

**3<sup>rd</sup> International HTC Symposium**  
**May 10-13, 2023, Seoul, South Korea**



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

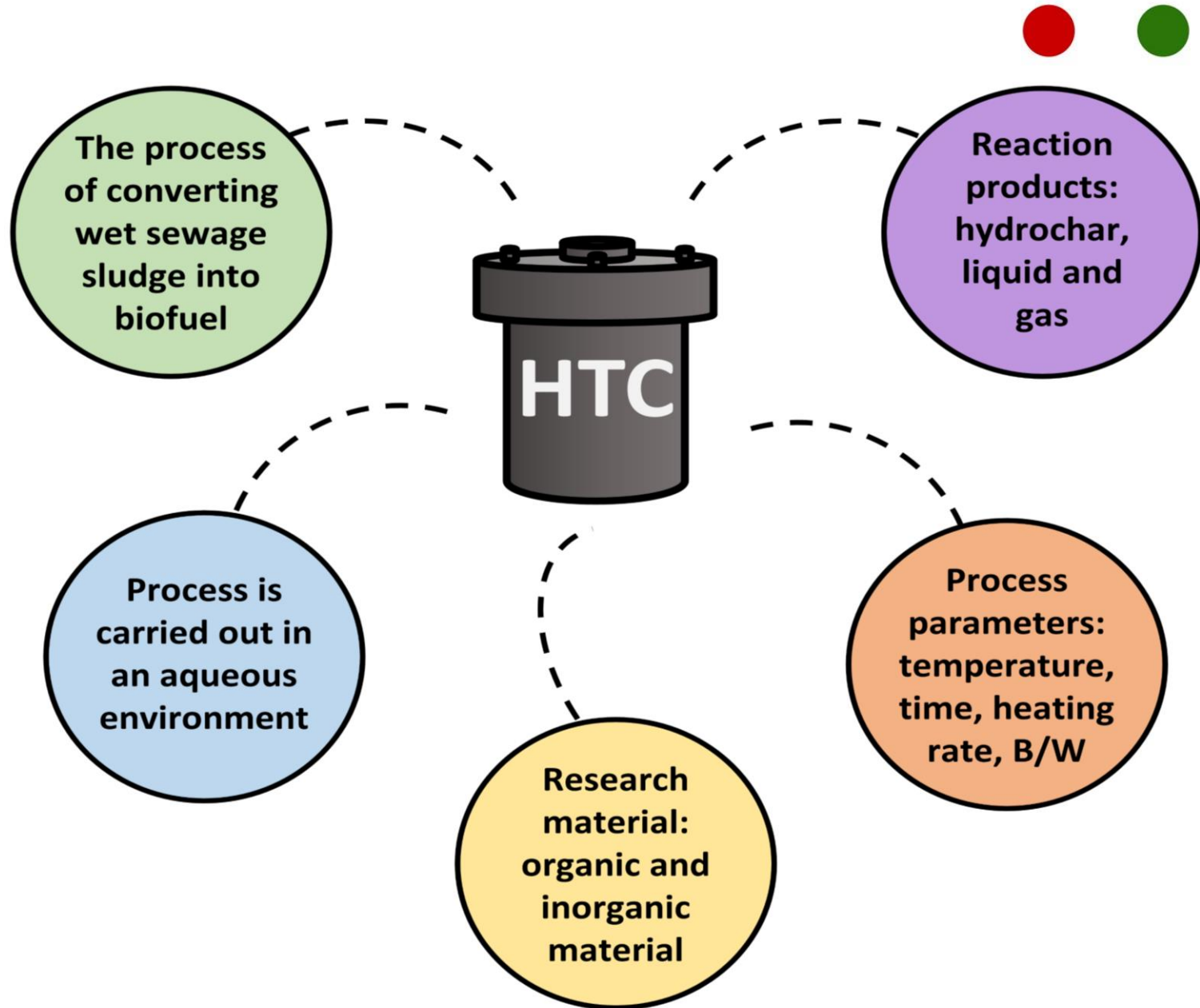
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# Presentation plan

- 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



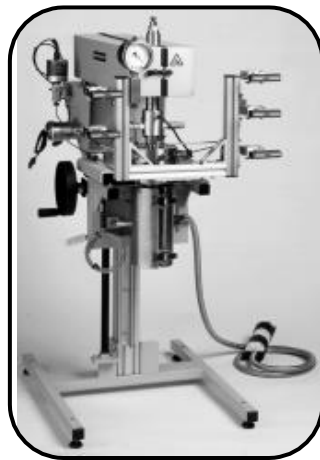
Cooling



Separation  
liquid and  
solid products



Drying  
hydrochar



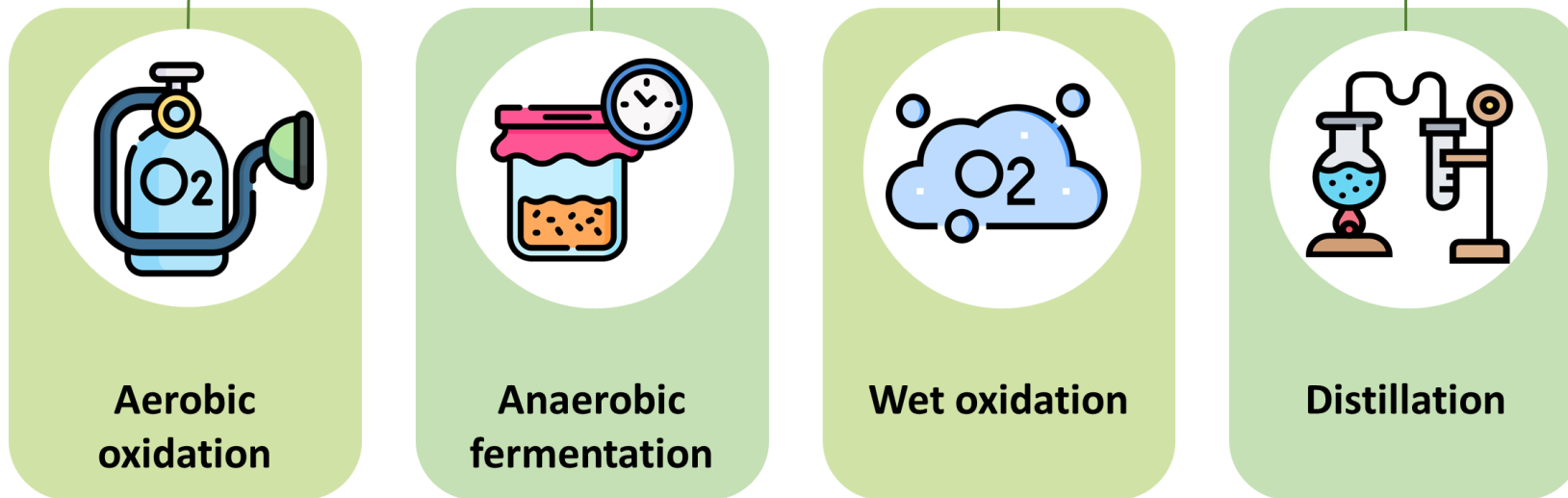
# Post-processing liquid analysis



# Purification of post-processing liquid



PURIFICATION OF POSTPROCESSING LIQUID HTC



# The main aim of the study

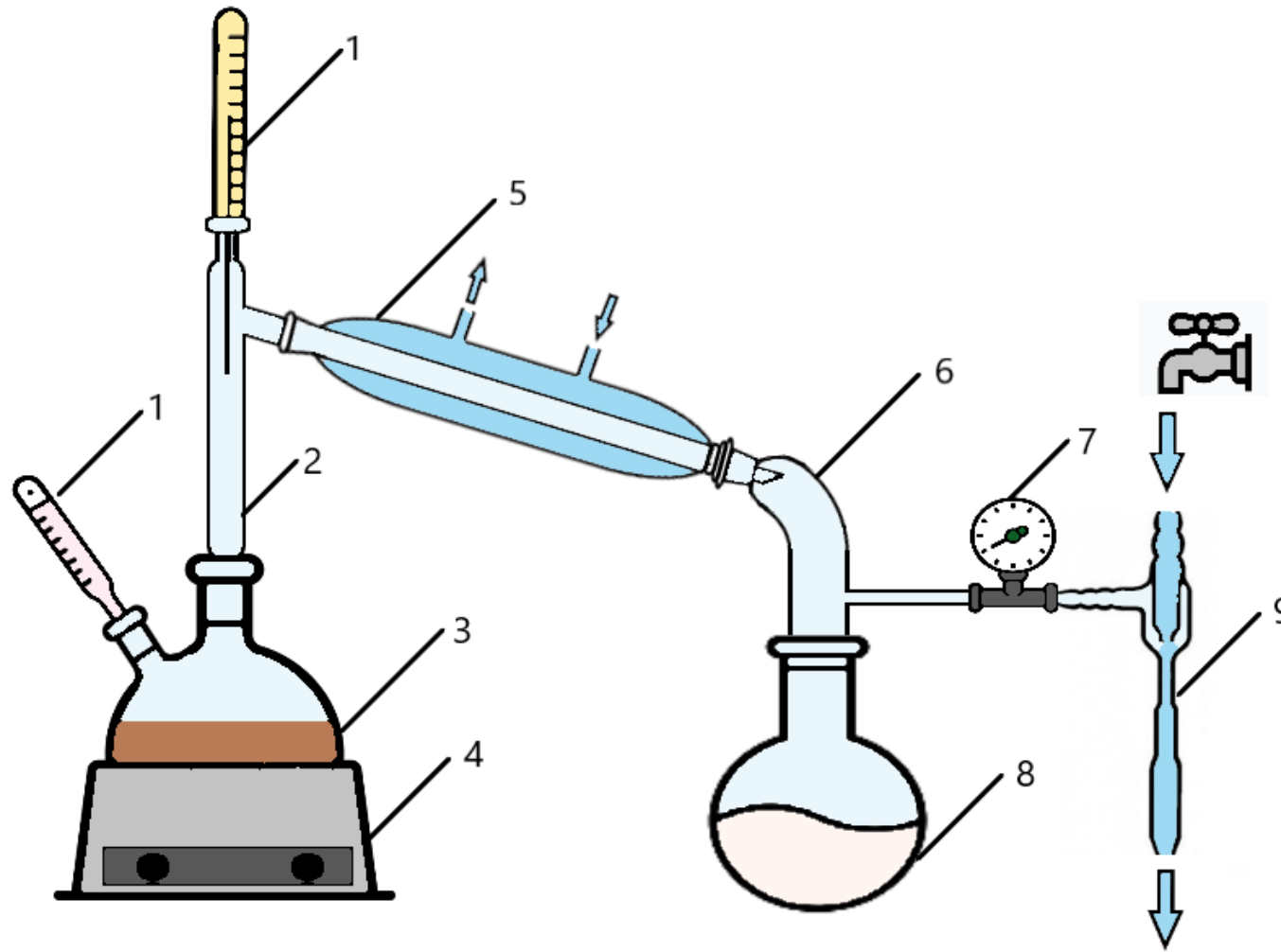


Investigation of the vacuum depth of distillation:  
0.0; -0.3; -0.5 bar on post-processing liquid  
(HTC filtrate)

Chemical and physical analysis of  
HTC filtrate and distillates

Selection of  
optimal distillation  
parameters

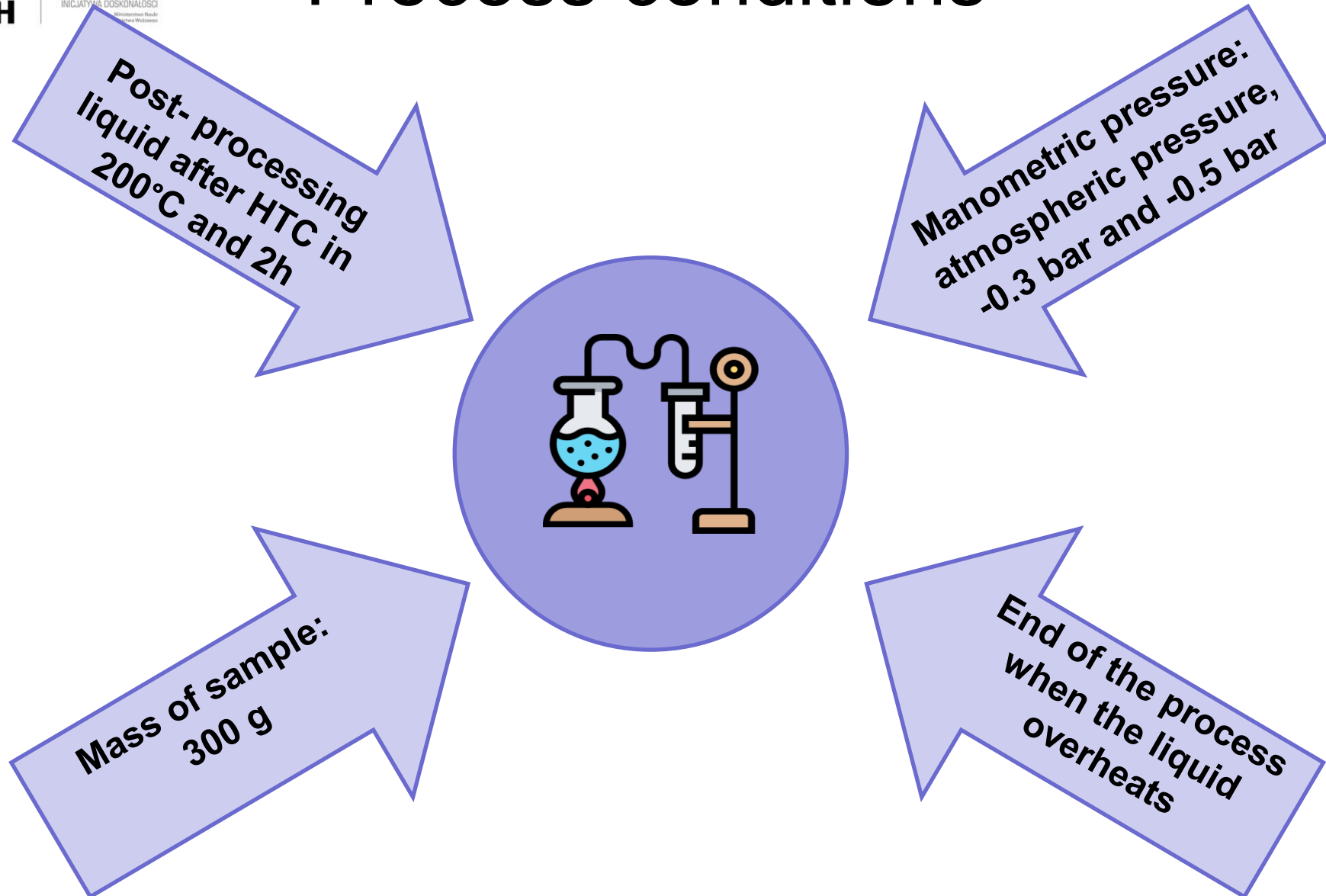
# Set-up of distillation process



- 1 - thermometer
- 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



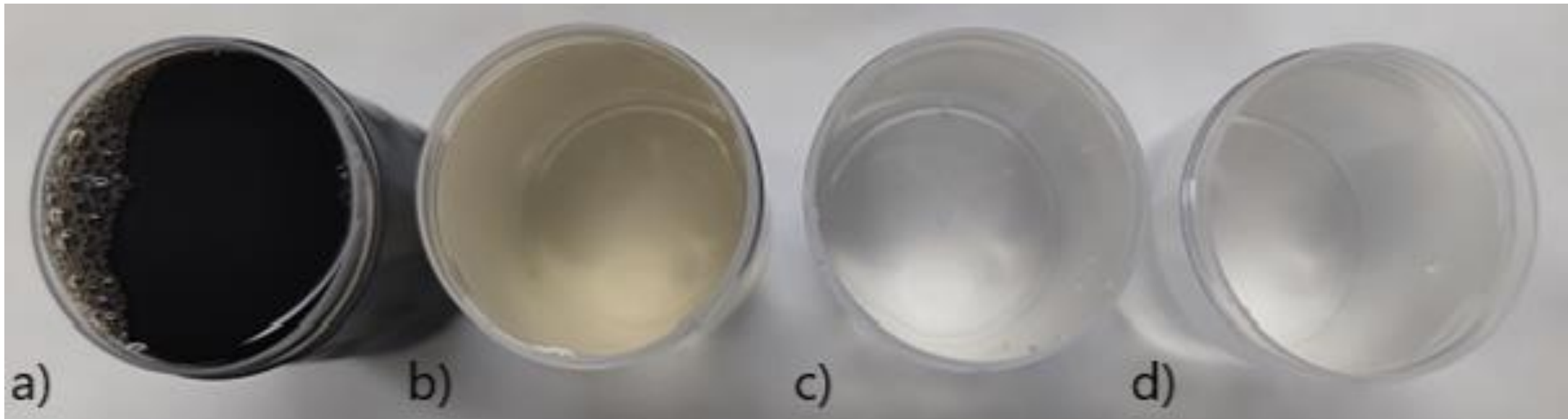
# Conditions



Table 1. Parameters of the experiment.

	<b>Initial mass [g]</b>	<b>Manometric pressure [bar]</b>	<b>Boiling point [C]</b>	<b>Mass of distillate [g]</b>	<b>Mass of distillation residue [g]</b>
<b>1.</b>	300	0	100.00	279.00	21.00
<b>2.</b>	300	-0,3	88.00	213.00	87.00
<b>3.</b>	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].

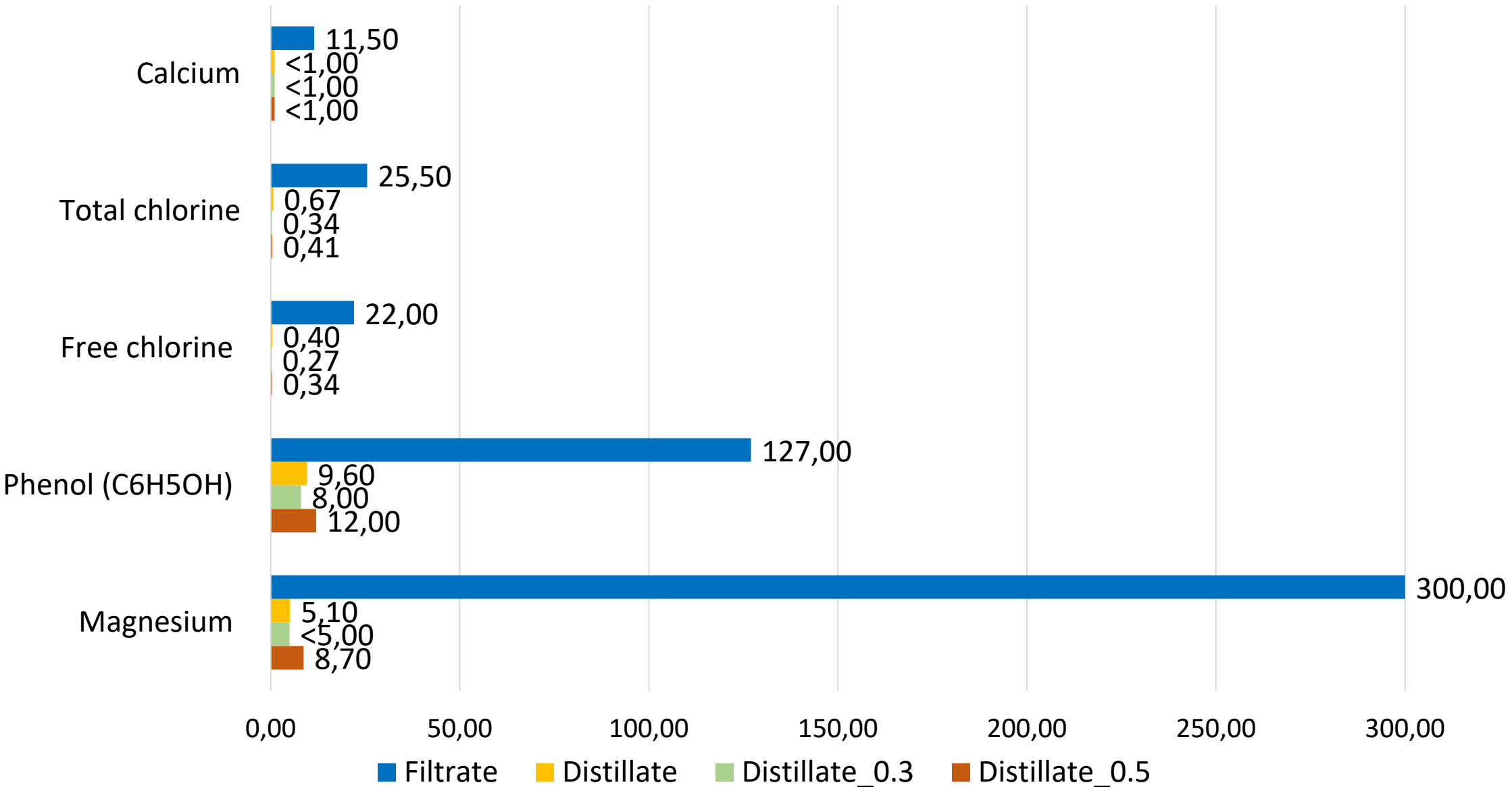




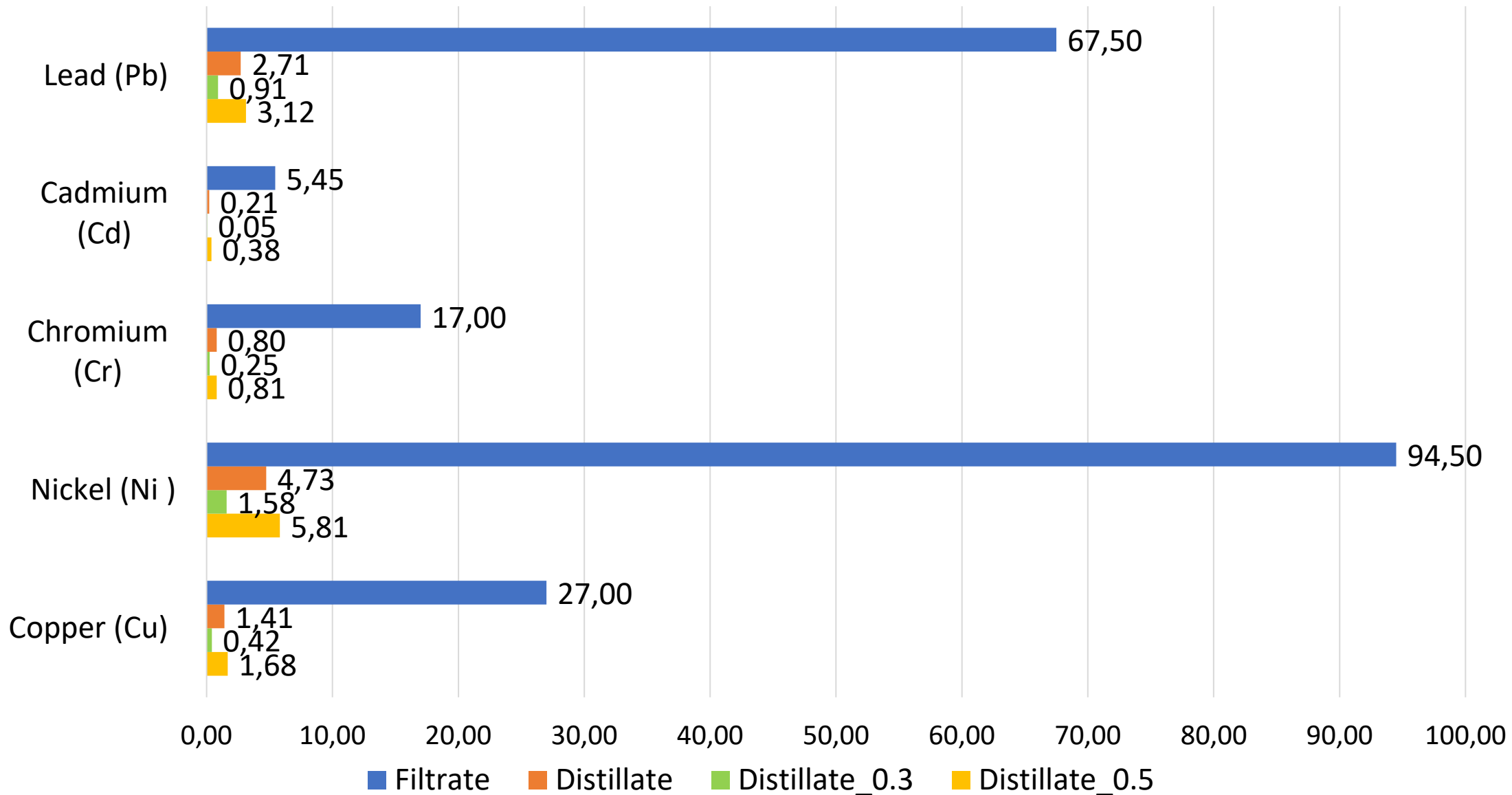
Table 2. Chemical and physical properties of filtrate and distillates.

	Filtrate	Distillate	Distillate_0.3	Distillate_0.5	Unit
<b>Chemical Oxygen Demand (COD)</b>	46210	2600 ↓	1180 ↓	1895 ↓	mg/L
<b>Ammonium Nitrogen</b>	655	950.0 ↑	550.0 ↓	1000.0 ↑	mg/L
<b>Phosphate (PO<sub>4</sub>-P)</b>	2585.0	9.8 ↓	4.3 ↓	5.5 ↓	mg/L
<b>Total Organic Carbon (TOC)</b>	16900	796 ↓	344 ↓	534 ↓	mg/L
<b>pH</b>	7.05	9.43 ↑	9.91 ↑	9.96 ↑	-
<b>Conductivity</b>	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<sub>4</sub>-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<sub>4</sub>-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!