DESIGN PROJECT – SIE 2026

BIBLIOGRAPHICAL AND TECHNICAL-ECONOMIC STUDY OF MICROPOLLUTANT TREATMENT PROCESSES

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CONTEXT

Organic micropollutants (MP)[1]

Organic substances present in trace concentrations

ng/l to µg/l

Toxic, persistent and bioaccumulating

Concern for human, animal and environmental health

Evolution of the Swiss MP regulations[2,3]

- **2006** – Launch of *Stratégie MicroPoll*
- **2009 - 2015** – Amendments to the Leaux and OEaux
- **2016** – Enforcement of the MP regulations

Involved wastewater treatment plants (WWTP)

- ≥ 80 000 Population Equivalents (PE)
- Discharge into sensitive environments

≥80% removal based on **12** indicator substances

75% Of the investment costs of the MP treatment line can be **financed** through the dedicated **FOEN fund**

RELEVANCE FOR VIDY WWTP

317 809 PE[4]
+ discharge into Lake Geneva → **Requirement to treat MP**

Since 2015: Reconstruction

- Construction of **enclosed facilities** and implementation of **air treatment**
- Construction of advanced and **ultracompact** biofilters for carbon and nitrogen removal

2014: initial choice for MP treatment
O_3 + PAC + SF

→ **2017:** detection of elevated bromide concentrations
Optional low O_3 dose + PAC + SF

2026: grant of funding based on 2017 MP treatment line

This work assesses current MP removal technologies and their suitability considering the project's constraints

APPROACH

Phase 1: Literature review

- Overview of the processes
- International and Swiss case studies
- Swiss legislation and anticipated amendments

Phase 2: Vidy WWTP characterization

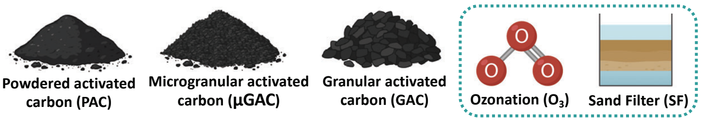
- Conditions: hydraulics and treatment chain
- Project's specific constraints

Phase 3: Process selection and multicriteria evaluation

- MP processes selection, criteria definition and development of methodological approach
- Multicriteria grid
- Sensitivity analysis

RESULTS

Components of MP treatment lines



O_3 + SF ruled out due to high bromide concentrations (as addressed by VSA[5]), despite it being a reference process

Table 1. Qualitative multicriteria classification of the selected processes

	Weight*	PAC + SF	µGAC (in fluidized bed)	O_3 + PAC + SF	O_3 + GAC (in fixed bed)
Costs	**29%**				
OPEX performance	50%	◑	◑	◕	●
CAPEX performance	33%	◕	●	◑	◕
Alignment with reference treatments	17%	●	●	◔	◔
Effluent water quality	**24%**				
Minimisation of oxidation by-products	50%	●	●	◑	◑
Removal of P and TSS	33%	●	○	●	◕
Disinfection	17%	◑	○	◕	◕
Operational adaptability and robustness	**19%**				
Regulatory evolution resilience	50%	◑	◑	●	●
Resilience to exceptional rainfall events	33%	◕	◑	●	◑
Resilience to reagent price volatility & shortages	17%	◑	◕	◕	●
Land footprint	**14%**	◕	●	◑	◕
CO_2 footprint	**10%**	◔	◕	◑	●
References	**5%**	●	◕	◔	◑
Final rank	**100%**	**2**	**3**	**4**	**1**

*Weight was defined for academic purposes. It should therefore be adjusted according to the stakeholders' priorities

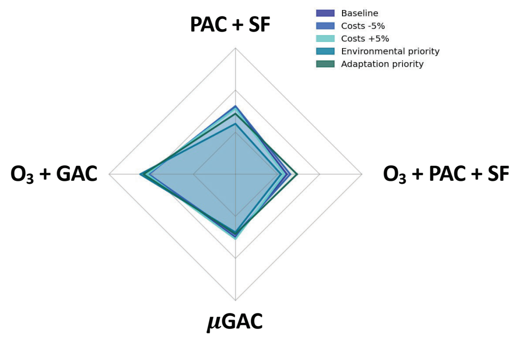


Figure 1. Graphical results (qualitative) of the sensitivity analysis; Environmental priority refers to a higher ponderation of effluent quality and CO_2 emissions, while Adaptation priority focuses on operational adaptability and robustness

This qualitative evaluation suggests that O_3 + GAC in fixed bed is the most suitable option

CONCLUSIONS AND LIMITATIONS

- **O_3 + GAC** seems to be a cost efficient, robust, adaptable and less CO_2 emitting option, it is a process already applied in Switzerland (Altenrhein WWTP)
- The selected process must achieve **80% micropollutant removal even without ozone injection**, to ensure bromate concentrations stay below the regulatory threshold
- **Quantitative data is limited for many parameters**, therefore the assessment relied on empirical data, operator feedback and literature rather than site-specific pilot tests

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