APPLICATION STUDY 2026

Direct dosing of **SCHAEFER PRECAphos®aktiv** into an activated sludge system for the simultaneous removal of phosphorus and micropollutants

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PROBLEM STATEMENT

Micropollutants

Requirements of the EU Urban Wastewater Treatment Directive (UWWTD) [1]:

- Removal of micropollutants in large wastewater treatment plants (>150,000 PE) and selected medium-sized plants (10,000–150,000 PE) by 2045
- Removal efficiency of ≥ 80% for at least six selected substances
- Need to upgrade wastewater treatment plants across Europe with technologies for targeted micropollutant removal

Challenges

- A dedicated treatment stage for micropollutant removal is typically implemented as a separate step downstream of secondary clarification (tertiary treatment, partial flow)
- Established methods include adsorption onto activated carbon and oxidative treatment with ozone
- High capital investment and significant specific treatment costs, particularly for smaller plants [2, 3]
- Operational complexity and maintenance effort associated with established technologies

Approach / Solution

- Development of a product by SCHAEFER KALK for the simultaneous removal of phosphorus and micropollutants based on calcium, iron, and activated carbon (**SCHAEFER PRECAphos®aktiv**)
- Direct dosing into the activated sludge tank (full-flow treatment)

METHODS

- Time-proportional dosing of **SCHAEFER PRECAphos®aktiv** into the influent of the nitrification stage at the Bleidenstadt wastewater treatment plant (50,000 PE), with constant daily dosing over a period of 12 months (January to December 2025)
- Gradual increase of the daily product dose over the experimental period
- Simultaneous 7-day composite sampling: influent to biological treatment and effluent after secondary clarification
- Analysis of 12 substances listed in the EU directive from filtered samples (0.45 µm), along with standard wastewater parameters
- Statistical evaluation in accordance with Directive 2009/90/EC [4]

Fig. 1: Wastewater treatment plant Bleidenstadt

RESULTS

Micropollutant removal as a function of product dosage

- Removal of the six most effectively eliminated substances (amisulpride, citalopram, clarithromycin, metoprolol, benzotriazole, irbesartan) exceeds the 80% threshold required by the UWWTD at a dosage of approximately 60 g/m³ of **SCHAEFER PRECAphos®aktiv** (excluding the removal contribution of primary clarification)

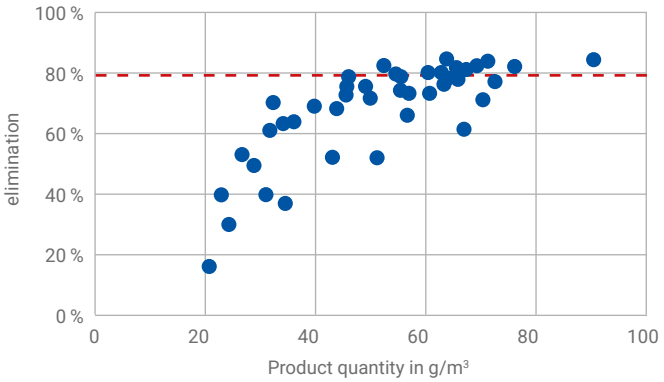

Fig. 2: Percentage removal of the six target substances as a function of daily product dose.

Removal of individual micropollutants

- Increasing the product dose significantly improves removal of benzotriazole, carbamazepine, irbesartan, methylbenzotriazole, metoprolol, venlafaxine, and hydrochlorothiazide
- A smaller effect is observed for diclofenac and candesartan
- No significant additional removal is achieved for amisulpride, citalopram, and clarithromycin with increasing dosage
- Results are consistent with studies in which powdered activated carbon was directly dosed into activated sludge systems [5, 6]

Operating costs for micropollutant removal, phosphate precipitation, and optimization of biological treatment

- Approximately €9.40 per PE per year or €0.11 per m³
- Operating costs are comparable to those of alternative micropollutant removal technologies [2]

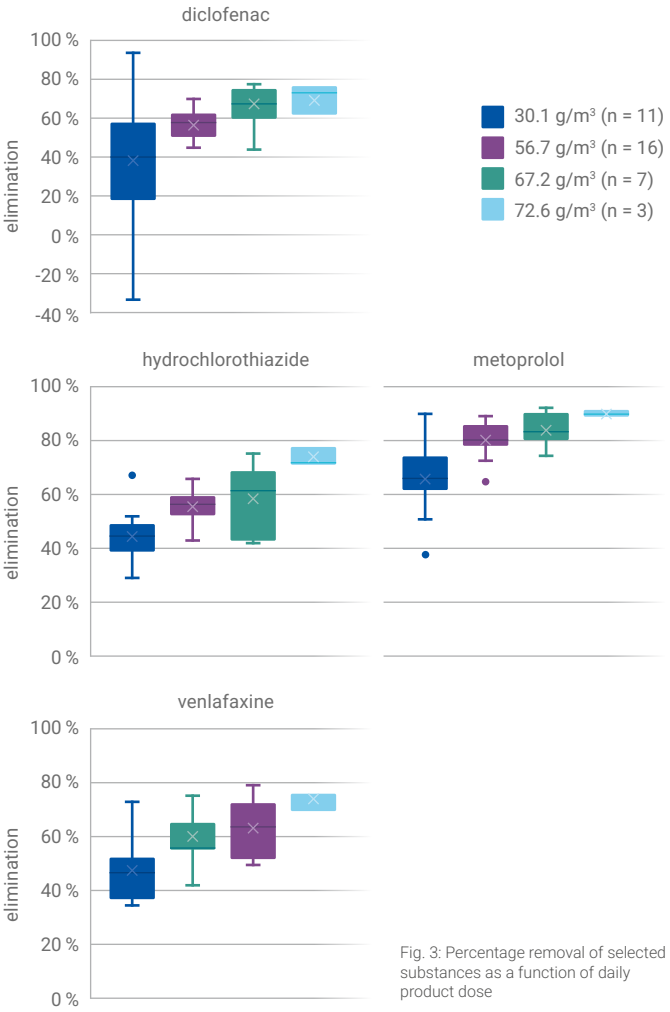

Fig. 3: Percentage removal of selected substances as a function of daily product dose

CONCLUSIONS

- Micropollutant removal meeting UWWTD requirements can be achieved without major additional technical or operational effort
- Existing infrastructure for phosphate precipitation using **SCHAEFER PRECAphos®** can continue to be utilized
- Conversion to **SCHAEFER PRECAphos®** or **SCHAEFER PRECAphos®aktiv** is straightforward and can be implemented rapidly
- The performance of the conventional wastewater treatment process is maintained or even improved
- Demand-based dosing can be implemented using appropriate monitoring and control systems
- Micropollutants are transferred to sludge treatment via excess sludge

ACKNOWLEDGEMENTS

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References

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