Pražské vodovody a kanalizace

Decentralized removal of micropollutants from infectious hospital wastewater

Ing. Robert Kvaček

5. 6. 2024

Innovation in Environmental Protection

Table of Contents

Basic Project Information

- Title: **Decentralized removal of micropollutants from infectious hospital wastewater**
- Grant Programme: **NF Call-3B 3.3.2.1 - „Trondheim“**
- Project Promoter: **Pražské vodovody a kanalizace**
- Project Partner: **Fakultní Thomayerova nemocnice**
- Grant: **23 099 715 CZK**

Supported by grant from the people of Norway.

Norway grants

STATE ENVIRONMENTAL FUND OF THE CZECH REPUBLIC

Working together for a green Europe

Goals and Expectations

- To successfully build and operate first quaternary hospital WWTP in Czechia
- To reduce the environmental pollution caused by hospital wastewater
  - A minimum pharmaceutical removal rate of 90% was required.
- To start a discussion about future hospital wastewater treatment

- **Goals:**
  - **Disinfection of WWTP by-pass**
  - **Modernization of mechanical pre-treatment**
  - **Introduction of quaternary wastewater treatment**

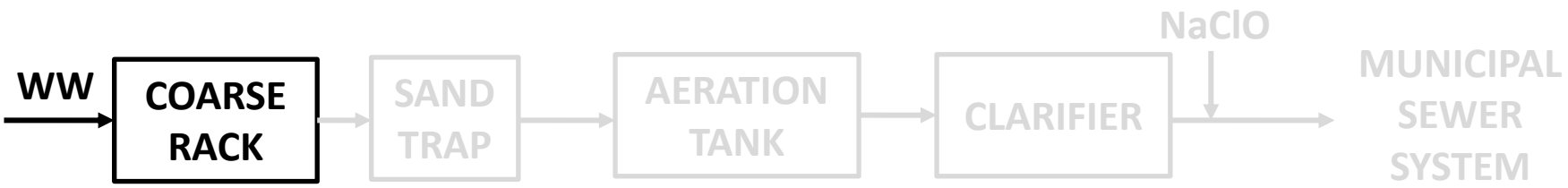
Hospital WWTP (1/4)

» WWTP capacity: **1 500 PE**

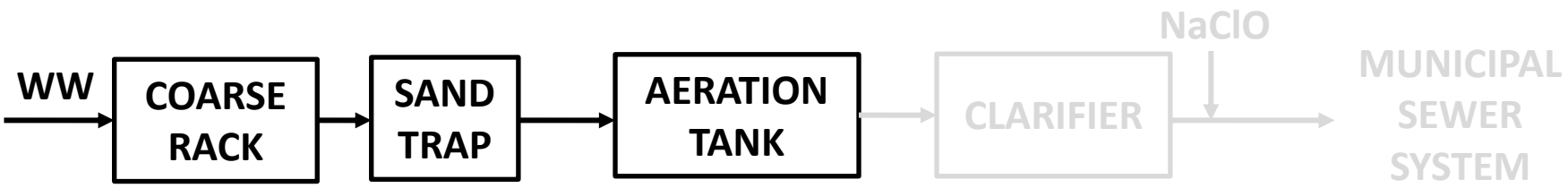
» **Inlet Characterization:**

Parameter	Unit	Average	Maximum
Flow rate	m^3/d	200	500
	m^3/h	8,3	-
COD_{Cr}	mg/l	551	1 300
BOD_5	mg/l	186	360
TSS	mg/l	131	350
$N\text{-}NH_4$	mg/l	27	64
pH	-	6.9 - 7.5	

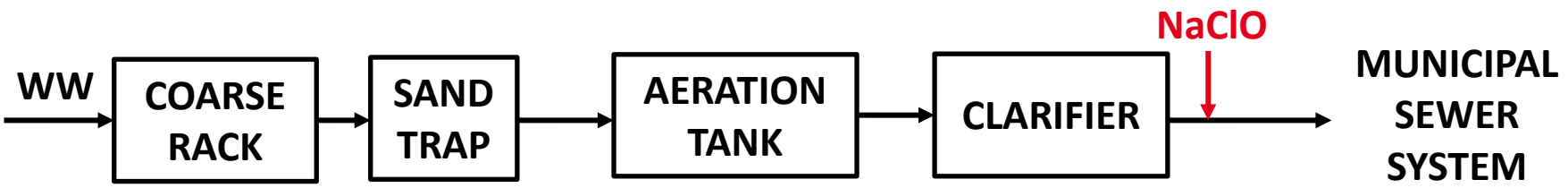
Hospital WWTP (2/4)



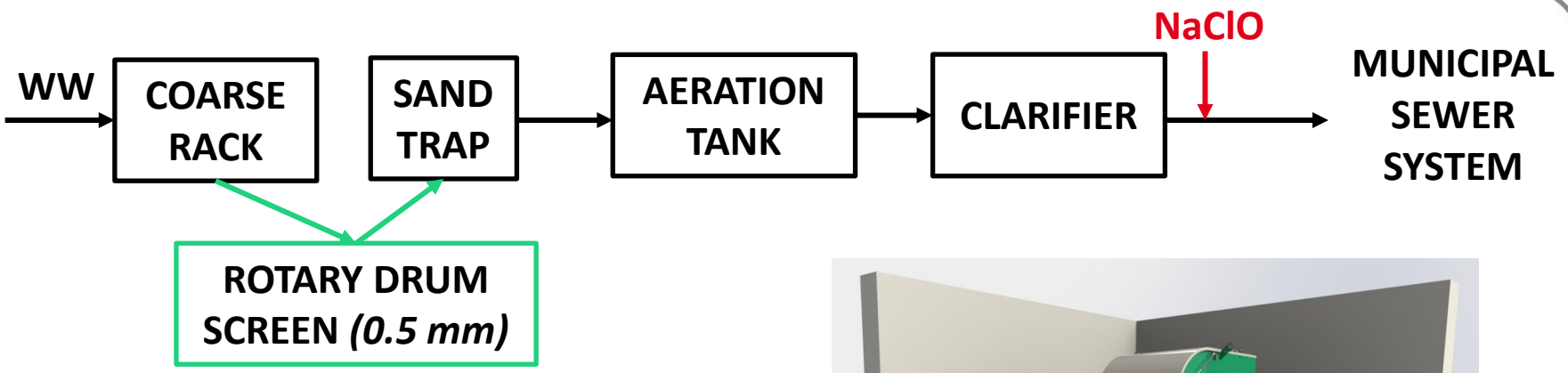
Hospital WWTP (3/4)

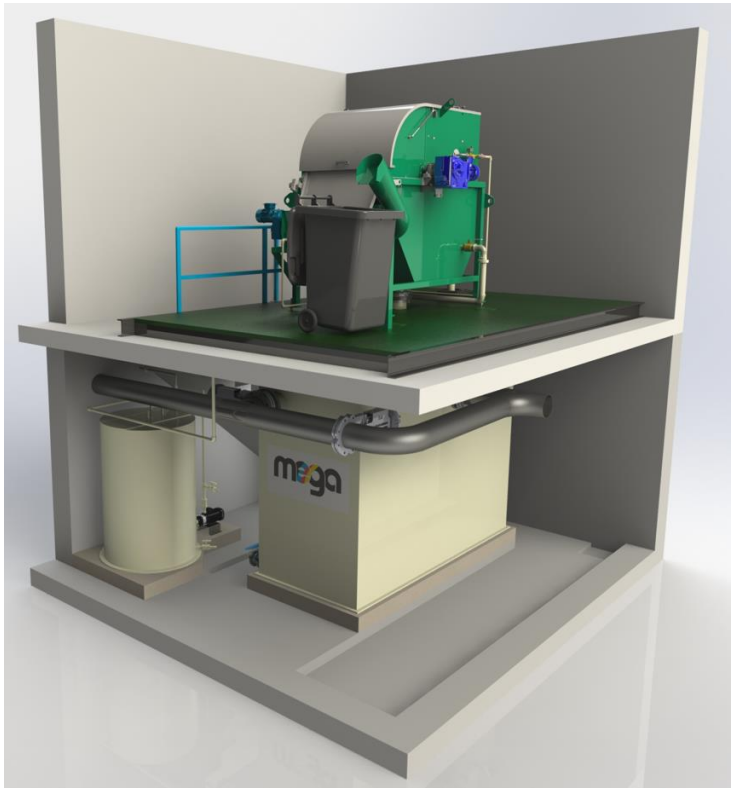


Hospital WWTP (4/4)

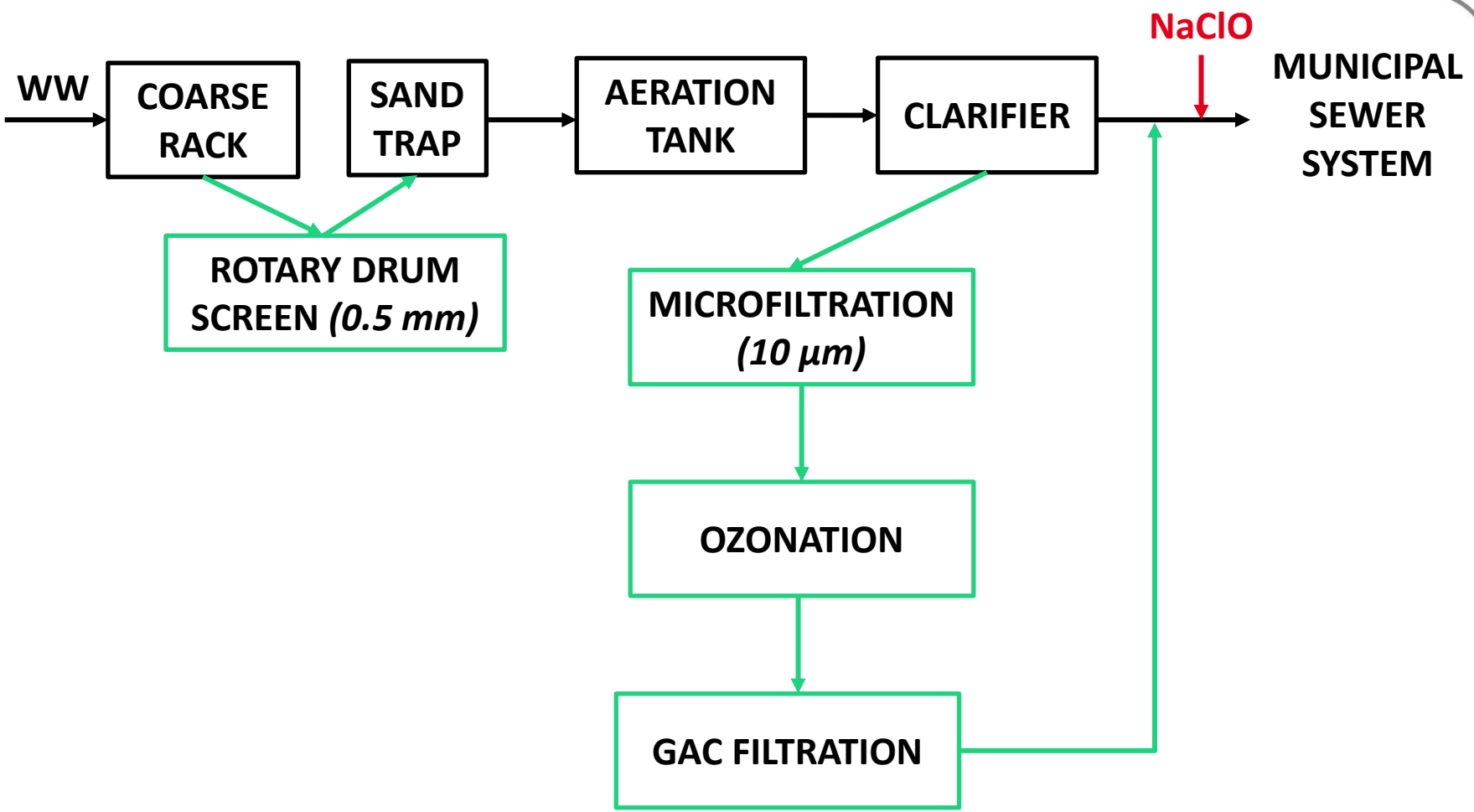


WWTP Modernization (1/6)

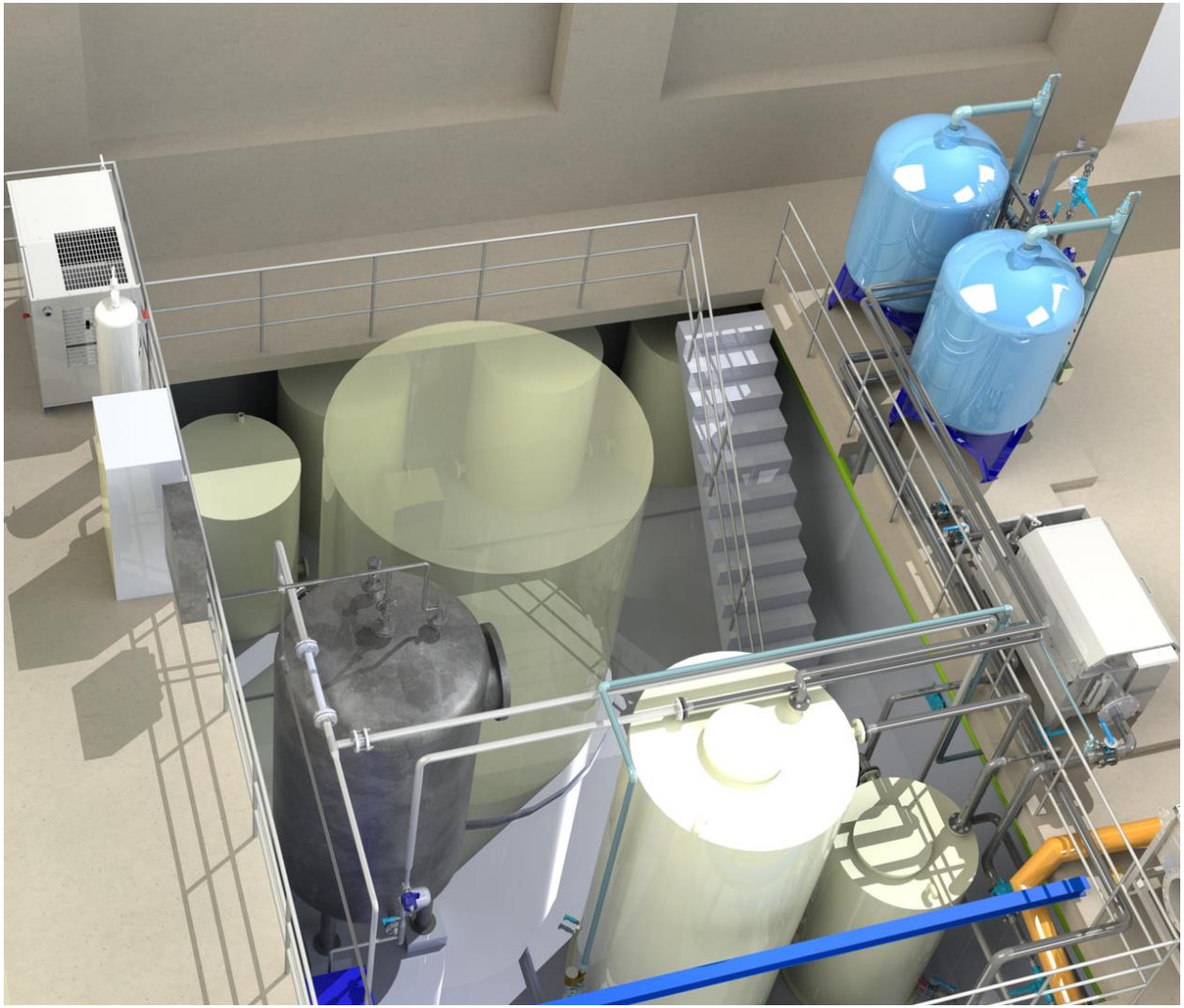




WWTP Modernization (2/6)



WWTP Modernization (3/6)



WWTP Modernization (4/6)

Microfiltration

Ozone Contact Tank

WWTP Modernization (5/6)

O_3 generator

Ozone Generator
5 - 15 ppm @ 10 m^3/h
50 - 150 g/h
Ozone Contact Tank
5 m^3
Ozone Destructor
catalytic; max. 18 Nm^3/h

WWTP Modernization (6/6)

GAC Filtration

GAC	
Ø	1 400 mm
$h_{sorbent}$	0.81 m
Q	2 × 5 m^3/h
V_{GAC}	2 × 1.25 m^3
Ɵ	15 minutes
$V_{wash\ water}$	6 - 7 m^3/10 min

Results (1/3)

» **Physico-chemical parameters were measured in 3 sampling points.**

- **Aeration Tank Inlet → Clarifier Outlet → GAC Filtration Outlet**

Physico-chemical parameters

Sampling Point	TSS [mg/l]	TSS [%]	COD_{Cr} [mg/l]	COD_{Cr} [%]	TOC [mg/l]	TOC [%]
Aeration Tank Inlet	230 ± 99	-	687 ± 157	-	-	-
Clarifier Outlet	72.3 ± 35.9	-	133 ± 110	-	34.3 ± 12.0	-
GAC Filtration Outlet	**4.0 ± 1.7**	**94.5**	**9.5 ± 5.3**	**92.9**	**5.8 ± 1.7**	**83.0**

Results (2/3)

- **Following the indicative list of pharmaceuticals (PHMs), 30 out of 33 PHMs were analyzed in 15 sampling campaigns.**
- **4 sampling points**
  - **Aeration Tank Inlet → Clarifier Outlet → Ozonation Outlet → GAC Filtration Outlet**
- **A minimum pharmaceutical removal rate of 90% between the clarifier outlet and GAC filtration outlet was required.**
- **25 out of 30 PHMs were completely removed by the quaternary line.**

Pharmaceuticals (PHM)

Sampling Point	Detected PHMs	Average Concentration [ng/l]	Removal Rate [%]
Aeration Tank Inlet	29 out of 30	518 188	-
Clarifier Outlet	28 out of 30	46 761	-
GAC Filtration Outlet	**5 out of 30**	**153**	**99.4**

Results (3/3)

Pharmaceuticals detected after the GAC filtration:

Pharmaceutical	Detection Limit [ng/l]	Frequency of Detection *15 samples*	Clarifier Outlet Ø Conc. [ng/l]	GAC Outlet Ø Conc. [ng/l]	Removal Rate [%]
Gabapentin	10	15 / 2	627 ± 266	12 ± 1	**99.7**
Metformin	20	15 / 13	716 ± 285	95 ± 62	**87.5**
Paracetamol	10	15 / 1	42 ± 16	19	**97.4**
Sulfamethoxazole	3	15 / 2	2 083 ± 1 876	3 ± 0	**100.0**
Telmisartan	20	15 / 2	5 021 ± 965	25 ± 5	**99.9**

Conclusion

- First quaternary wastewater treatment operation in Czechia
- Efficiency of the new technology has been confirmed by the laboratory results.
  - TSS were removed by 94.5%.
  - COD_{Cr} removal rate reached 92.9%.
  - TOC concentration was decreased by 83.0%.
  - The quaternary technology removed 99.4% of pharmaceutical concentration.
- Project Presentation
  - Participation in Official Document by the State Environmental Fund
  - Press Conferences
  - Technical Conferences and Magazines

Thank you for your attention!