Wasserwirtschaft
Wissen macht Zukunft
DWA-Landesverbandstagung
Baden-Württemberg
19.–20. Oktober 2021

SWECO

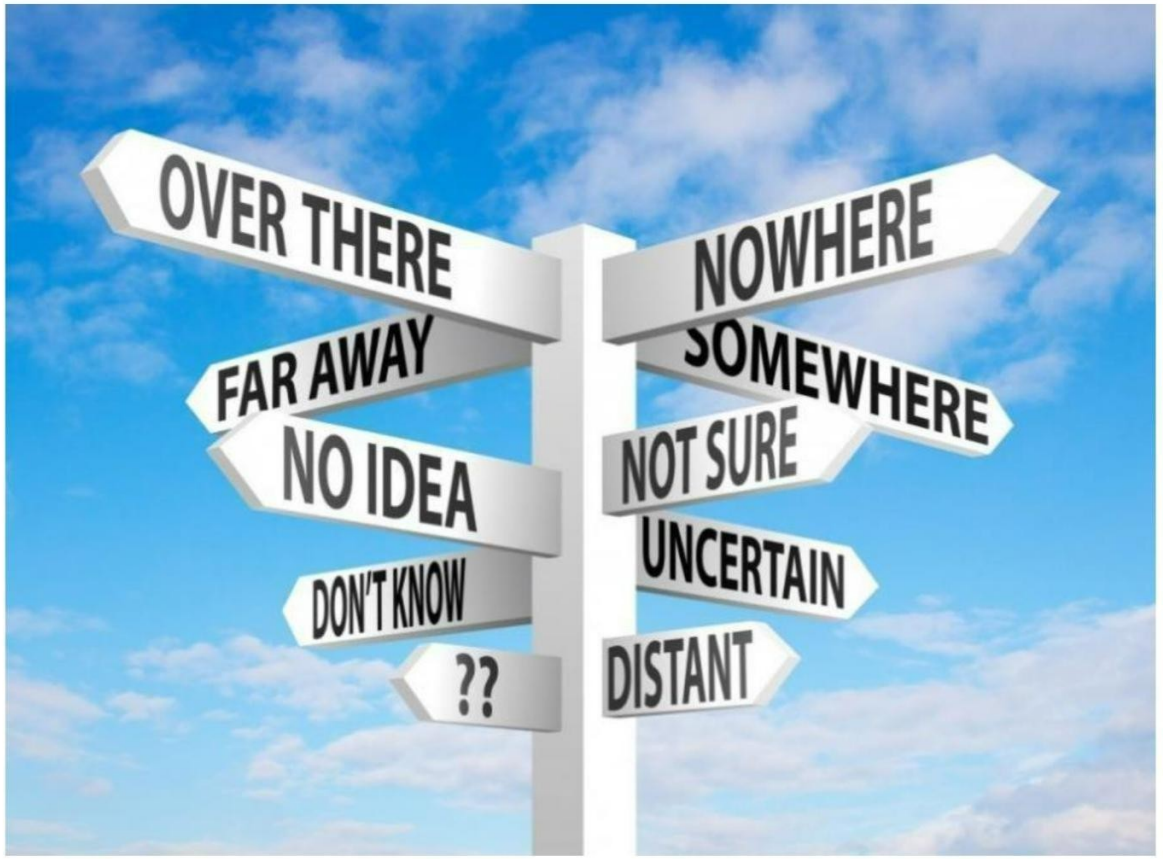
Construction of a new GAC filtration system at the WWTP Immendingen-Geisingen for phosphorus and trace substance elimination

Novelty or commonplace?

Sweco GmbH - Dr.-Ing. Sebastian Platz - 20.10.2021

Structure

- Project process and project team
- Excursus GAC filtration
- Presentation of the WWTP
- Planning and dimensioning
- Impressions of the construction
- GAC selection and GAC installation
- Operating experience and initial measurement results
- Conclusion

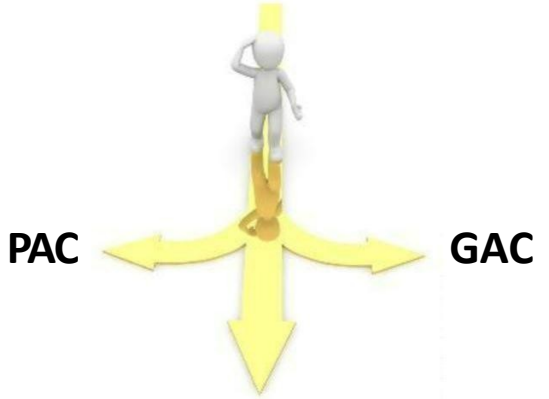


Quelle: ralphhoweministries.com, AdobeStock_51071376-e147103710667

Project process and project team

Jedele and Partner GmbH, Stuttgart

- Feasibility study 4th treatment stage (2016)
  → High priority, as discharged before Danube sinkhole
  → Recommendation of GAC filtration as partial flow treatment
  → High funding rate of 80% determined
- Preliminary project (2017)
  – Comparision of continuous and discontinuous GAC filtration
  – Determination of the partial flow with $Q_{max,Spur}$ 150 L/s
  – Design recommendation (number of chambers, GAC volumme, etc.)
- VgV awarding procedure (2018)
  → Götzelmann + Partner GmbH together with
  IBR Ingenieurbüro Redlich and Partner GmbH









GAC filtration (1) – General overview

GAC filtration in general:

- Adsorption of trace substances on granulated activated carbon with simultaneous particle retention
- GAC can be regenerated and reused
- Fixed bed adsorber, rarely floating/fluidized bed
- Continuous and discontinuous mode of operation
- With or without prior filtration of the wastewater (→ suitability as final filtration)

DWA-Works:

- *Feb. 2019: „Abwasserfiltration durch Raumfilter nach biologischer Reinigung“ (Arbeitsblatt DWA-A 203)*
- *March 2019: „Aktivkohleeinsatz auf kommunalen Kläranlagen zur Spurenstoffentfernung - Verfahrensvarianten, Reinigungsleistung und betriebliche Aspekte“ (DWA-Themen, AG KA-8.6)*
- *Sep. 2021: „ Spurenstoffentfernung auf kommunalen Kläranlagen - Teil 2: Einsatz von Aktivkohle - Verfahrensgrundsätze und Bemessung (Merkblatt DWA-M 285-2)*

GAC-filtration (2) – The beginnings

First GAC filters in practise by retrofitting/converting sand filters:

- WWTP Düren-Merken (2011-2012): MUNLV TP5 „MIKROFlock“, sand filter conversion, GAC filter bed height 1,2 m; later 1,5 m, very short GAC service life of 3.000 – 4.000 BV
- WWTP Obere Lutter (2011-2014): Conversion of 5 filter cells into an activated carbon adsorber, GAC filter bed height 2,5 m, service life of up to 20 months possible
- WWTP Gütersloh-Putzhagen (2012-2016): Conversion of 2 filter cells into large adsorbers with granulated activated carbon, GAC bed height 2,75 m, EBCT of 33 min, still high trace substance removal capacity >80% at 13.000 BV
- WWTP Wuppertal-Buchenhofen (2013-2015): FilterAK+ project, retrofitting of a filter cell, GAK filter bed height approx. 2.0 m up to approx. 23,000 BV (12 months)
- WWTP Rietberg, WWTP Bad Oeynhausen, WWTP Mannheim…

Primary Clarifier Immendingen-Geisingen

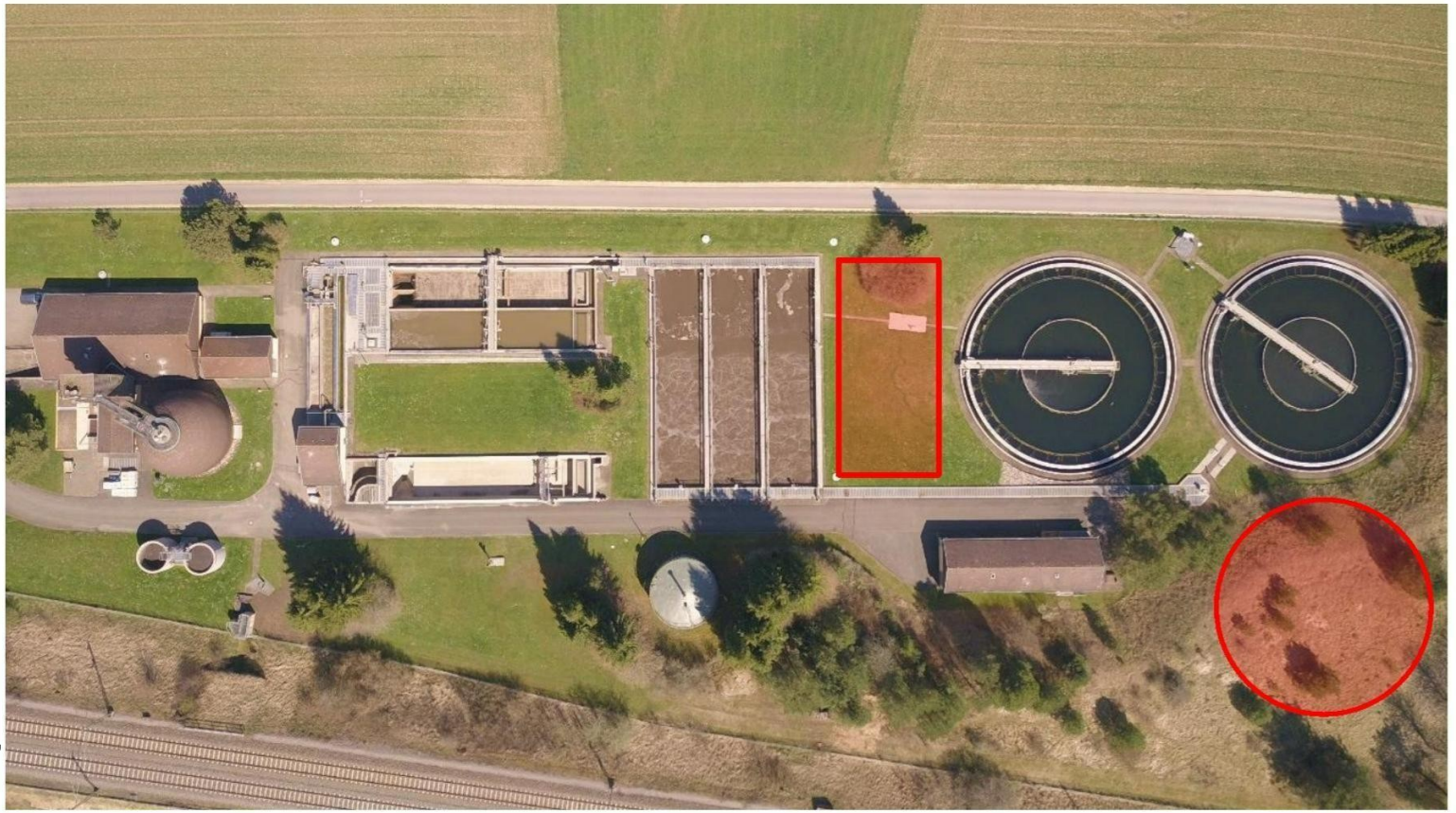
Key data of the WWTP and availability of space

Basic data:

- Expansion size: 25.500 PE
  (current load: approx. 16.000 PE)
- Q_T: 134 L/s / Q_M: 236 L/s
- Wastewater volume: 2,0 - 2,6 Mio. m³/a
- JSM: 1,1 - 1,5 Mio. m³/a
- External water: approx. 50 - 75 %

Basins / treatment stages:

- RÜB: 15 / PW: 6 / KleinPW: 14 / RKB: 1
- Aerated grit/fat trap: 110 m³
- Primary clarifier: 285 m³
- Aeration (3x 1.050 m³):
  - Upstream denitrification (1.275 m³, 40,5 %)
  - Nitrification (1.875 m³)
- Secondary clarifier (2 x 1.875 m³ / 702 m²)
- Sludge digestion, mesophilic (1.200 m³)
- CHP 50 kW , gas tank 250 m³, mill,
  Filtrate storage 285 m³, Secondary thickener,
  2 Sludge silos, chamber filter press

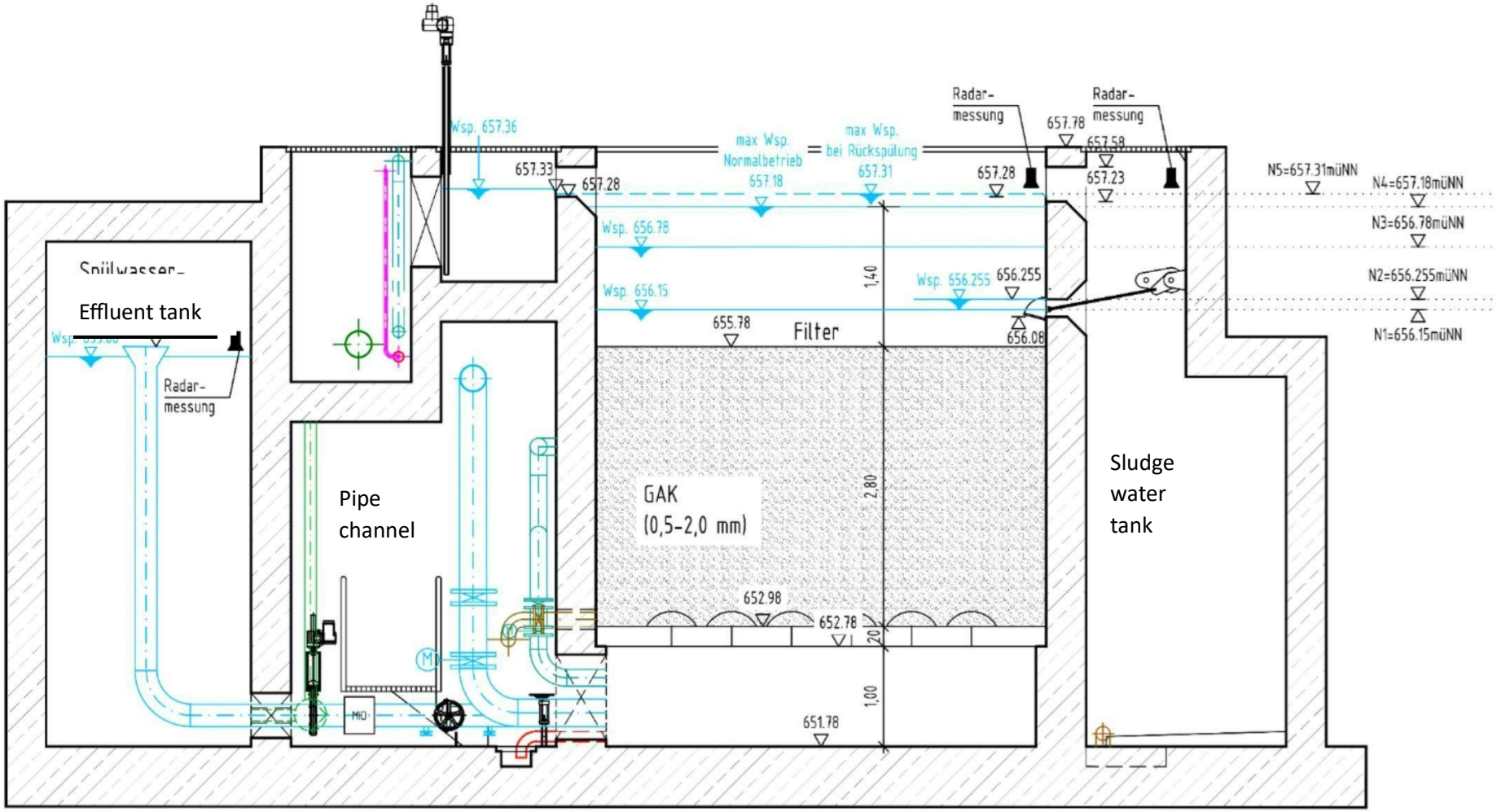


Planning and dimensioning (1) - Overview

Specifications and objectives in the draft

- Discontinuous filtration (defined in the preliminary project)
- Determination of the construction site/open area
- Connection to the outlet structure during operation
- Efficient feeding by means of vortex pumps
- Determination of 6 filter chambers of 13,5 m² each
- Empty bed contact time >25-30 min
- Filter bed height of 2,8 m → approx. 225 m³ GAC
- MID quantity measurement of each filter cell
- Flushing water tank sufficient for 2 flushes
- Development of flushing program (water/air)
- Discharge of the GAC
- Optimum input of precipitant for P-precipitation
- Simultaneous renewal of the electrical engineering and renewal of the blowers, RLS pumps and retrofitting of orifice regulating slides and a C-source dosing system

Planning and dimensioning (2) - Structure



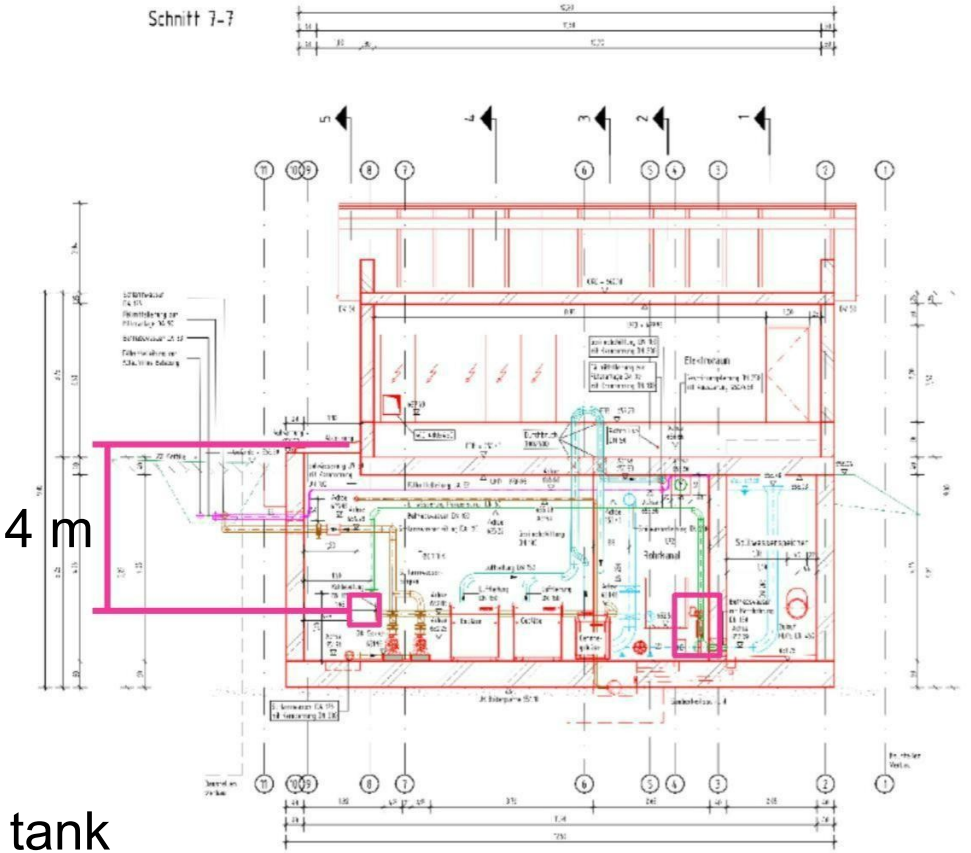
Planning and dimensioning (3) – GAC expansion

- Removal by vehicle not possible, as the lower edge of the filter bed is approx. 4 m below ground surface

  → Solution: Liquid jet solids pump



Quelle: www.koerting.de



Δh = ca. 4 m

- Next problem: Pump requires 35 m³/h @ 7 bar

  → Solution: Operating water pump on flushing water tank

Construction phase (1) - Impressions







Construction phase (2) - Impressions





Contruction phase (3) - Impressions





Construction phase (4) - Impressions







GAC selection

Donau Carbon Hydraffin AR 8x30

- Grain diameter: 0,6 – 2,36 mm
- Bulk density (dry): 500 kg/m³
  Bulk density (after rinsing): 350 - 400 kg/m³
- Raw material: Mixed coal base
- Purchase price: 570 €/m³
  (→ approx. 130.000 € net total)
- References: WWTP Bad Oeynhausen, WWTP Gütersloh-Putzhagen, WWTP Mannheim, WWTP Emmingen-Liptingen, WWTP Fridingen,…



Quelle: www.shutterstock.com

GAC delivery and installation (1)

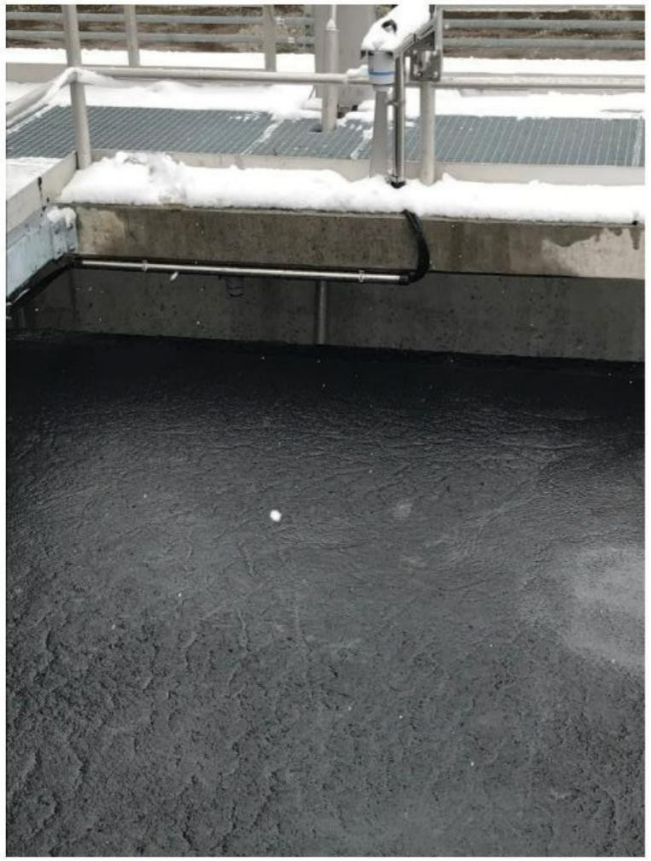




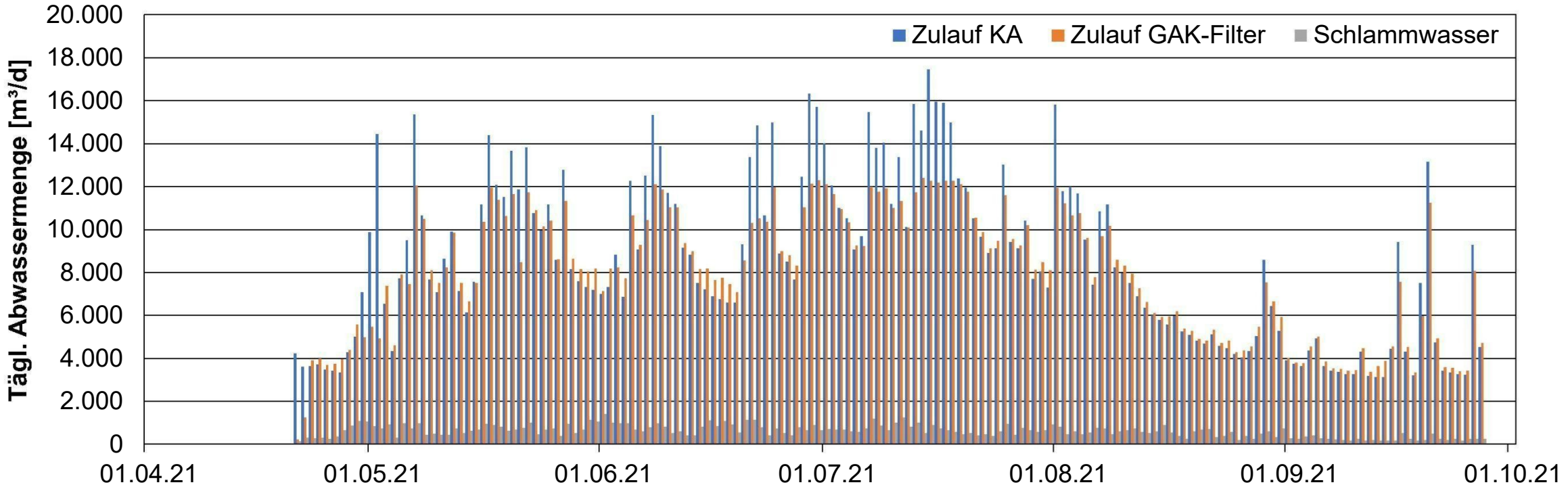
GAC delivery and installation (2)







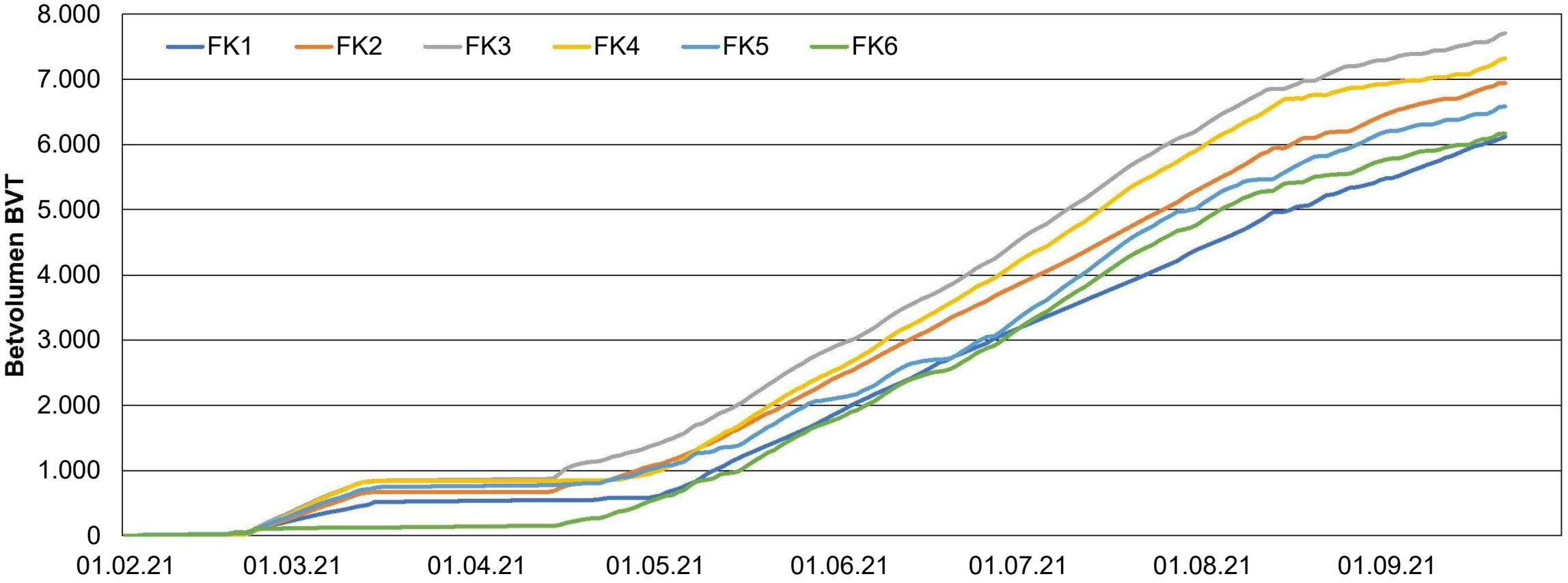
Operating experience (1) – Wastewater volume



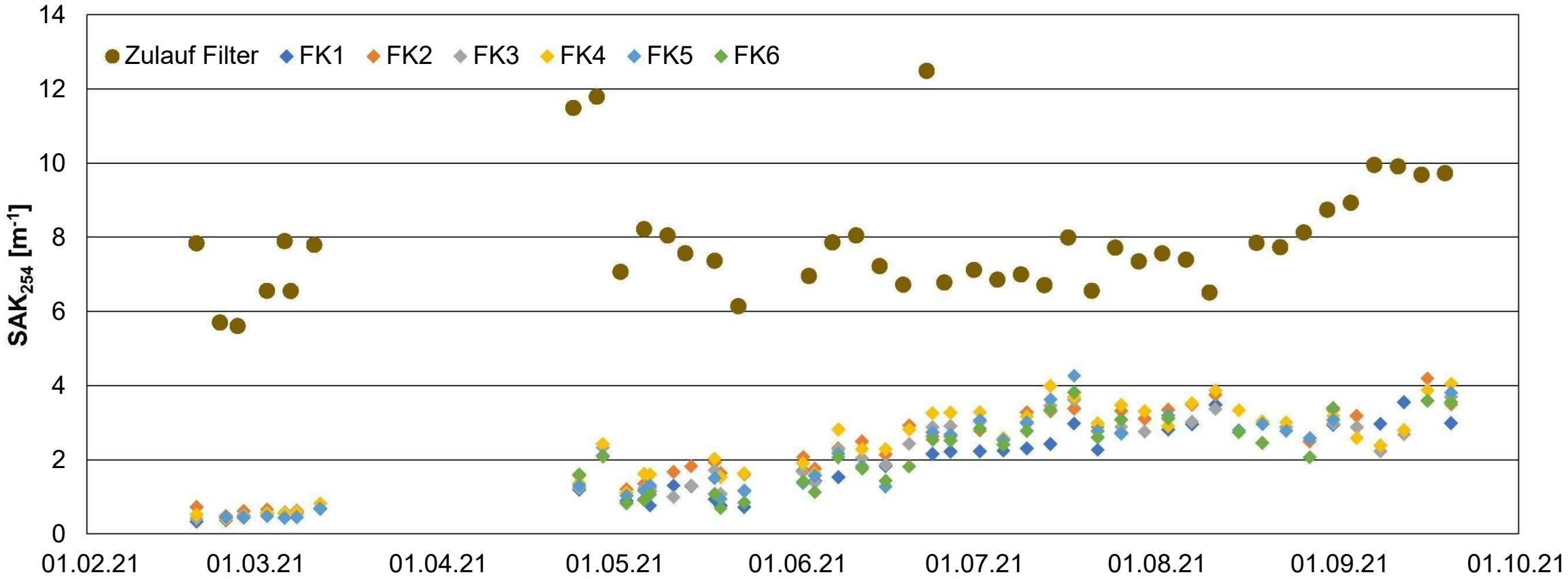
Volume treated since commissioning: **85,6 %** (= filter feed – sludge water)

Sludge water production: **7,3 %** (in relation to the inlet of the wastewater treatment plant)

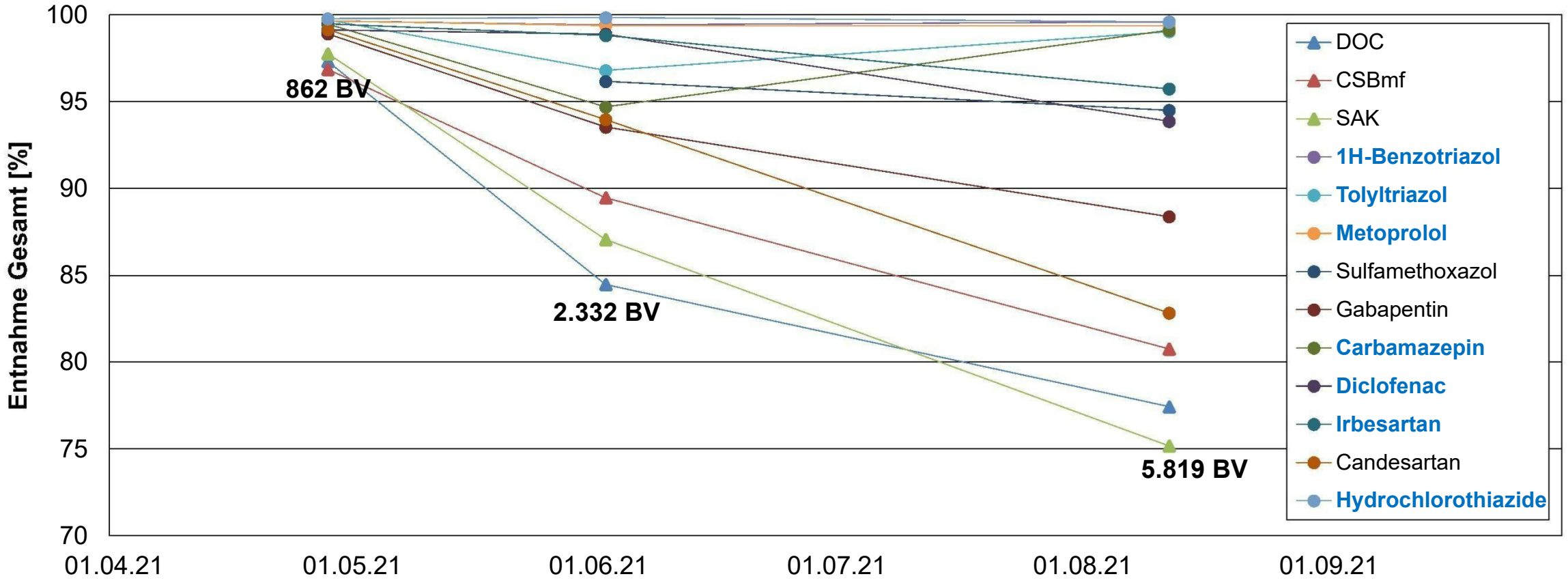
Operating experience (2) – bed volumes



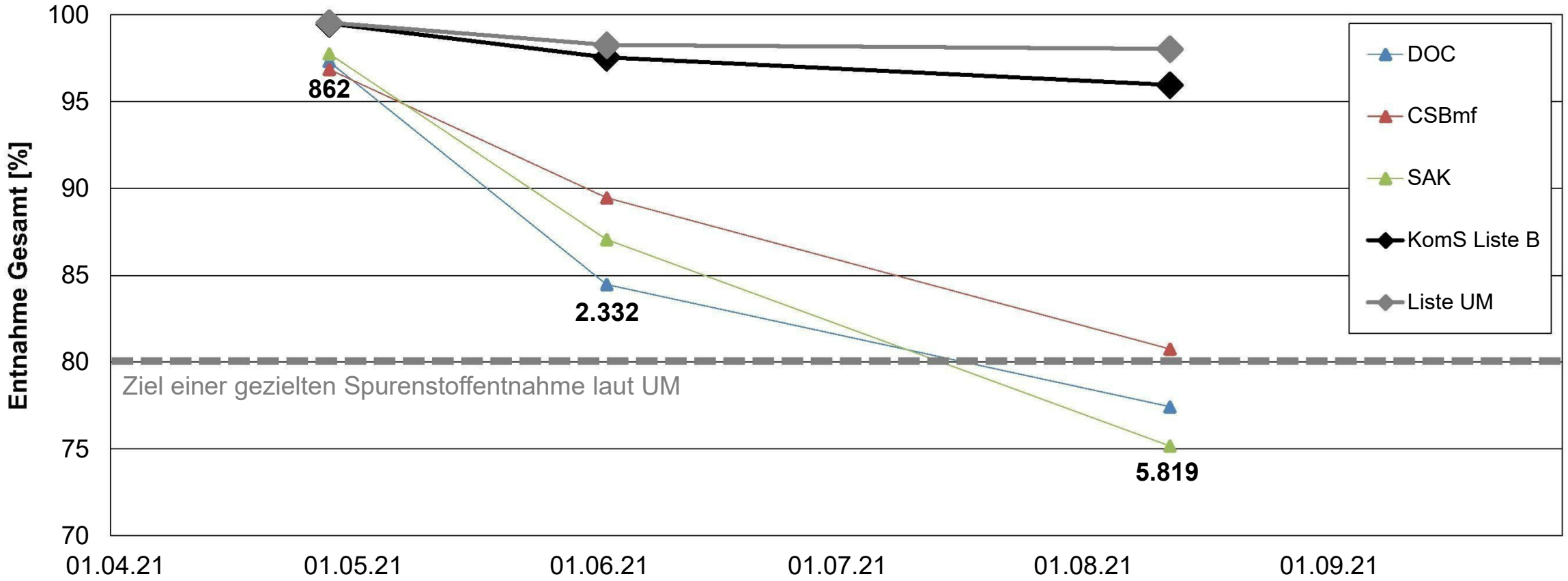
Operating experience (3) – SAK_{254} progressions



Operating experience (4) – Elimination of trace substances



Operating experience (5) – Elimination of trace substance



Conclusion

- GAC filtration has been researched and tested for 10 years now, but the first new construction of a discontinuous GAC filter was at the Immendingen-Geisingen WWTP
- Less transferability of the known sand filter technology parameters than assumed
- Important parameters: High empty bed contact time, high number of filter cells in parallel operation, equal distribution of the wastewater, renewal of the GAC to be considered, selection of a suitable GAC material
- Short planning and construction time as well as short commissioning and optimization phases
- First six months showed stable plant operation
- After 6,000 BV still very high trace substance removal, P elimination also very good
- Currently little potential for optimization
- Production costs of € 4.2 million “manageable” with high subsidity rate


„Fürchte dich nicht vor Fehlern.
Du wirst Fehler machen.
Lass dich davon nicht aufhalten.“
(Benjamin Franklin, 1706-1790)

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