BENCHMARKING ENERGY EFFICIENCY IN WASTEWATER TREATMENT

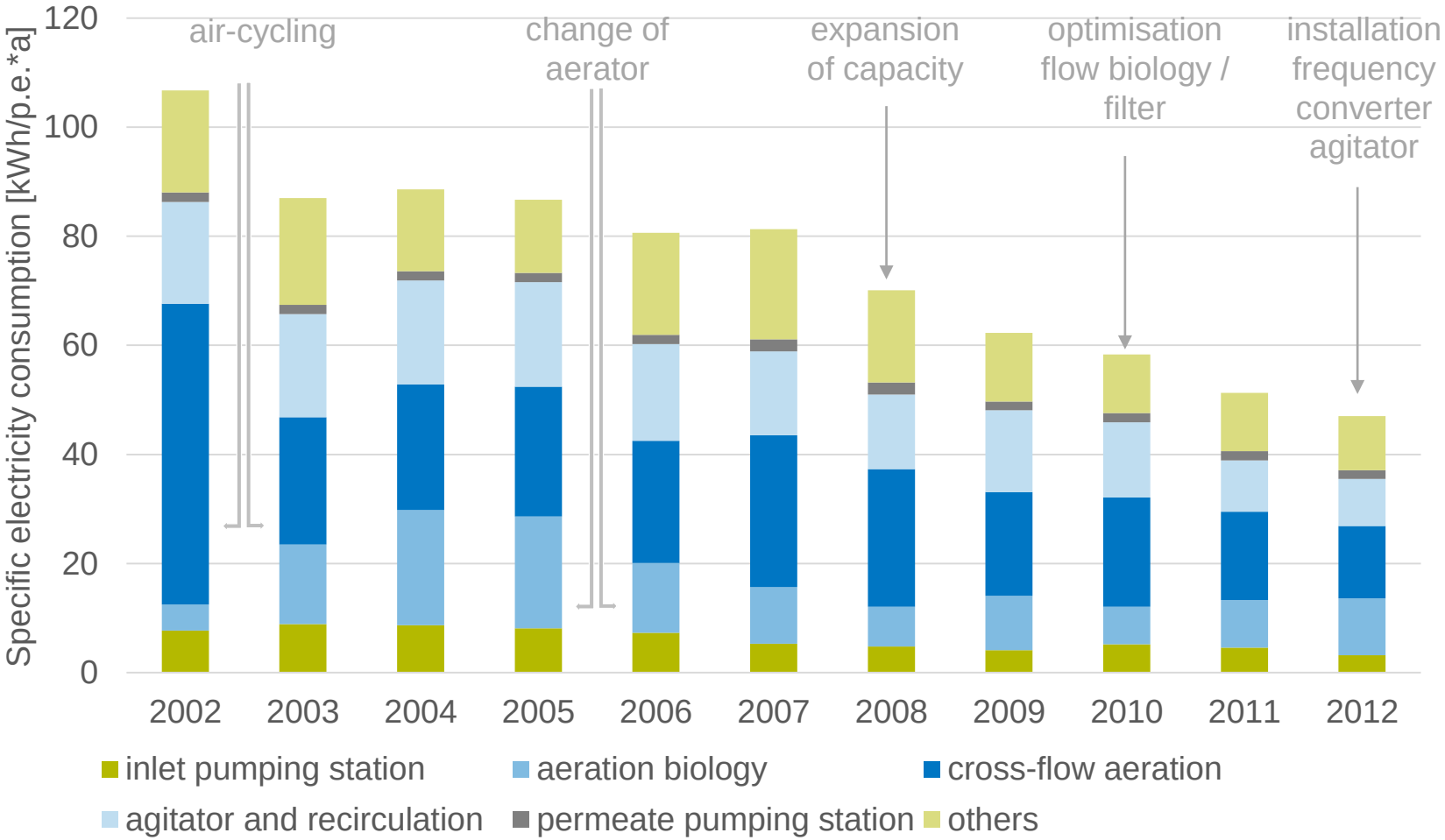
20 years of experience in Germany

Liege, 7th November 2019, Filip Bertzbach

A SUCCESSFUL METHOD JUST CELEBRATES THESE DAYS …

- 20 years of benchmarking WWTP in Germany
- ~ 270 plants participated since 1998
- ~ 180 WWTPs < 100.000 p.e
- ~ 40 WWTP participating each year
- In sum 17 mio. p.e. in 2019 (~11% of treated loads in Germany)

ONE EXAMPLE OF IT‘S SUCCESS (OF ONE PLANT)



Source: KWL Leipzig

HOW DOES BENCHMARKING SUPPORT?

- Structured view on the performance
- Meaningful and supported assessment
- Best-practice exchange

BENCHMARKING ENERGY EFFICIENCY IS PART OF AN ESTABLISHED „BENCHMARKING WORLD“

- Methods are standardized in ~ 20 benchmarking circles
  - utility level,
  - sewer operation
  - sewer construction
  - laboratories
  - water production,
  - human resources
  - waste water treatment plants
  - (…)
- Energy efficiency is performance criteria on all levels
- 250 – 400 participants each year
- Work steps following international benchmarking standards

Preparation, Planning	Data acquisition	Determination of benchmarks	Analysis	Implementation
• Objectives • Participant • Scope and level of detail • Data collection system	• Data collection • Data synthesizing • Data validation	• Calculation of performance indicators • Clustering • Determination of benchmarks • Report drafts	• Causal analysis • Improvement potential • Action plan	• Integration in operational procedures • Checking of success

Work steps and activities according to ISO 24523.2017

„ benchmarking is a systematic process for the identification of, becoming acquainted with and for adoption of successful practices of benchmarking partners”

ISO 24523:2017

COMPARABILITY FRAMEWORK: SUB-PROCESS SCHEME

costs, technical performance, context information, energy consumption

Mechanical treatment	Screening plant	Grit chamber	Primary treatment	…
Biological treatment	Activated sludge tank	Fixed bed reactor	Clarification	…
Advanced treatment	Filtration	UV disinfection	Ozonisation system	…
Sludge stabilisation	Sludge pre-thickener	Digester	Sludge post-thickener	…
Sludge-disposal	Mechanical dewatering	Sewage sludge drying	Sewage sludge incineration	…
Management, Infrastructure	Premises/ Infrastructure	Workshops	Laboratory	…

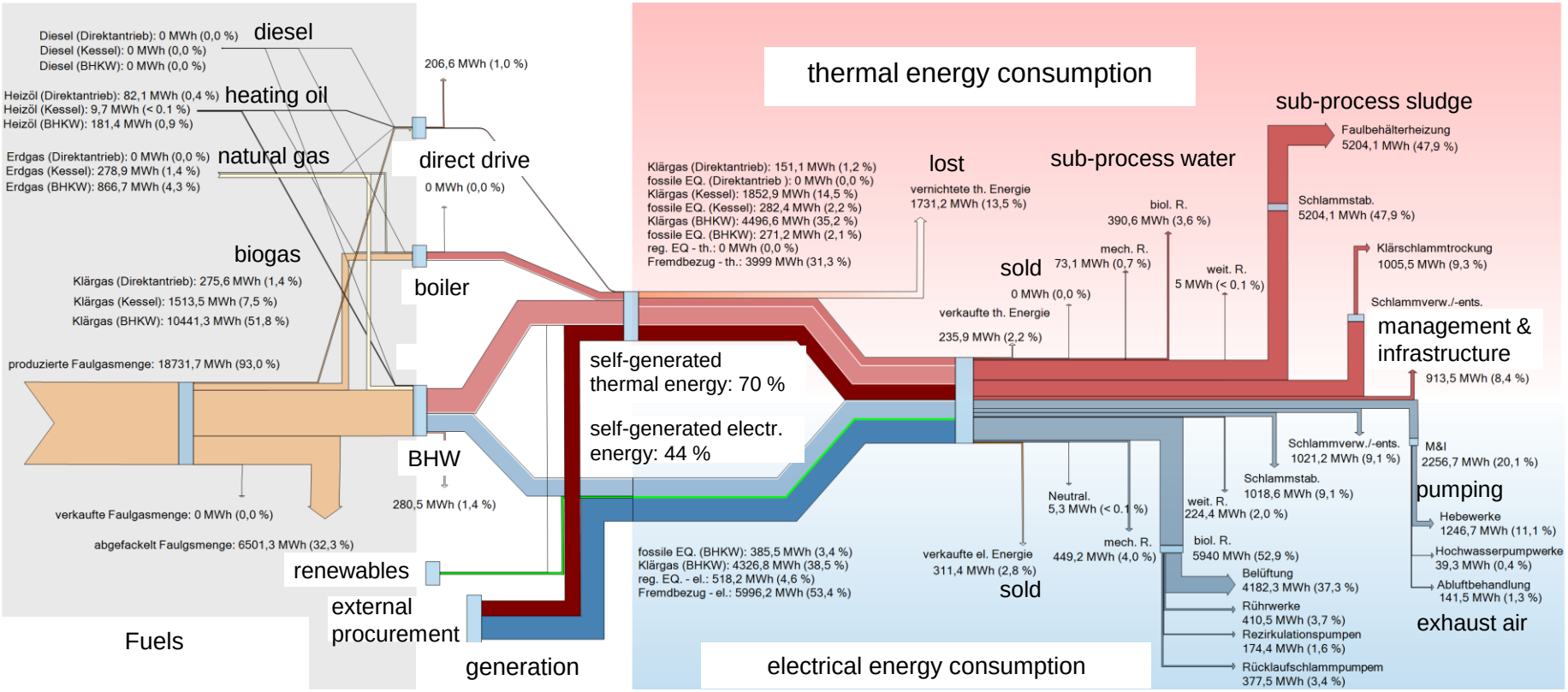
energy generation

per system	Direct drive	Boiler	Block heating works	Renewables

„ Main components of a performance indicator system are clear, detailed and shared definitions … in order to achieve an uniform understanding...“

ISO 24523:2017

VISUALISATION OF ENERGY FLOW OF EACH PLANT



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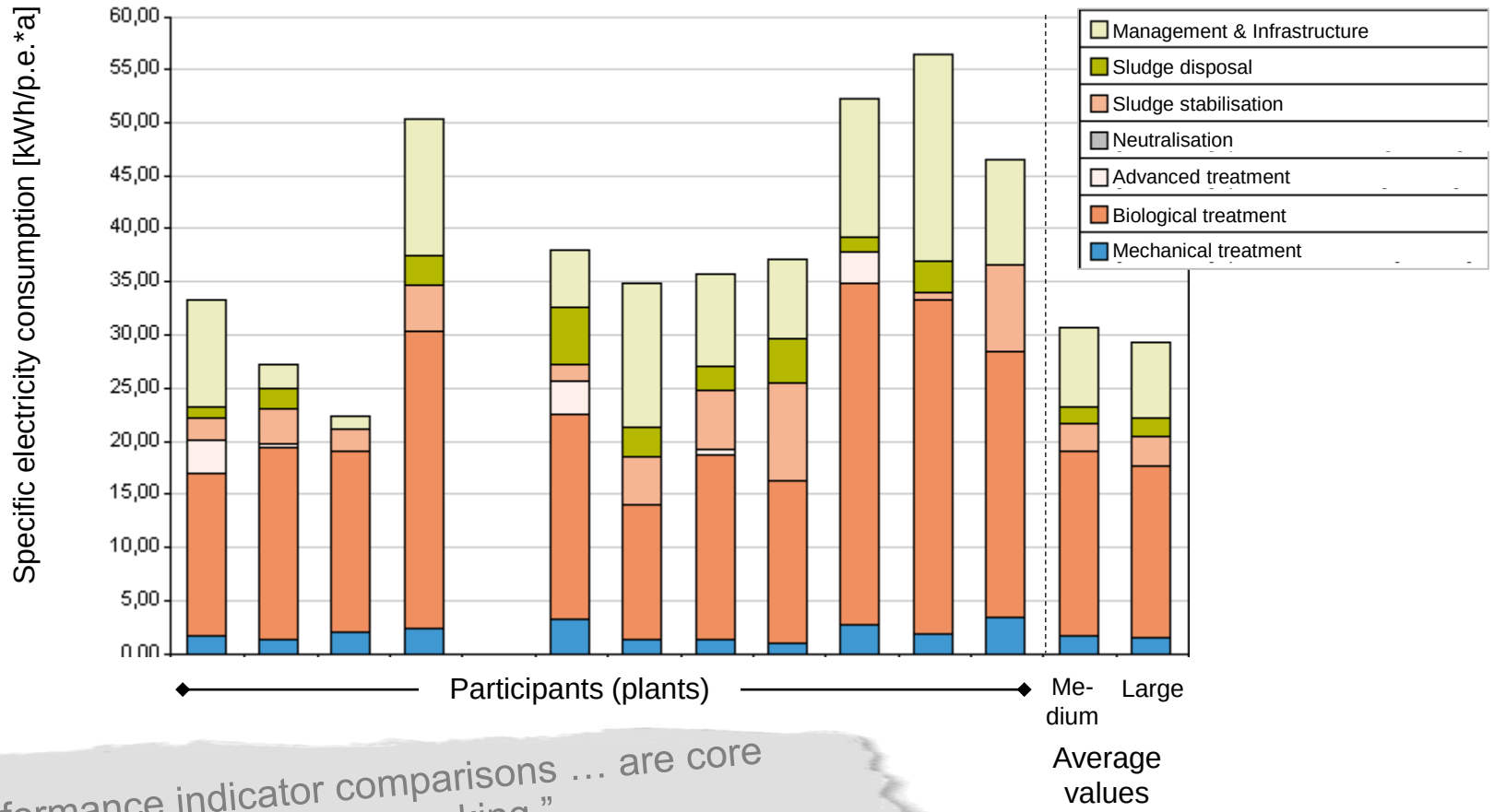
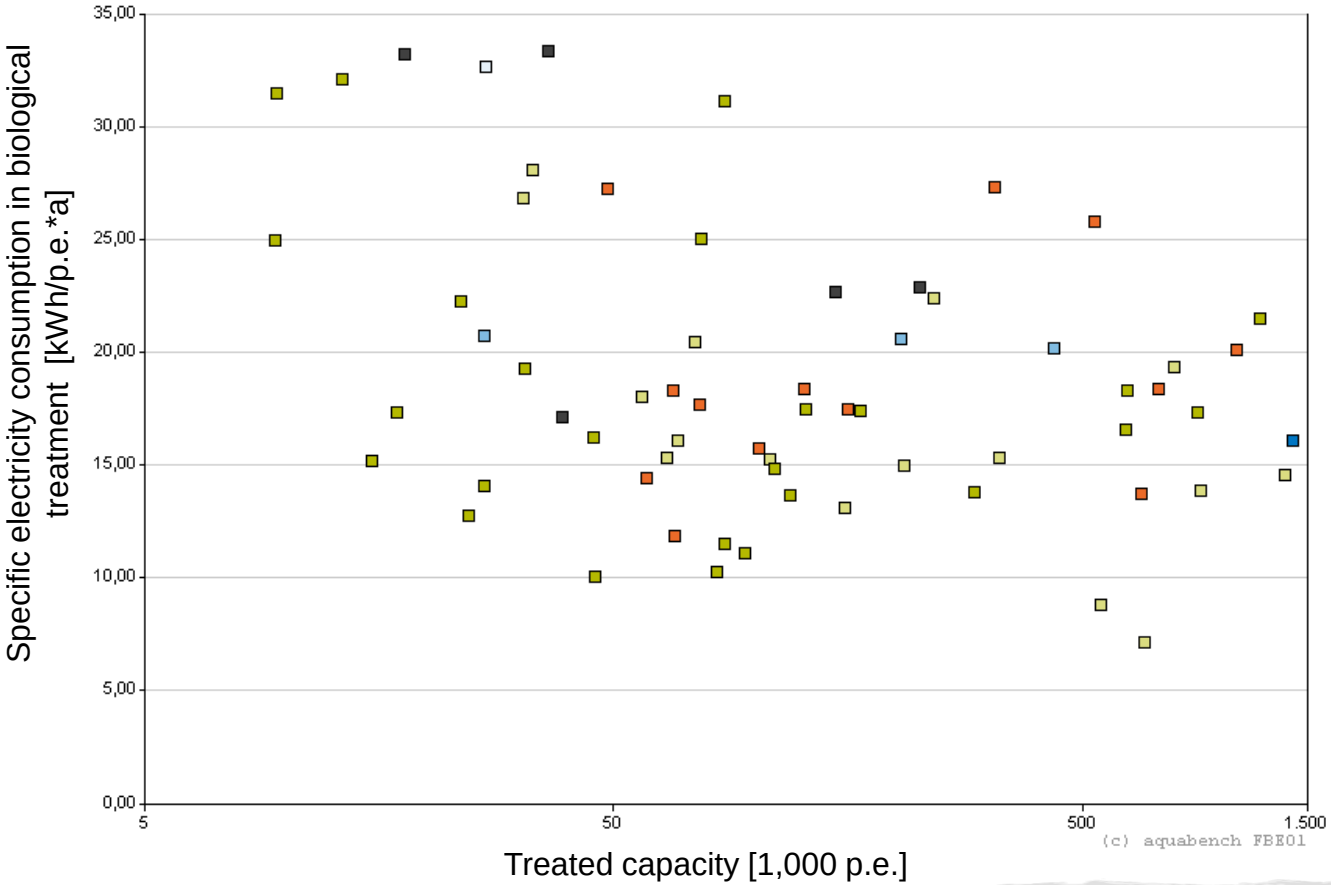
PERFORMANCE INDICATORS – E.G. ENERGY CONSUMPTION



„ Performance indicator comparisons … are core components of each benchmarking."

ISO 24523:2017

MORE DETAILED ANALYSIS INCLUDES ADDITIONAL CONTEXT INFORMATION, E.G. SIZE AND AERATION PROCEDURES



Pressure aerators:

- Tubephragm
- Plate membrane
- Ceramic plates
- Ceramic candles
- General pressure aerators

Surface aerators

Others

„ A comparability … only exists if the context information .. is taken into account.“ ISO 24523:2017

REPORTS AND TOOLS TO SUPPORT ANALYSIS

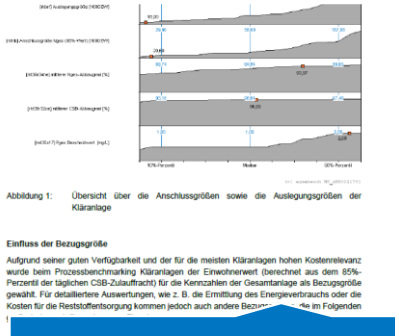
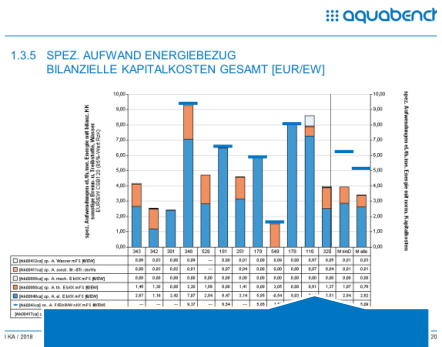


Abbildung 1: Übersicht über die Anschlussgrößen sowie die Auslegungsgrößen der Kläranlage

Einfluss der Bezugsgröße

Aufgrund seiner guten Verfügbarkeit und der für die meisten Kläranlagen hohen Kostenrelevanz wurde beim Prozessbenchmarking Kläranlagen der Einwohnerwert (berechnet aus dem 85%-Perzentil der täglichen CSB-Zulauffracht) für die Kennzahlen der Gesamtanlage als Bezugsgröße gewählt. Für detailliertere Auswertungen, wie z. B. die Ermittlung des Energieverbrauchs oder die Kosten für die Reststoffentsorgung kommen jedoch auch andere Bezu… im Folgenden

Management summary



Graphical reports

Berechnungsformel [Code Eingabewert]	2013
)e40 + ree20e40 - ree20e42 + ree23e40 - ree23e42 + ree16e43)	---
9e40 + ree20e40 - ree20e42 + ree23e40 - 3e42 + ree16e43)) / (ret31m32 / 0,12)	44,51
.9e40 + ree20e40 - ree20e42 + ree23e40 - + ree16e43)) / ((ret31m34 / 11) * 1000)	37,32
3e43 + (ree19e40))) / (ret31m32 / 0,12)	44,51
0e40 - ree20e42 + ree23e40 - ree23e42	---
340 - ree20e42 + ree23e40 - ree23e42)) /	

Definitions

Gesamtanlage						
Anlage:	**KA-Nr**					
Erhebungsjahr: 2018		**2018**	**2017**		**Auswahlliste typischer Ursachen:**	**Bewertungss**
Besonderheiten aus Datenerhebung		IBN Belüfter	---		1. Eingesetzte Anlagentechnik /Aggregat	sehr relev
Besonderheiten (WS-EJ)		---	---		2. Betriebsweise	mehr relev
Besonderheiten (WS Vorjahr)		---	---		3. Betriebliche Besonderheiten im EJ	relev
					4. Einfluss der Bezugsgröße	nicht so relev
					5. Messungenauigkeit / Schätzung	überhaupt nicht relev
Kennzahl / Code	**Gruppe: gr**	**2018**	**2017**		**Typische Ursachen**	**Erläuterung**
spez. Betriebsaufwand	0,07 0,15 0,28	190.000	168.000	**absolut (EUR)**	Drop Down Menü	weitergehende Erläuterung
		13,1	-1,2	**Δ in % zum Vorjahr**	Drop Down Menü	weitergehende Erläuterung
		-	-	**Δ absolut zum Vorjahr**	Drop Down Menü	weitergehende Erläuterung
in EUR / EW (85.P)	0,11	16,50	16,50	**EUR / EW**	Weitere Ursache	Ihre Eingabe
rkk0012ca		0,0	0,0	**Δ in % zum Vorjahr**	Verbindung zu Maßnahme Nr.	Ihre Eingabe

Detailed cause analysis

HOW DOES BENCHMARKING SUPPORT?

- Structured view on the performance
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EXPERT WORKSHOPS COMMUNICATE „UP TO MINUTE INDUSTRY KNOWLEDGE“

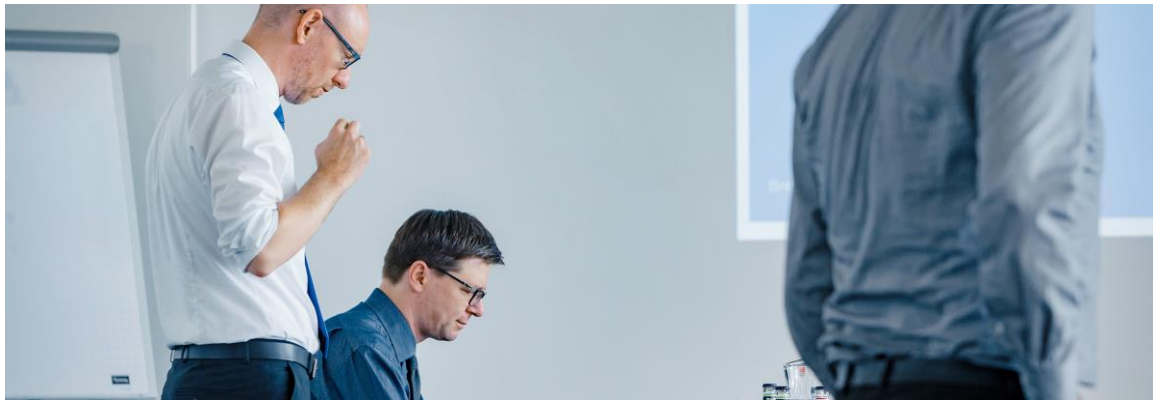
- Each year at least 4 work-shops in total (each two days)
- Separate meetings for large, medium sized and / or municipal and industrial WWTP‘s
- ~ 80 -100 experts exchange experiences
- Explanation and discussion of the shown analysis
- Knowledge picnic by focused background presentations
- Networking opportunities and site visits

COULD YOU PICK UP SOMETHING?

- Each plant documents its action proposal
- More than 460 proposals are documented (since 2014), e.g.
  - ~ 100 proposals for biological treatment (especially for aerators, blowers, compressors or agitators)
  - ~ 150 proposals for other energy related proposals (incl. energy production)
  - ~ 35 proposals for sludge stabilisation and biogas production

3 Cause analysis and action planning

Action proposal	**Successive replacement of old with efficient horizontal agitators**
Sub-process	Biological treatment agitator
Inducement	Technically obsolete vertical agitators
Objective	Reduction of electricity demand for denitrification by 50%
Status	in planning



SUMMARY AND INVITATION

- Established benchmarking method offers
  - Structured view on performance
  - Meaningful and supported assessment
  - Best-practice exchange for „up-to minute industrial knowledge“
- Currently, three WWTP‘s from Sweden and Germany are looking for partners to use method on international level.

International best practices of wastewater treatment plants

Using benchmarking at process level for improvement

„Assessing performance“, „exchanging experiences on technologies and practices“ and „working focused and systematically on improvement opportunities“ - based on this motivation German operators have been developing a structured benchmarking approach since 1996. More than 270 wastewater treatment plants (WWTPs) have participated.

aquabench has received a new request in 2019 to invite European and international WWTPs of all sizes and all technologies to an international search of best practices based on developed methods.

Approach

Benchmarking at process level of WWTP is focused on important performance areas:

- Treatment performance
- Operational costs
- Staff
- Energy management
- Sludge treatment and disposal

Treatment perfor-mance | Costs | Staff | Energy | Sludge

Context information and specifications of each plant

The structured benchmarking approach

- takes into account differing context information and operational characteristics
- follows well known steps of benchmarking according to international and national standards, by German Water Associations (DVGW/DWA), European Benchmarking Co-operation (EBC) and International Organisation for Standardization (ISO)
- brings in German data and experience from 20 years of benchmarking with more than 270 WTTPs

HAPPY TO SHARE KNOWLEDGE …

Your Contact

Filip Bertzbach
Tel.: 040 47 11 24-31
f.bertzbach@aquabench.de

Eva Wortmann
Tel.: 02203 359 29-24
e.wortmann@aquabench.de

Pamela Raehmel
Tel.: 02203 359 29-16
p.raehmel@aquabench.de

Jan Kreienborg
Tel.: 02203 359 29-28
j.kreienborg@aquabench.de

aquabench GmbH

Office Hamburg
Ferdinandstr. 6, 20095 Hamburg

Office Cologne
Frankfurter Str. 520, 51145 Köln

www.aquabench.de