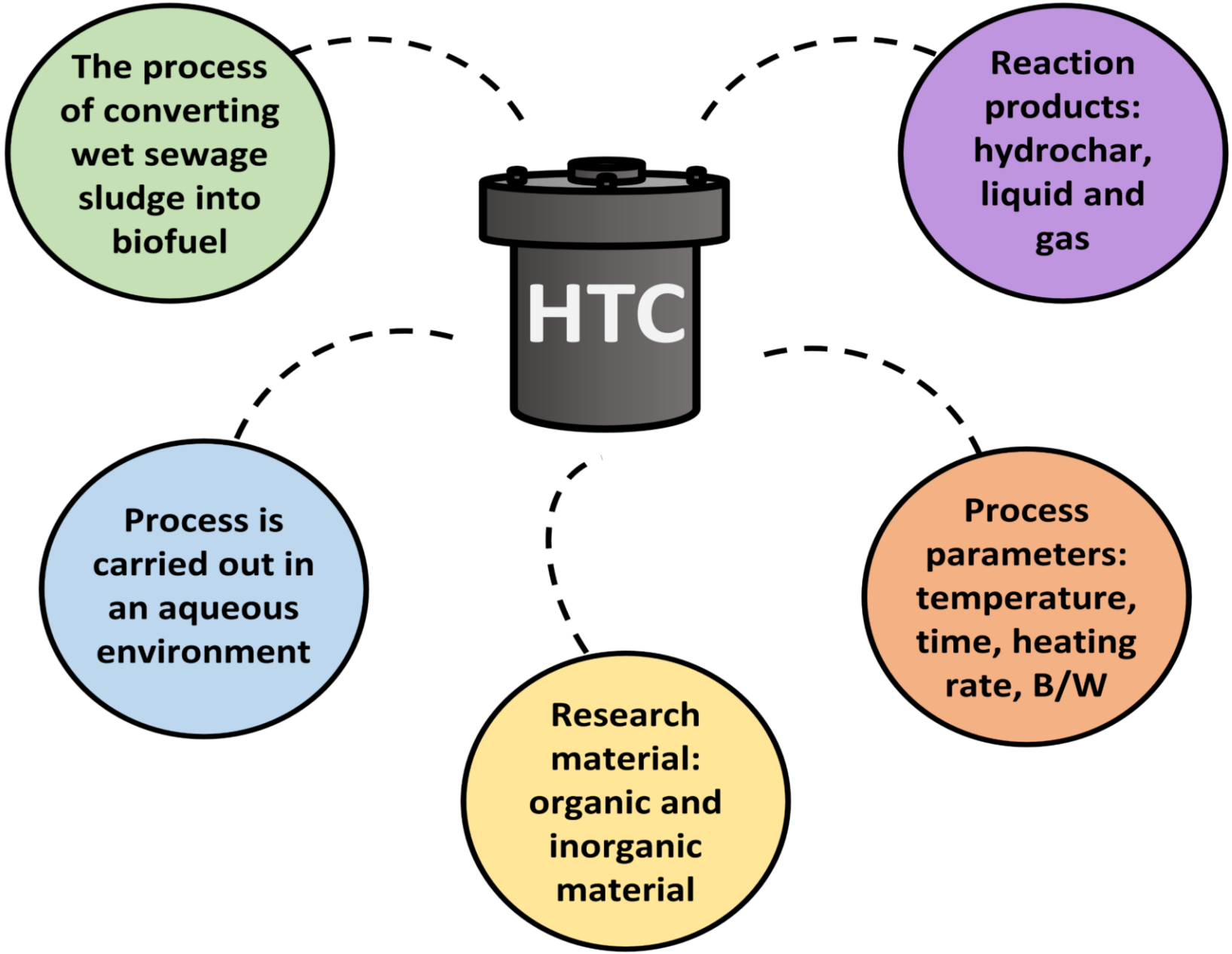
Presentation plan

- Introduction: hydrothermal carbonization process of sewage sludge: benefits and problems.
- The main goal of the studies.
- HTC experimental procedure.
- The distillation of post-processing liquid.
- Analysis of the results.
- Conclusions.

What is the HTC?



Experimental procedure

Sample preparation → HTC investigation → Cooling → Separation → Dried hydrochar

Post-processing liquid analysis

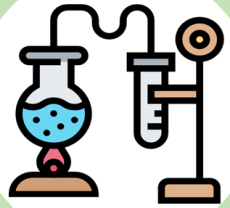
Purification of post-processing liquid

PURIFICATION OF POSTPROCESSING LIQUID HTC

Aerobic oxidation

Anaerobic fermentation

Wet oxidation



Distillation

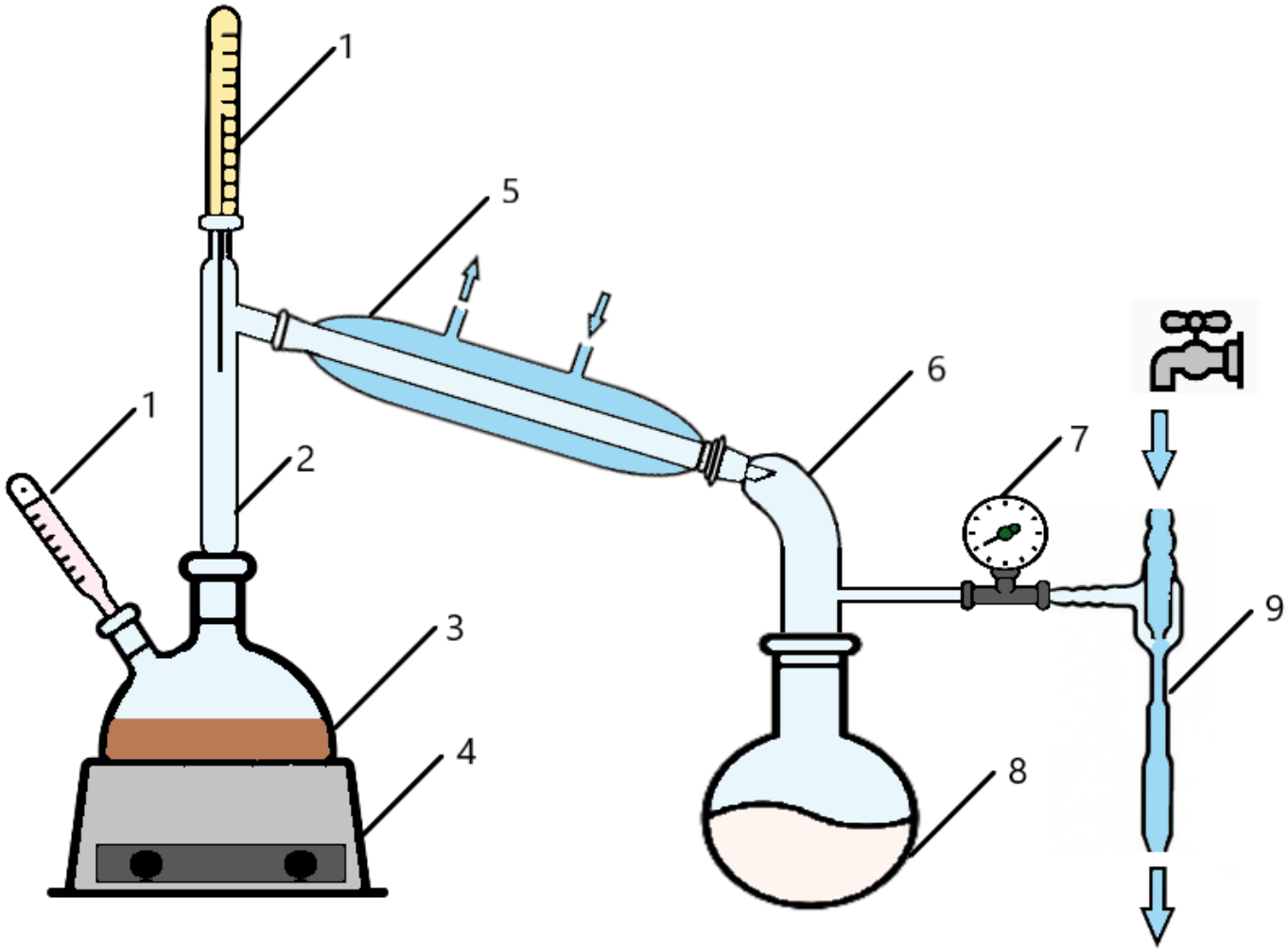
The main aim of the study

Investigation of the vacuum depth of distillation:
0.0; -0.3; -0.5 bar on post-processing liquid
(HTC filtrate)

Chemical and physical analysis of
HTC filtrate and distillates

Selection of
optimal distillation
parameters

Set-up of distillation process



1 - termometer

2 - still head

3 - round bottomed flask

4 - heat source

5 - condenser

6 - still receiver

7 - manometer

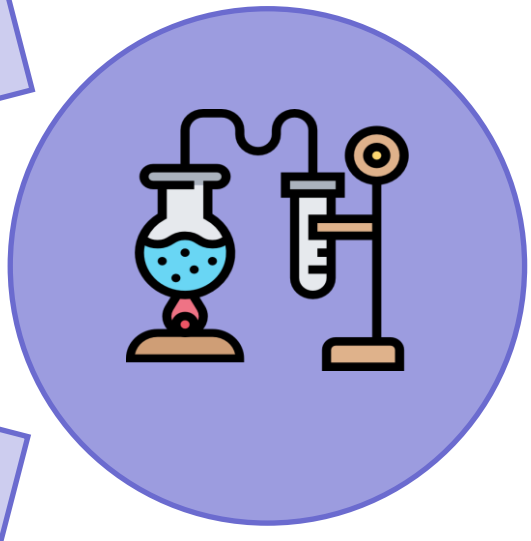
8 - receiving flask

9 - water pump

Process conditions

Post- processing liquid after HTC in 200°C and 2h

Manometric pressure: atmospheric pressure, -0,3 bar and -0,5 bar



Mass of sample: 300 g

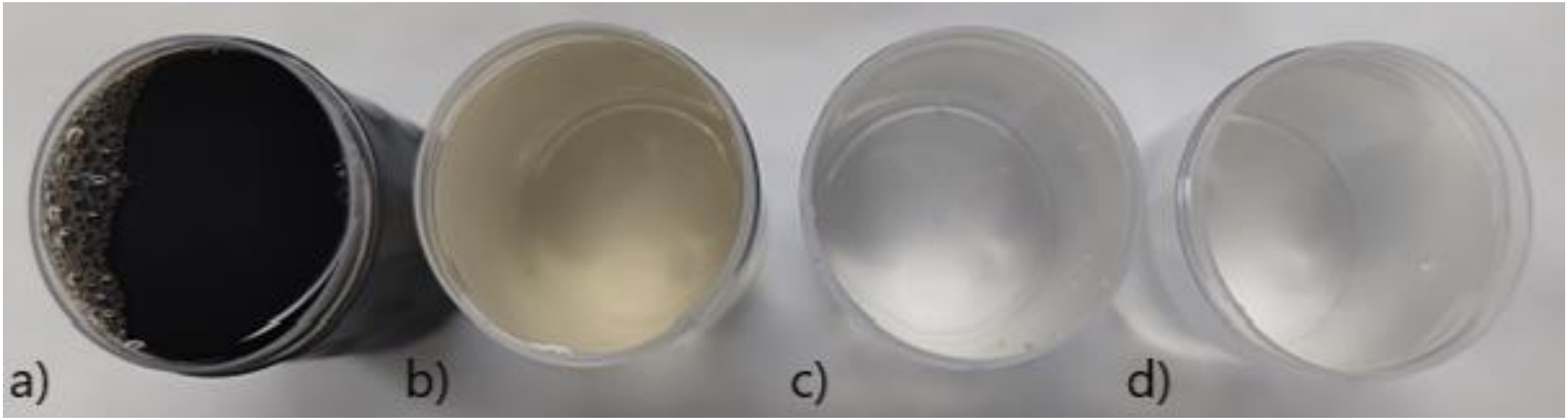
End of the process when the liquid overheats

Conditions

Table 1. Parameters of the experiment.

	Initial mass [g]	Manometric pressure [bar]	Boiling point [C]	Mass of distillate [g]	Mass of distillation residue [g]
1.	300	0	100.00	279.00	21.00
2.	300	-0,3	88.00	213.00	87.00
3.	300	-0,5	77.80	177.00	123.00

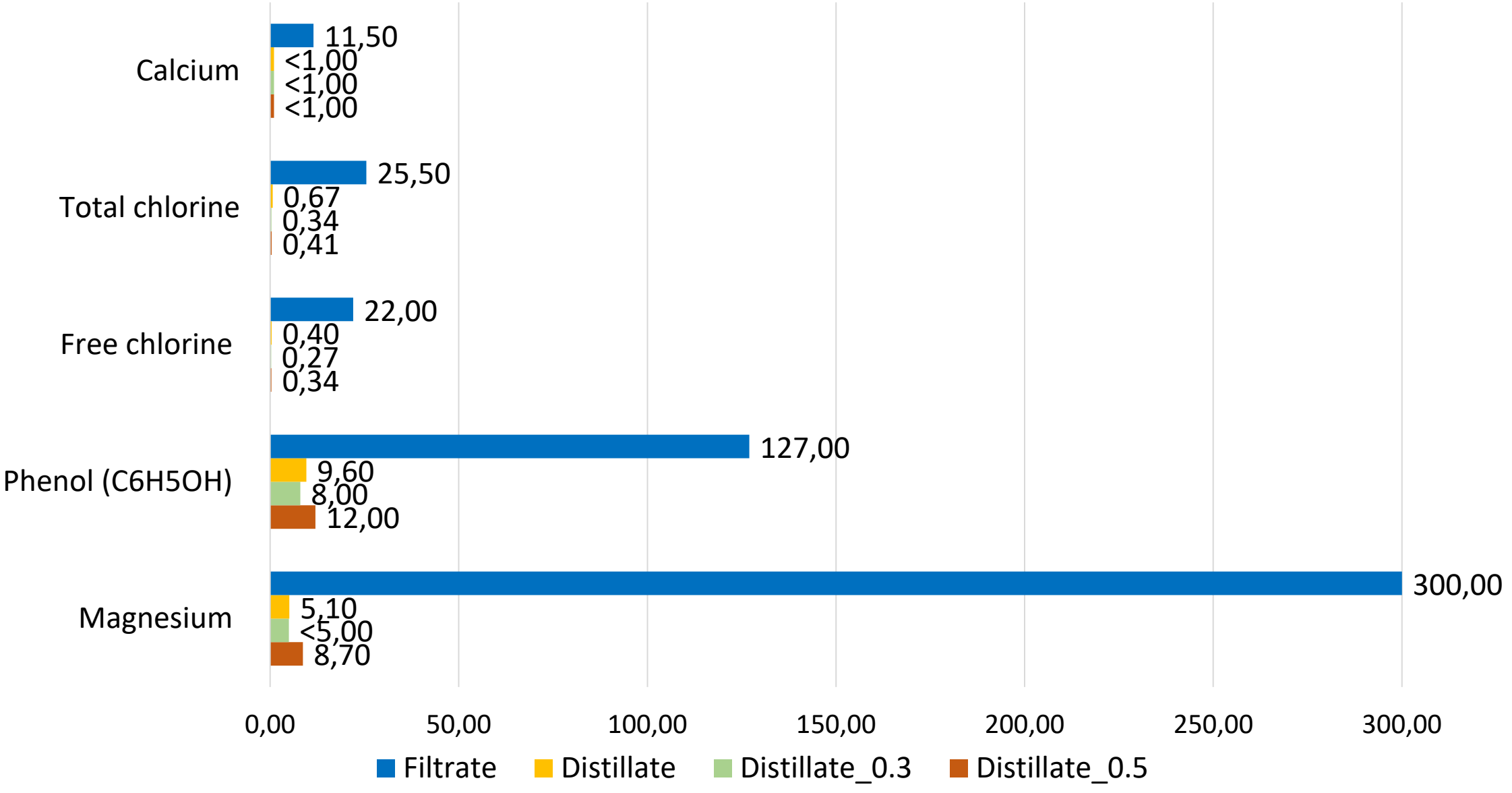
Filtrate and distillates



(a) HTC filtrate; (b) distillate under atmospheric pressure; (c) -0,3 bar; (d) – 0,5 bar

Results

Figure 1. Chemical and physical properties of filtrate and distillates [mg/L].



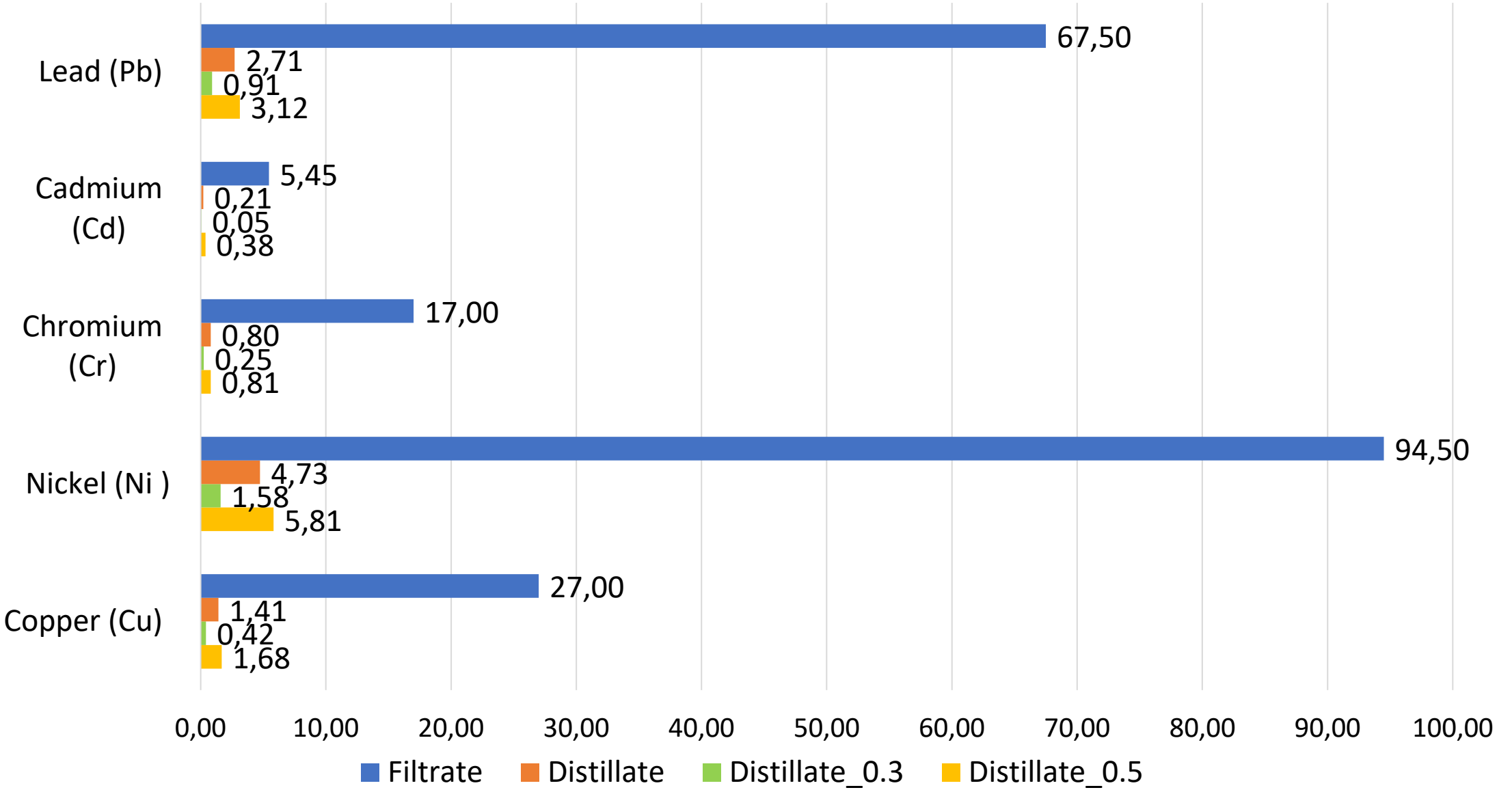
Results

Table 2. Chemical and physical properties of filtrate and distillates.

	Filtrate	Distillate	Distillate_0.3	Distillate_0.5	Unit
Chemical Oxygen Demand (COD)	46210	2600 ↓	1180 ↓	1895 ↓	mg/L
Ammonium Nitrogen	655	950.0 ↑	550.0 ↓	1000.0 ↑	mg/L
Phosphate (PO_4-P)	2585.0	9.8 ↓	4.3 ↓	5.5 ↓	mg/L
Total Organic Carbon (TOC)	16900	796 ↓	344 ↓	534 ↓	mg/L
pH	7.05	9.43 ↑	9.91 ↑	9.96 ↑	-
Conductivity	10.880	2.110 ↓	0.502 ↓	0.992 ↓	mS/cm

Results

Figure 2. Heavy metal contents in filtrate and distillates [mg/L]



Conclusions

- Distillation processes is an adequate method to remove contaminants.
- Atmospheric pressure distillation removed:
  - 95% of COD and TOC
  - 99.5% of PO_4-P
  - 93% of Phenol
  - over 90% of Heavy Metals
  - over 97% of free and total Chlorine.
- Distillation at a reduced pressure at -0,3 bar removed:
  - 98% of COD and TOC
  - 99.9% of PO_4-P
  - 94% of Phenol
  - over 98% of Heavy Metals and free and total chlorine.
- Lowering the pressure to -0,5 bar did not cause any significant effects.
- The boiling point of the liquid is lowered at reduced pressure.

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Thank you for your attention!