Water Solutions

by zahnen

Efficient. Modular.

Ready for the future.

Customized system solutions for reliable discharge limits, stable processes, and efficient water use.

— Ranging from secure compliance of discharge limits to recycling into industrial water loops.



zahnen TECHNIK

Why we need to act now

Operators in municipalities and industry face increasing demands and limited space. Traditional technologies are reaching their limits here. How can we meet our standards for the highest water quality and fast processes despite scarce resources?

The core problem

Increasing discharge requirements, fluctuating loads, and limited space are putting pressure on day-to-day operations. At the same time, operators must run their facilities economically, safely, and in compliance with regulations at all times, while reliably meeting target values. This applies even when inflow, weather, and operating conditions are constantly changing.

- Stricter monitoring limits for phosphorus, requirements for 80% elimination of micropollutants and removal of microplastic.
- Growing documentation and reporting requirements.
- Lack of space hinders expansion. Traditional technologies often cannot be retrofitted.
- Fluctuating influent flows and inaccurate measurement values. Unstable dosing and increasing process risk.
- High investment pressure for new treatment stages to remove various micropollutants.



A POSSIBLE SCENARIO

When standard procedures are not sufficient

The existing plant is reaching its limits. Water with varying contaminants and different micropollutants poses special challenges for treatment, while only limited space is available. Fluctuating inflow volumes and peak loads further complicate treatment, and stricter legal requirements render standard procedures inadequate. At the same time, Water Reuse opens up new opportunities for the efficient use of water resources.

What is needed are integrated and flexible system solutions rather than more isolated, stand-alone solutions.

SYSTEM SOLUTION

Scalable. Customizable. Future-proof.

Water Solutions by zahnen

What is Water Solutions?

A modular system for the safe and cost-effective treatment of wastewater, process water, and industrial water. Whether as a containerized or stationary solution, all steps work together seamlessly. Water Solutions by zahnen combines process engineering, separation, sensor technology, and digital control into an integrated system solution. **Precisely tailored to your facility and objectives.**

- **Combines heavy-duty filter technology with intelligent process control.**
- **Guaranteed maximum safety during peak loads in the smallest of spaces.**

Modular system

From initial analysis to digital control, our components can be tailored precisely to your project and combined in any configuration.

- **Flexbed Filter** (Separation)
- **Dosing & Process Engineering**
- **Sensors & Measurement** (e.g., Trace Guard)
- **Control, Documentation & Monitoring**

Services

- **Analysis, design, comparison of alternatives**
- **Pilot studies / scientific support**
- **Application regimes** (PAHs, defoliants)
- **Optimization & training**

System Solutions

- **Container (plug-and-play) or stationary**
- **Reproducible, robust, low-maintenance low wear**
- **Easy to retrofit**
- **Tailored precisely to your requirements**

FOR EXAMPLE

- **Micropollutant Removal (MPR)** PAC & Flexbed
- **PKompakt** Coagulants & Filter Technology

Products

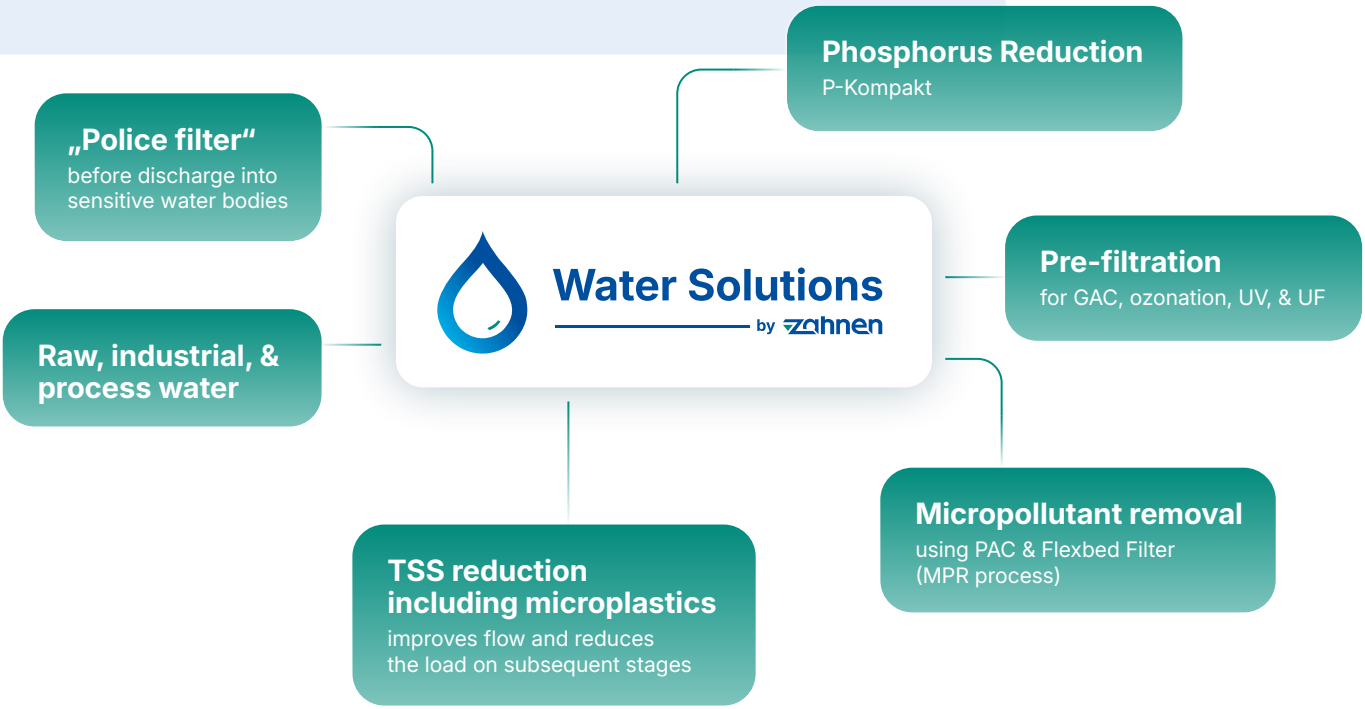
- **Flexbed Filter** The heart of the separation process for micropollutants, AFS, microplastics, and phosphorus
- **Smart Sensors & Cloud Connectivity** such as Control Cloud by zahnen
- **Trace Guard** with real-time sensors & inline measurement for trace substance monitoring & dosing control
- **Control & dosing technology**

Benefits at a glance

We develop a solution tailored specifically to your system, not the other way around.

- **TRANSPARENT**
  Real-time measurement & control
- **COMPLIANCE**
  Integrated documentation
- **EASY TO OPERATE**
  Sturdy & low-maintenance
- **SAFE**
  Reliably meets target values
- **EFFICIENT**
  Space-saving, automated, resource-efficient

Where our system solutions are used



THE SOLUTION FOR WATER & WASTEWATER SYSTEMS

From planning to implementation

For you as the operator, this means a clearly structured process from analysis through to stable operation, with a single point of contact and consistent accountability.

Analysis & Target Scenario

- Identify contaminants & constraints
- Derive the variant: Micropollutant removal, Phosphorus removal, TSS removal
  Additional variants depending on water composition
- Decision about container solution vs. stationary plant
- Technical & economic evaluation for an optimal solution

Installation & Integration

- Plug & Play or structural integration
- Hydraulic & electrical connections
- Installation of Flexbed Filter & Trace Guard (Inlet & Outlet)
- From compact Plug & Play containers to custom-designed large-scale systems. The Flexbed filter can be scaled to meet your requirements

System Planning & Design

- Hydraulics & Space Requirements
- Process Control
- Selection of Flexbed Filter Type, Sensors & Dosing Technology
- Safety & Quality Concept

Operation & Documentation

- Use of operating chemicals (PAC + coagulant)
- Monitoring & Optimization
- Optional Cloud Monitoring

Digital Level

Every system is secure, robust, and capable of being documented

Upon request, we equip our system solutions with the **Control Cloud by zahnen** to enable intelligent control and ensure user-friendly and efficient operation.

FLEXBED FILTER

The heart of water solutions

Space-saving, efficient, and future-proof.

As the central separation stage, the Flexbed Filter ensures consistent discharge values, high operational reliability, and minimal space requirements, even under challenging conditions.



Flexbed Filter by zahnen

Unique in performance & efficiency

- **Wide range of applications**
  SMicropollutant removal (by using Pac), Pre-filtration (upstream to GAC/UV/ozone/UF), Phosphorus removal, removal of TSS & microplastics, Industrial water, process water & water reuse
- **Durable, low-maintenance & fully automatic**
- **Stable during peak loads**
  No clogging
- **Compact design thanks to high hydraulic head**
  Ideal for existing installations with limited space
- **High-quality filtrate**
  Low effluent turbidity
- **Backwashing with raw water**
  No filtrate / fresh water

Added value

Fewer disruptions, more stable operations & lower OPEX.



Why the Flexbed Filter by zahnen?

Robust, compact and reliable. That's exactly what matters in everyday use.

Kathrin Gantner, Ph.D. (Eng.)
Senior Technical Consultant
Water Solutions

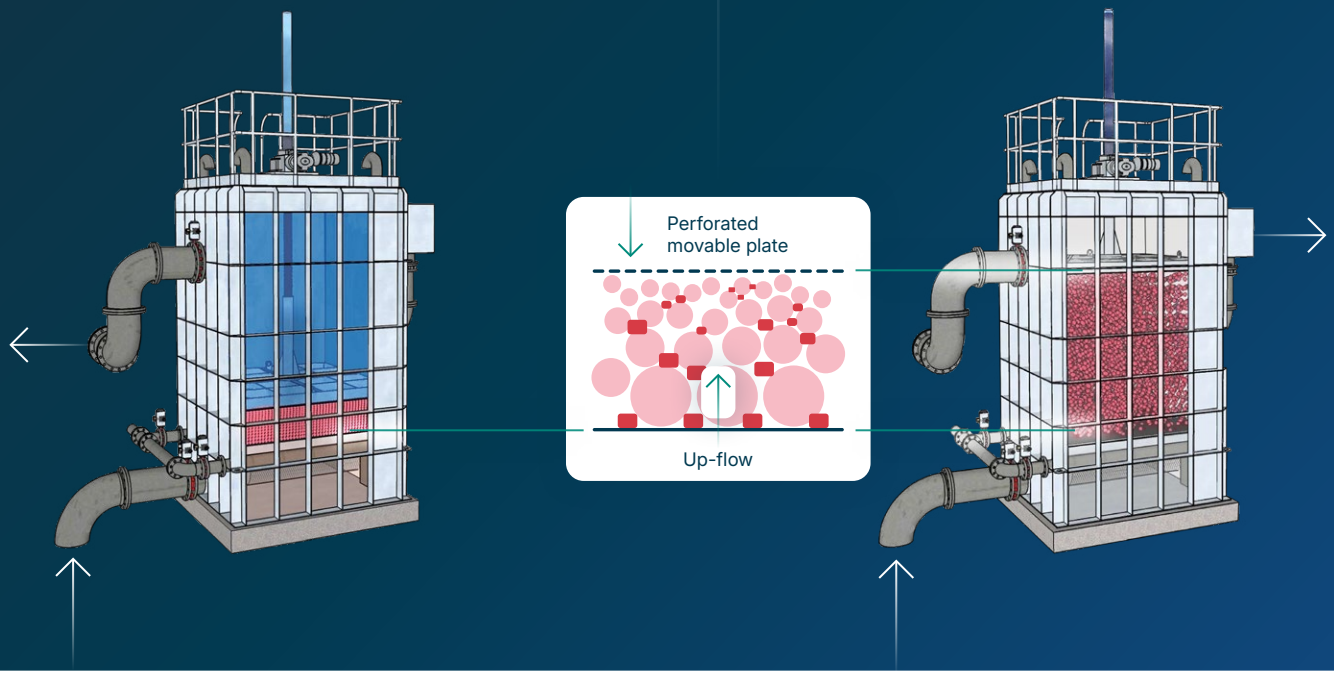
How does the Flexbed filter work?

Filtration

- **Up-flow filtration**
  The water flows in an upflow from the bottom through a specially designed, compressible filter bed
- **Compressed filter bed**
  A movable plate compresses the filter material, creating graduatet pore sizes
- **Pore size gradient**
  Particles are reliably retained, and the purified water exits at the top
- **Adaptation to particle sizes**
  Pore sizes in the filter bed can be adjusted to particle sizes by varying the com-pression
- **High filtration rate**
  High hydraulic loading (up to 75 $m^3/m^2 \cdot h$)

Backwash

- As the load increases, the filter resistance rises
- Backwashing starts automatically at a preset filter pressure
- The movable plate moves upward, and the filter bed is specifically loosened
- Cleaning via combined water-air backwash in the up-flow (using raw water and air, without fresh water or filtrate)
- Alternating feed of pressurized air from both sides ensures high cleaning performance
- Fully operational again after 25 minutes



Offers the benefits of a multi-layer filter with simple and resource-efficient backwashing

Flexbed Filter technology combines the advantages of conventional depth and surface and surface filters with minimal space requirements, high durability, and maximum operational reliability.

The long-lasting filter balls have a life span of over 10 years.

How the Flexbed Filter works

PRODUCT RANGE

Flexbed Filters Standard Sizes

The Water Solutions system is modular in design and flexibly scalable, ranging from a compact plug-and-play container to a custom-designed large-scale plant. The Flexbed Filter is seamlessly integrated into the overall system.

Type	Filter bed area m × m	Capacity at v = 75 m³ / m² × h	Sizes a	b	c	d
1	0.5 × 0.5	19	0.8	0.8	2.6	3.8
2	0.75 × 0.75	42	1.0	1.0	2.7	3.9
3	1.0 × 1.0	75	1.4	1.4	3.0	4.5
4	1.25 × 1.25	117	1.6	1.6	3.2	4.6
5	1.5 × 1.5	169	1.9	1.9	3.5	4.9
6	1.75 × 1.75	230	2.1	2.1	3.9	5.2
7	2.0 × 2.0	300	2.4	2.4	3.8	5.3

External dimensions

a = Width
b = Length
c = Height (without spindle)
d = Height (including spindle)

Our system modules

Water Solutions by zahnen

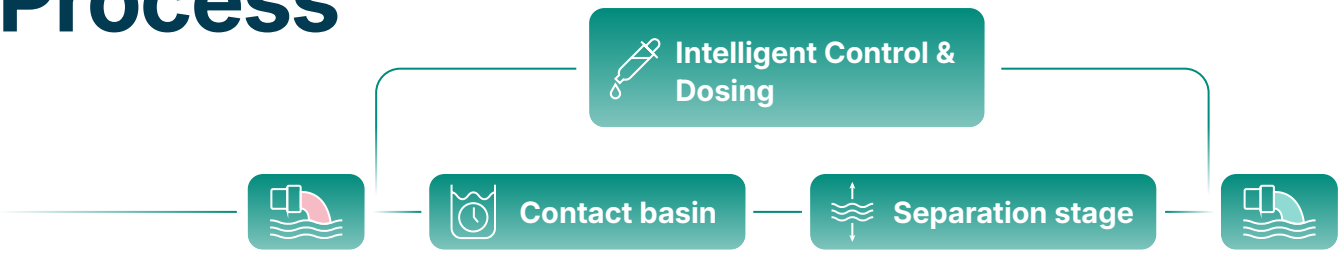
Micropollutant removal
Water Solutions MPR (PAC & Flexbed Filters)

Phosphorus Removal
P-Kompakt (Precipitant & Flexbed Filter)

TSS Removal
to ensure compliance with the lowest turbidity levels in the effluent.

PROCESS INTERFACES

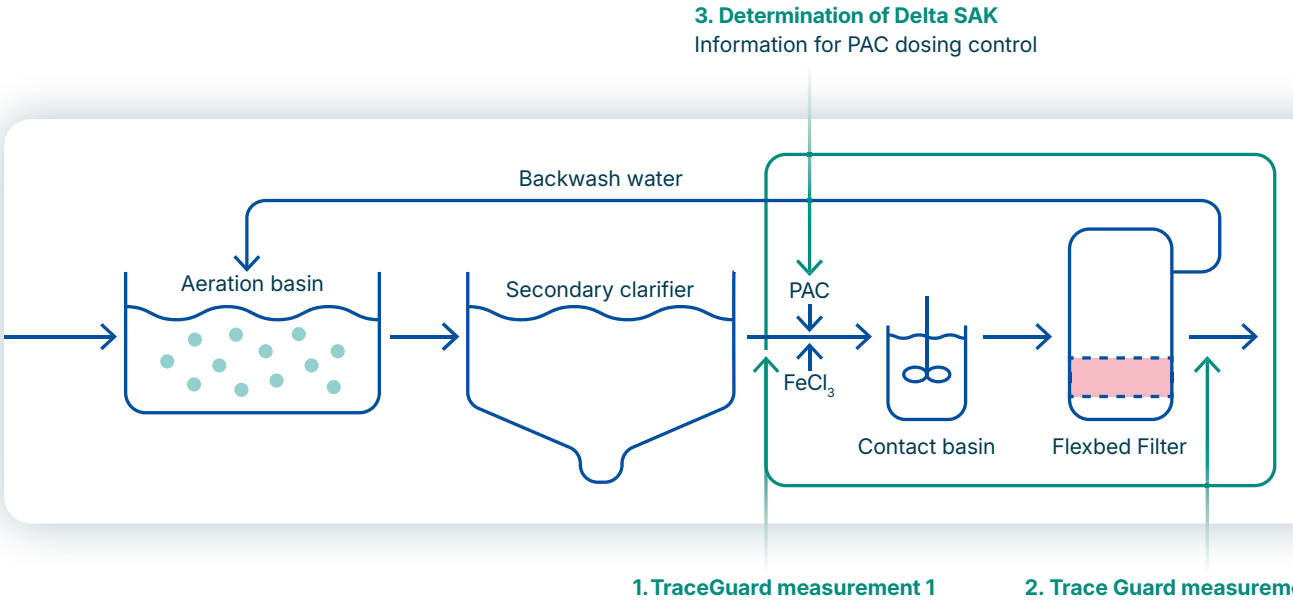
MPR as a Modular Treatment Process



Dosing (PAC & Coagulants)
Precise, demand-driven dosing with intelligent control.

Adsorption
Short hydraulic retention time and optimized flow conditions in the contact basin.

Separation (Flexbed)
Efficient retention of loaded powdered activated carbon (PAC < 4%), precipitated phosphorus, and other suspended solids (< 2 NTU). **More than 80% reduction of micropollutants in the treatment plant effluent achievable.**

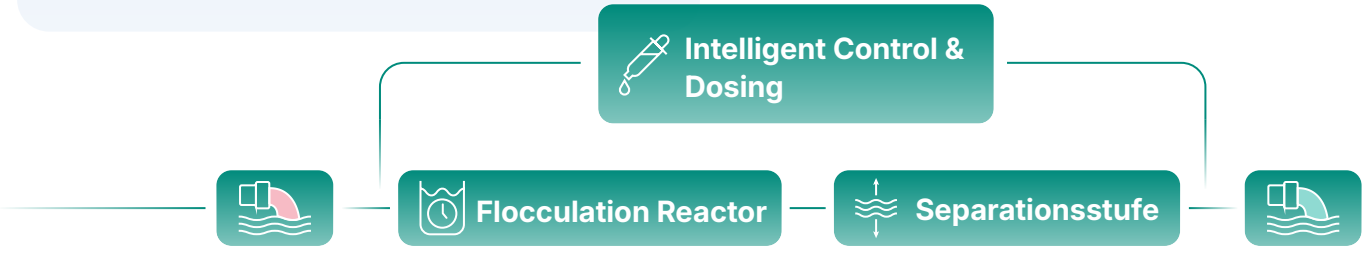


Treatment process with P-Kompakt

Nominal flow rates of the 5 standard configurations (containerized system)

- up to 15 m³/h
- up to 30 m³/h
- up to 60 m³/h
- up to 90 m³/h
- up to 125 m³/h

Custom sizes available on request.



Dosing (Coagulant)

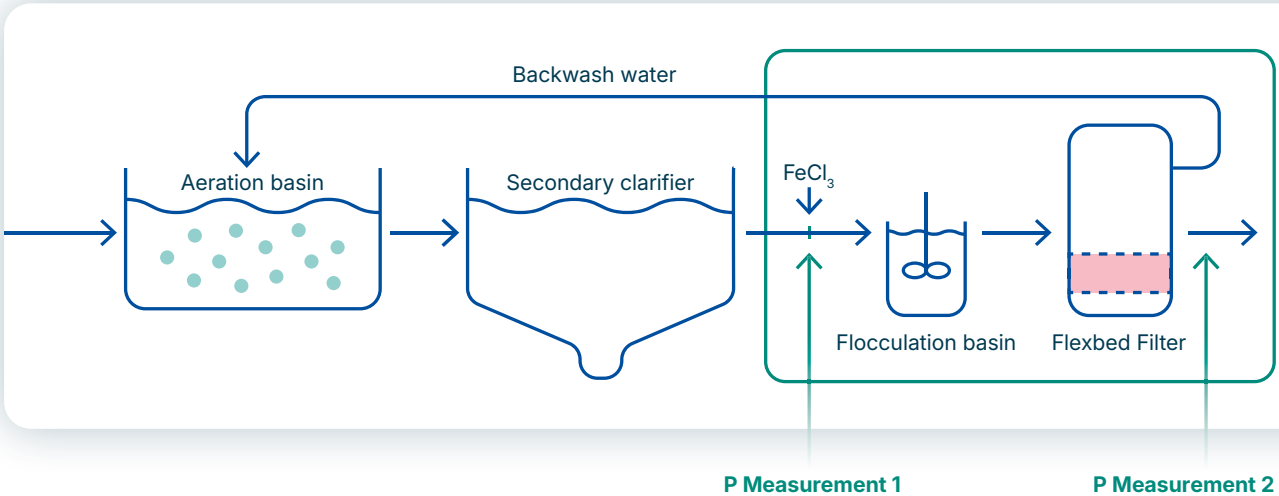
Precise, demand-driven dosing with intelligent control.

Precipitation

Optimized hydraulic conditions in the flocculation reactor ensure effective mixing of the coagulant and efficient floc formation.

Separation (Flexbed Filter)

Lowest phosphorus concentrations in the effluent (< 0.2 mg/L) achievable after two-stage precipitation.



Real-time measurement for reliable process control

The Trace Guard is the in-line sensor and control system for Water Solutions systems and the fourth purification stage. It measures micropollutant concentrations with precision and stability,requiring minimal maintenance.

Trace Guard by zahnen

Technology & operating principle

In-line UV absorbance measurement with dual-beam optics

255 nm
UV-C range
for the detection of organic compounds (e.g. micropollutants)

860 nm
Effluent (after PAC, ozonation, GAC, etc.)
for turbidity-compensated UV absorbance measurement

Large optical path length: 50 mm

Installation options

- **2-inch process connection, on both sides**
- **Installation in main line or bypass**
- **Protection class IPX4**
- **Splash-proof housing**

Control center

- **Robust housing**
- **7-inch touchscreen for operation & maintenance**
- **Profibus interface to the higher-level control system (PLC)**
- **Control Cloud connection** (optional)
  - Remote monitoring
  - Automatic calibration
  - Trend Analysis & Data Export
  - Remote Access to the Measurement System

Measurement before & after the 4. cleaning stage

Functions

of the Trace Guard within the MPR system solution (PAC & Flexbed)

Trace Guard by zahnen

Measurement of micropollutant concentration

UPSTREAM
of PAC contact basin

DOWNSTREAM
of Flexbed Filter Separation

Ideally suited for PAC dosing control

Prevents over- and underdosing

In downstream treatment processes

Ozonation
Dynamically control ozone dosing

GAC Filter
Monitor activated carbon exhaustion

PAC
Optimize demand-driven dosing

Benefits for your business

Safe and reliable water treatment processes

- Accurate real-time data & precise dosing
- Optimized PAC or ozone dosages
- Fewer chemicals & lower costs
- Automatically documented (for regulatory authorities, EMSR)

Avoid errors & stabilize operations

- Prevents under- & overdosing
- Detects fluctuating feed concentrations
- Responds in minutes instead of hours

Rugged & durable

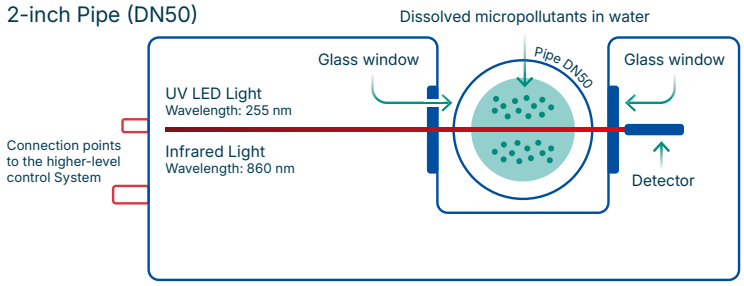
- LED technology for long service life & low-maintenance operation
- No drift-prone broadband light source and no complex spectral evaluation electronics required

Digital future-readiness

- Profibus integration
- Cloud-ready
- Remote maintenance & remote service

Pipeline installation

2-inch Pipe (DN50)



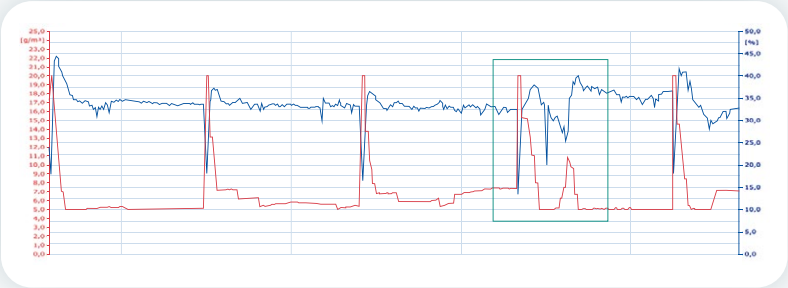


Delta UV absorbance curve

Delta UV absorbance
Measured value

PAC-Dosing
Manipulated variable

Increased PAC dosing leads, with a time lag, to an increase in Delta UV absorbance. This results in a stable control loop.



The role in the system

Measurement before and after the fourth cleaning stage → Delta visible.
Control variable for PAC / ozone

Safety first:
Technology and data remain protected.

Benefits

- **Precise dosing**
- **Fewer resources**
- **Reliable processes**
- **Automatic reports**

WATER SOLUTIONS

Results & performance metrics

EXAMPLE: DICLOFENAC
Influent **3,3** µg/L
Effluent **0,65** µg/L

96 %*
PAC retention
in powered activated carbon-based processes

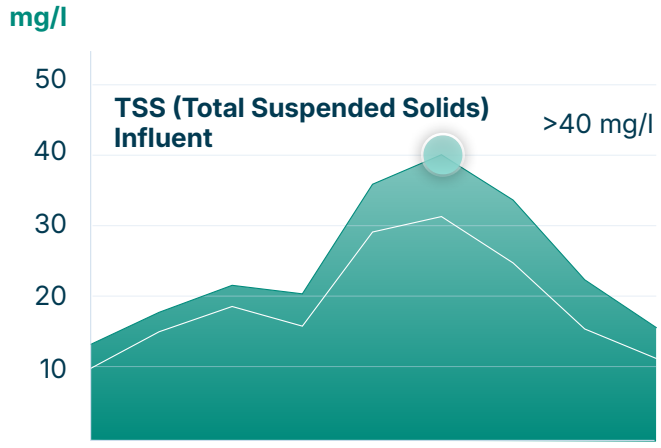
80 %*
Less micropollutants
Reduction along the entire system (Wastewater treatment plant)

Maximum elimination

*Project-based estimates. Results vary depending on scope and data quality.

High-performance filtration
Particle separation efficiency from 1–5 µm Provides reliable protection against PAC carryover and turbidity in the effluent (NTU ≤ 2.0)

Broad spectrum of activity
Effective removal of pharmaceuticals (antibiotics, beta-blockers), biocides, corrosion inhibitors, and substances of ecotoxicological concern



Load capacity of the Flexbed Filter

Extremely high load stability
Reliable operation even under peak concentration loads, without risk of clogging.

High hydraulic throughput
Average surface loading rate of approx. 75 $m^3/m^2 x$ h

Resource efficiency in operation

Low OPEX
Minimized internal consumption and optimized activated carbon use through precise dosing control.

Flexbed Filter Backwashing
Resource-efficient cleaning using raw ater; no need for fresh water or valuable

Proven in Practice
Over 20 implemented projects in municipal and industrial applications.

Long Service Life
Filter media lifetime >10 years (PFAS-free), low-maintenance design and fully automated operation.

Capacity

High solids loading capacity
High loading capacity (~15 kg/m³), reduced backwash frequency improves operational efficiency.

Modular & flexible
Available as a containerized solution or stationary installation for any plant size; ideal for retrofit applications.

What you achieve with Water Solutions

- **Efficient operation** with predictable OPEX
- **Stable performance** even under peak load conditions
- **Reliable Compliance** with effluent discharge limits
- **Proven technology** in municipal and industrial water treatment plants
- **Minimal footprint** due to compact system design

Technologies and interfaces are selected based on the specific application and are not necessarily part of every system configuration.

Individual technologies shown are specifically designed for Water Solutions applications and are implemented accordingly.

Future-proofing & process control

Precise compliance

Reliable compliance with micropollutant removal targets as required by regulatory standards, with minimal operational effort.

Maximum operational safety

Demand-driven differential pressure and turbidity control. Fully automated, clogging-resistant and process-stable operation.

Optimized efficiency

Efficient activated carbon dosing: predictable OPEX with maximum environmental protection.

Advanced Technology, Easy to Operate with Reliable Results

Clean water

The treated water can be returned to technical applications and internal process cycles or safely discharged into receiving waters.



Verified quality

EA technically robust, field-proven process with integrated, continuous quality monitoring.

SERVICES

Our solutions scale from compact systems to large-scale treatment plants.

Energy optimization

to increase operational efficiency

- Analysis of actual consumption and peak loads
- Action plans for energy and chemical savings
- Optimization of dosing and operational strategies
- Upgrade of instrumentation and control systems (I&C) for demand-driven operation
- Optional: monitoring and reporting via cloud-based solutions

Pilot testing & funding support

Minimize risks, enable innovation

- Performance data and impact assessments for funding applications
- Funding screening (federal / state / programs)
- Support with applications and verification concepts
- Combination of pilot testing and funding programs

- ✓ Flexbed filter systems as turnkey packages and/ or Water Solutions system solutions for micropollutant, phosphorus, and TSS removal
- ✓ Implementation of intelligent operational management (powdered activated carbon & coagulant dosing)
- ✓ Online monitoring via cloud-based control system (Control Cloud by zahnen)
- ✓ Service agreements
- ✓ Service package

CUSTOMER INQUIRIES

Key facts at a glance

Information and answers to frequently asked questions about our services and projects.

Added value & operational benefits

Typical results

- Increased operational reliability
- Stable & reliable compliance with target values
- Automated verification & reporting
- Faster response to load variations
- Reduced energy & operating costs

With our energy check, you can unlock additional savings potential in energy and chemical consumption and improve your performance data and reporting quality.

Investment & cost efficiency

Depending on plant size & configuration, we provide a tailored process design including transparent cost estimation.

Cost drivers include

- Type of treatment process
- System configuration
- Installation type (containerized or stationary)
- Structural requirements (civil works)
- Number of measurement points
- Type of integration (logging, gateway, retrofit)
- Sensor technology & modules
- Service & Hosting
- Functional scope (SCADA, AI, control systems)

We provide a clear, transparent, & modular cost breakdown for reliable & predictable investment planning.

Operational experience & project references

We have successfully implemented numerous projects with our Flexbed filters.



NORTH RHINE-WESTPHALIA

Alte Schanze Paderborn

Removal of suspended solids (TSS) and particulate COD from landfill leachate.

PLANT DATA

- Landfill leachate treatment
- 2 Flexbed Filters, Type 1
- 19 m^3/h
- Duplex stainless steel
- Commissioned in 2019



NORTH RHINE-WESTPHALIA

Barntrup Wastewater Treatment Plant

Removal of micropollutants (via powdered activated carbon) and reduction of phosphorus concentrations.

PLANT DATA

- Municipal wastewater treatment plant with quaternary treatment stage
- 12,400 PE (population equivalents)
- 4 Flexbed Filters, Type 7
- 160 L/s peak flow
- In operation since 2018

Feedback from practice

The Flexbed Filters operate reliably even under peak load conditions (TSS peaks) without additional operational effort. This is exactly what we were looking for and it has reduced our operating costs.

MORE REFERENCES
Water Solutions

MORE REFERENCES
Flexbed Filters

Water treatment with decades of experience

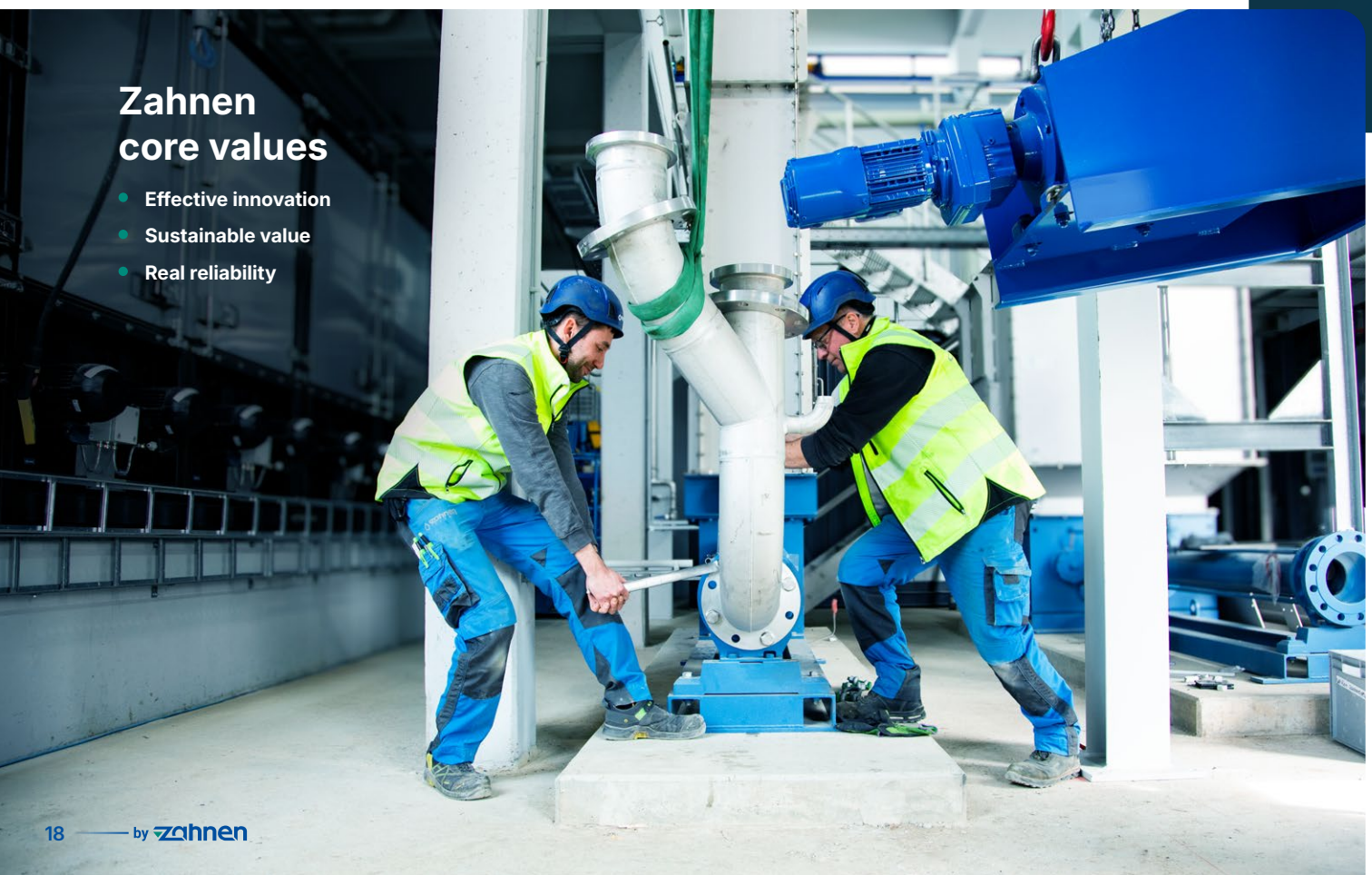
We are passionate plant engineers

Driven by our vision that everyone has the right to have clean water, Zahnen Technik develops holistic solutions for water and wastewater technology. Founded in 1958, we combine technical expertise, innovative strength, and experience from over 500 projects to ensure water quality and design plants that are both efficient and sustainable.

Our practical experience in the water sector forms the foundation of our water solutions world.







Zahnen core values

- Effective innovation
- Sustainable value
- Real reliability

CORE COMPETENCIES

Innovative solutions for a safe & sustainable water supply

Digitalization

Efficient planning & reliable expert knowledge with Wave Cloud & Control Cloud

Process Engineering

Reliable process solutions for water & wastewater treatment plants

Standardization

Consistent standards for quality, efficiency, and reusability

Mechanical Engineering

Construction & manufacturing of mechanical system components

Electrical Engineering

Planning & implementation of smart control andautomation systems

For over 68 years, we have been combining process engineering with innovative project management.

With a nationwide presence

As part of Deutsche Wasser Holding, we combine local expertise with nationwide reach, drawing on over 1,000 completed projects

100 %
specialized in
water & waste-water systems





Request a personalized consultation now

Together, we analyze your plant, evaluate options, and develop a customized system solution.



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