Für Mensch & Umwelt

Umwelt Bundesamt

PWTAG Conference 2025 Loughborough

Water treatment of public swimming pools according to DIN 19643

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Section II 3.2 Swimming Pool Water, Chemical Analytics

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50 Jahre Umweltbundesamt 1974–2024

Biographical Note

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Standardization Committee CEN TC 230 WG 1 Physical and biochemical methods

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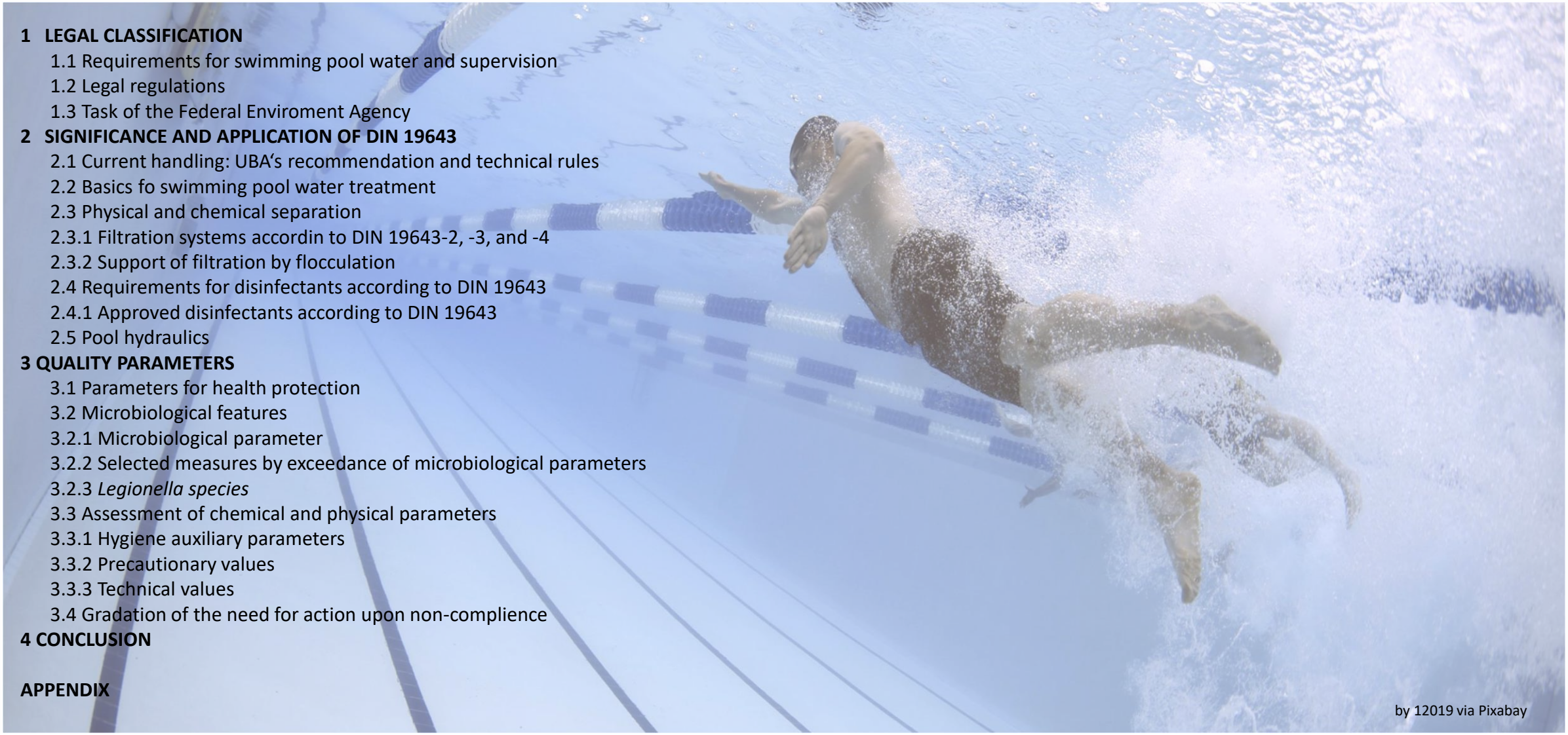
Agenda



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1.1 Requirements for swimming pool water and supervision

FEDERAL INFECTION PROTECTION ACT §37 PARAGRAPH 2

Water, … in public baths and in other not exclusively privately used facilities for the purpose of swimming and bathing …

has to have a quality that by its use any sorrow of a threat to human health, especially from pathogenes must be excluded. For public swimming pools and spas the respective watertreatment must involve disinfection.

In Germany there are currently
10.112 public baths
1.642 indoor swimming pools,
2.468 outdoor swimming pools,
387 combined swimming pools,
944 school swimming pools

FEDERAL INFECTION PROTECTION ACT §37 PARAGRAPH 3

…public swimming pools and spas … including thier water treament systems are, with reference to the quality requirements, subject to supervision by [local] health authorities […]

Source:

https://baederleben.de/abfragen/baeder-suche.php

Approx. 380 local health authorities

1.2 Legal regulations

FEDERAL INFECTION PROTECTION ACT §38 PARAGRAPH 2

The federal Ministry of Health determines by ordinance wih agreement of the Federal Council

1. Requirements [for water in public swimming pools and spas]
2. How public swimming pools and spas and the water in them are superviced regarding hygiene
3. Which duties are imcumbent upon public swimming pool operators, which water testings and in which intervals are necessary
4. In which cases the water in public swimming pools, that does not comply with quality requirements, must not be used
5. That for treament of water for use in public swimming pools an spas only substances and methods are use that comply with generally accepted technical rules and standards and are published in a list by the Federal Environment Agency

BUT: Theory only so far → NO ordinance issued yet

1.3 Task of the Federal Enviroment Agency

FEDERAL INFECTION PROTECTION ACT §40

According to this act the Federal Environment Agency has to develop conceptions for prophylaxis, detection and prevention of spread of diseases via water paths. For the fulfillment of these task consulting committees may be installed that may issue recommendations for the protection of human health

in lack of an ordinance

Hygienic requirements for public baths and their supervion
Recommendation of the Federal Enviroment agency consulted by the Federal Ministry of Health‘s committee on swimming
pools and spas
(in German only)

Available free of charge
https://www.umweltbundesamt.de/sites/default/files/medien/374/dokumente/hygieneanforderungen_ueeberwachung_baeder_2014_57.pdf

2.1 Current handling: UBA‘s recommendation and technical rules

Swimming pool water treatment according to DIN 19643

NORM [AKTUELL]

DIN 19643-1:2023-06

DIN 19643 Part 1

General Requirements (construction, operation and supervision)

DIN 19643 Part 2
Process including depth or precoat filtration

DIN 19643 Part 3
Process including ozonation

DIN 19643 Part 4
Ultrafiltration

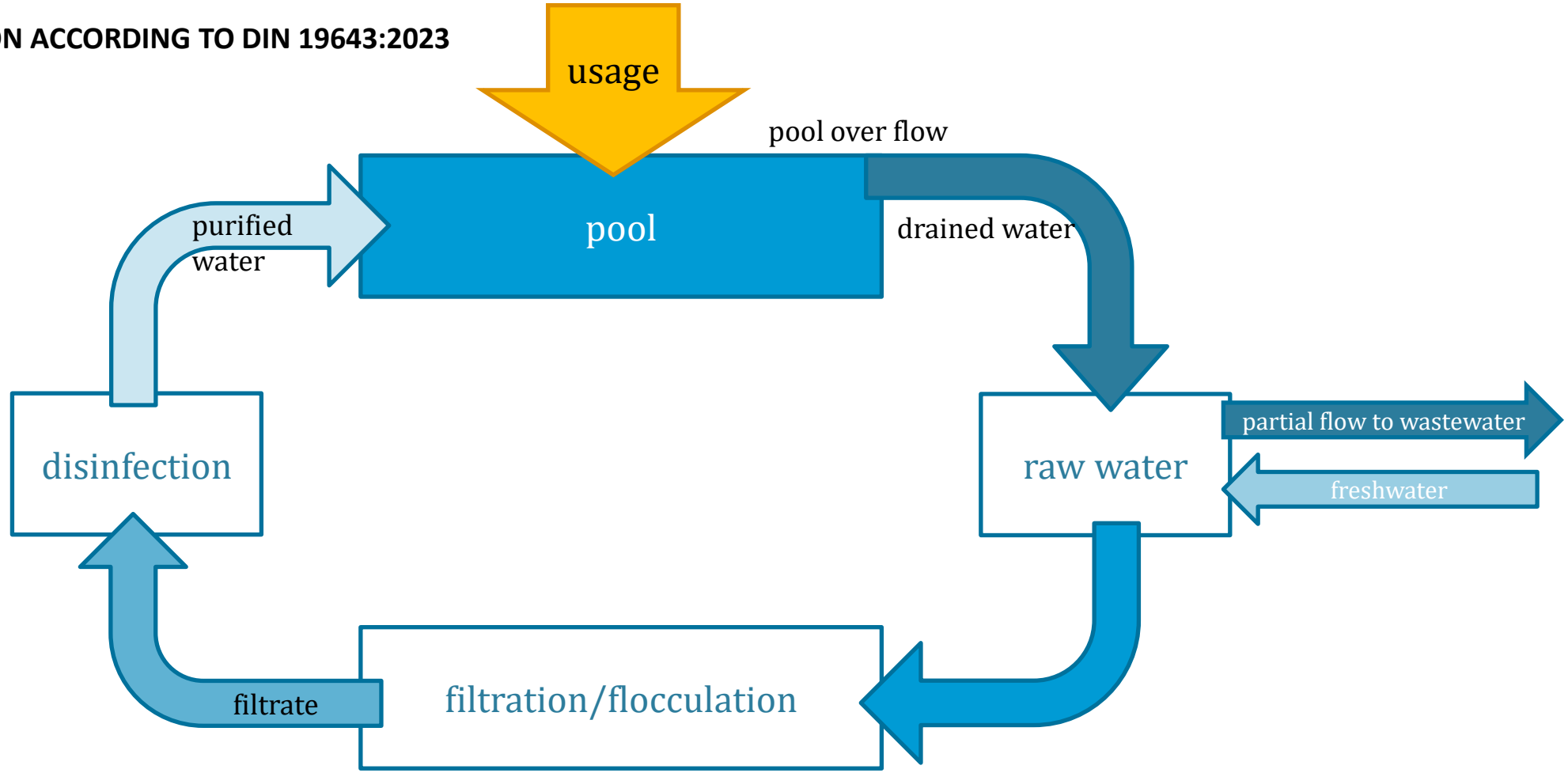
DIN 19643 Part 5
Ozone-bromine-process

Commentary on DIN 19643

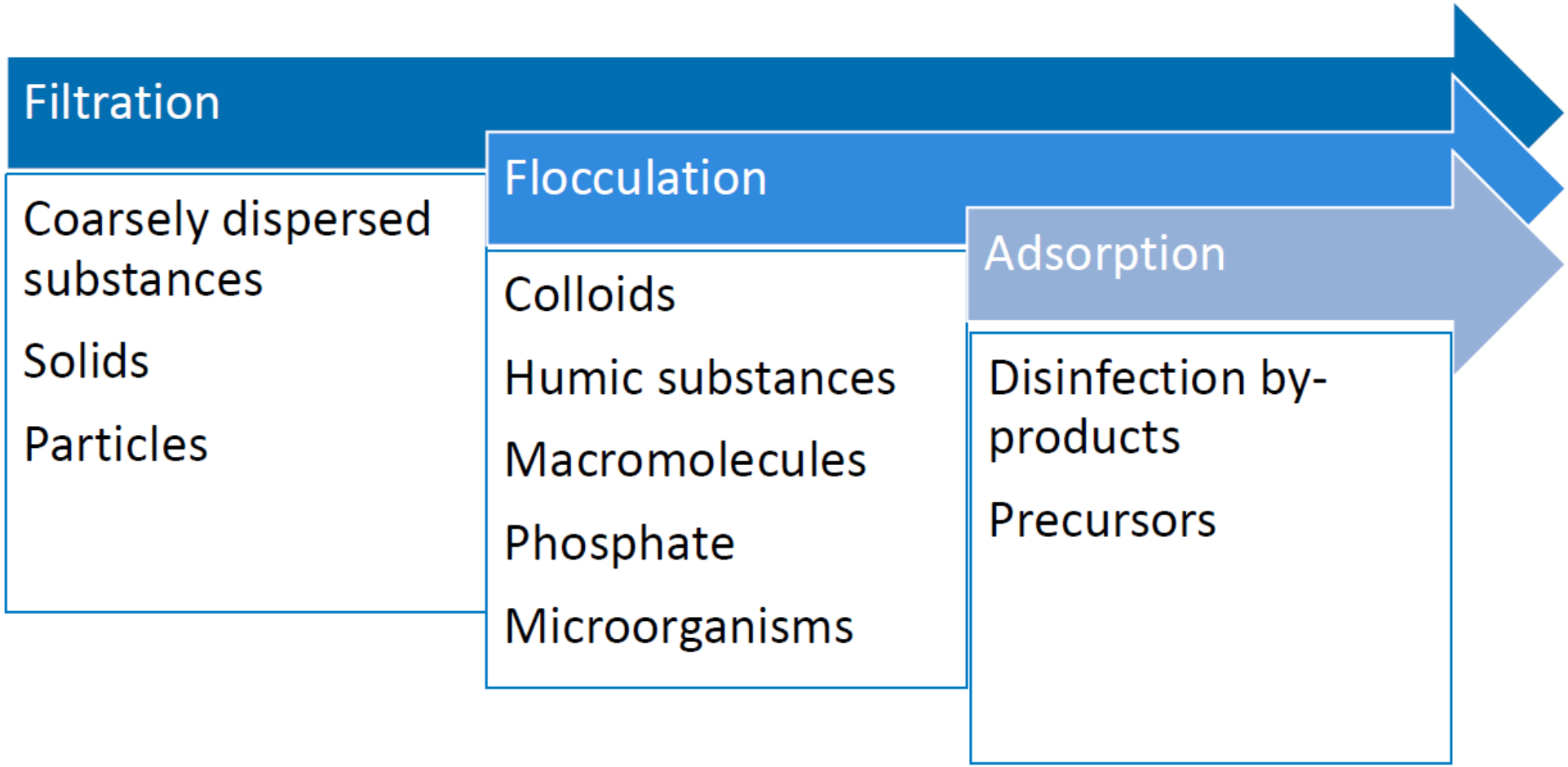
Hygienic requirements for public baths and their supervion
Recommendation of the Federal Enviroment agcency consulted by the Federal Ministry of Health‘s committee on swimming pools and spas
(in German only)

2.2 Basics of swimming pool water treatment

SCHEMATIC DEPICTION ACCORDING TO DIN 19643:2023

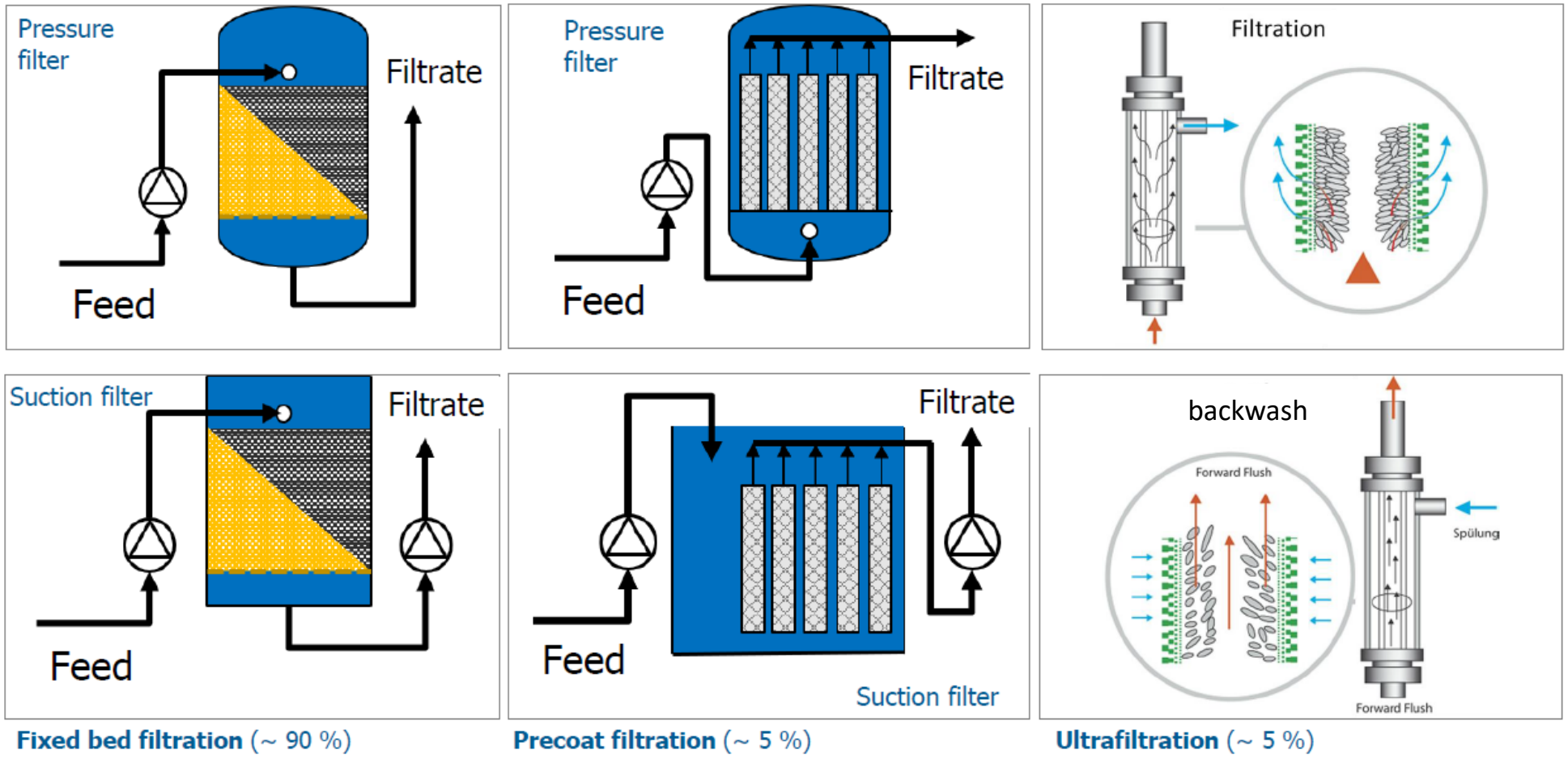


2.3 Physical and chemical separation



Graphic by D.P. Dygutsch, Dr. Nüsken Chemie GmbH

2.3.1 Filtration systems accordin to DIN 19643-2, -3, and -4



Fixed bed filtration (~ 90 %) **Precoat filtration** (~ 5 %) **Ultrafiltration** (~ 5 %)

Graphic by A. Reuß, OSPA

2.3.2 Support of filtration by flocculation

Removes pollutants
- dust, particles,
- colloids
- disperse substances

Saves chemicals
- Chlorine is consumed only with germs, not pollutants

optimized flocculation and filtration

Removes germs
- Unicellular organisms
- bacteria
- Fungus
- Viruses

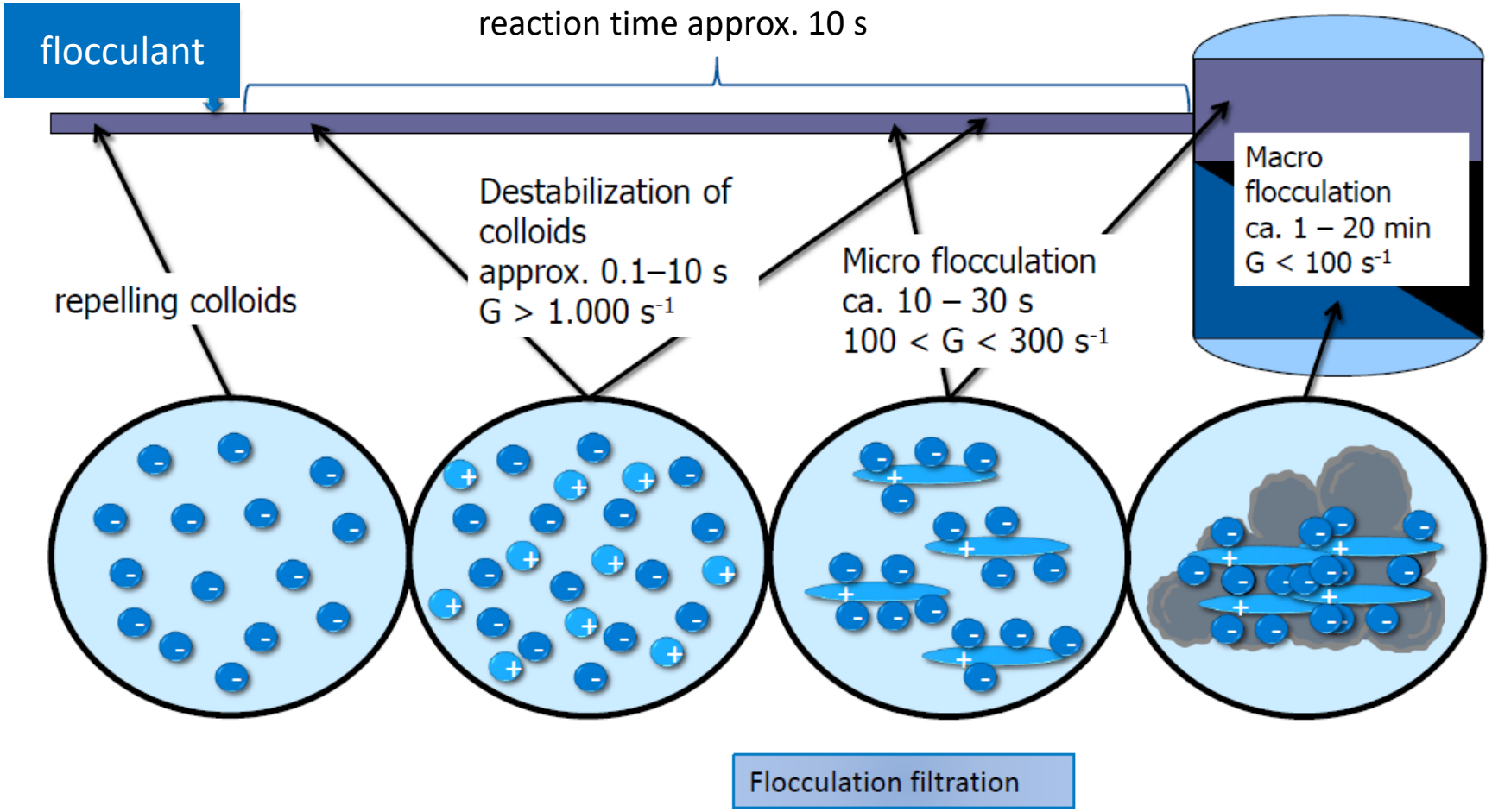
especially those, that are not destroyed by disinfection (chlorination)

Avoids and reduces disinfection by-products
- AOX, THM
- Combined Chlorine

Improves filtration process significantly

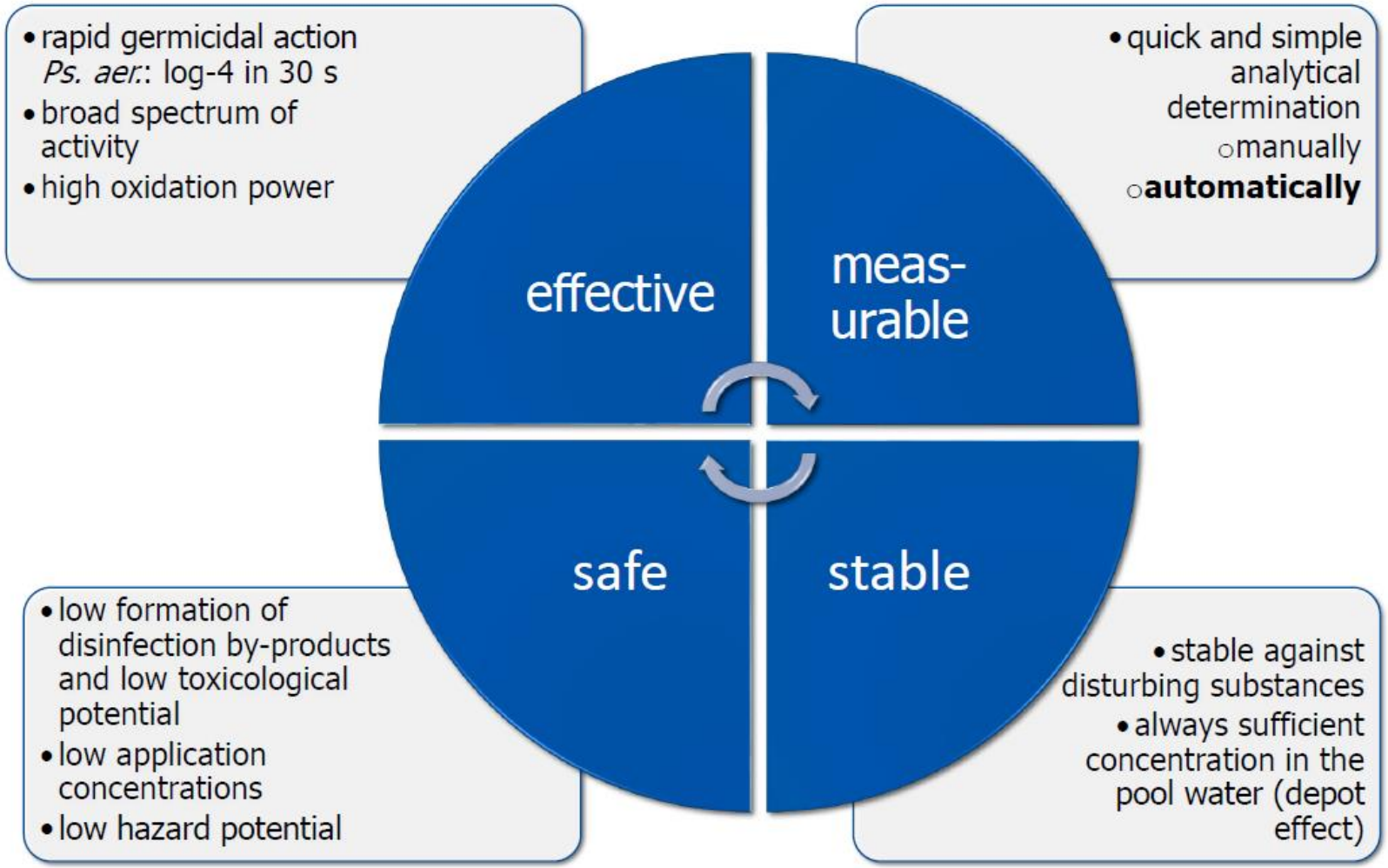
Graphic by D.P. Dygutsch, Dr. Nüsken Chemie GmbH

2.3.2 Support of filtration by flocculation



Graphic by D.P. Dygutsch, Dr. Nüsken Chemie GmbH

2.4 Requirements for disinfectants according to DIN 19643



Graphic by A. Reuß, OSPA

2.4.1 Approved disinfectants according to DIN 19643

- **Chlorine**
  - Chlorine gas, Sodium hypochlorite, Calcium hypochlorite
  - Sodium chloride electrolysis
- **Bromine**
  - in-situ generated with ozone
  - By chlorination of bromide-containing water
- **Ozone**
  - for the generation of bromine
  - for ozone treatment according to DIN 19643-3
- **Chlorine Dioxide**
  - for the disinfecting filter backwash process

➔ automated measuring and control

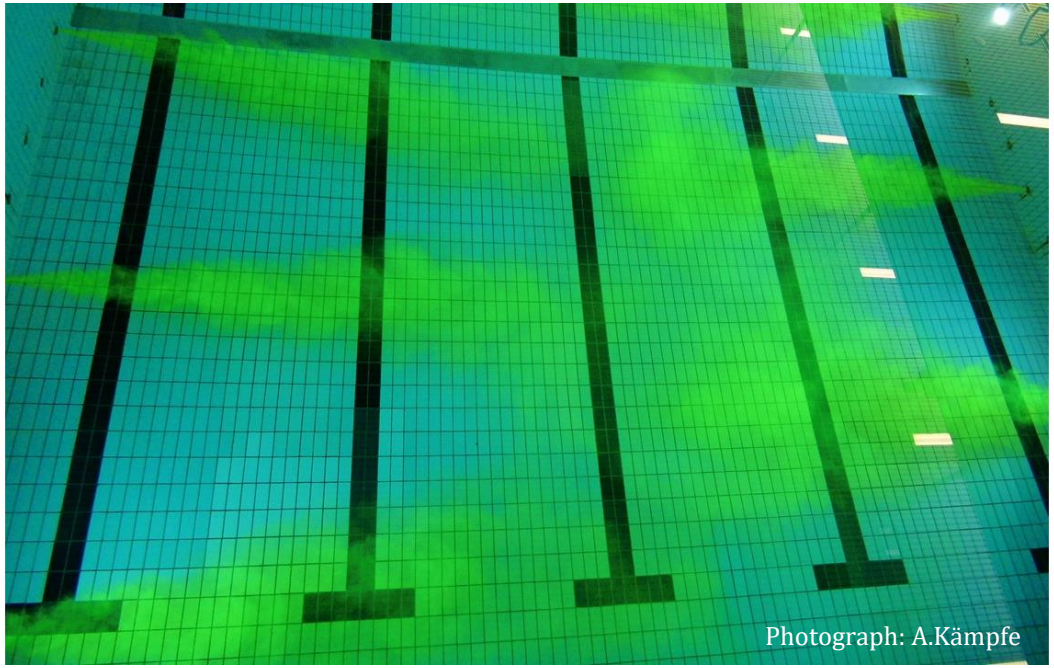
- [...] Microorganisms brought in by bathers and from the surrounding area are destroyed by an oxidizing disinfectant contained in the pool water.
- For disinfection, a germicidal effect on Pseudomonas aeruginosa of four orders of magnitude within 30 seconds is assumed.
- Disinfectants may only be present in the pool water in the required concentration.
- The disinfectants must meet the purity criteria stipulated in the respective product standards (DIN EN).
- All disinfectants must meet the EU Biocidal Products Regulation (active substance approval and biocidal product authorization or respective dossier pending).

➔ no organic chlorine, no Cyanuric acid
➔ no UV disinfection (only for reduction of combined chlorine)

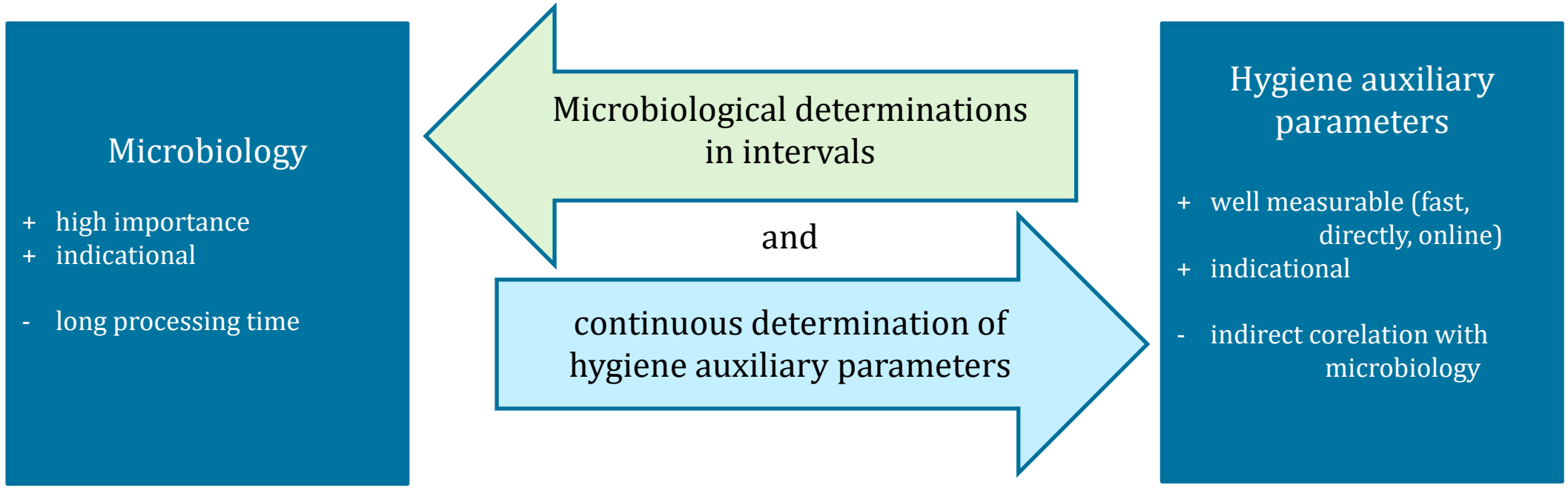
Graphic by A. Reuß, OSPA

2.5 Pool hydraulics

- Proof of efficient pool hydraulics by means of a functional testing according to DIN EN 15288-1:2019-05
  - advantage of an overflow channel
  - Discharge of contaminations (colour dot method)
  - efficient distribution of disinfectant (via colouration test: 90 % in 15 min) (photograph)
  - Determination of „dead“ zones


Photograph: A.Kämpfe

3.1 Parameters for health protection



3.2 Microbiological features

Originates from:

swimmers and bathers
environment (animals, leafs, birds,…)
fresh water (e.g. wells)
cleaning products and disinfectants
…

source: http://bilder.augsburger-allgemeine.de/img/augsburg-land/crop26024111/9364789594-ctopTeaser-w1200/IMG-0409.jpg;

Quelle: pixabay.com

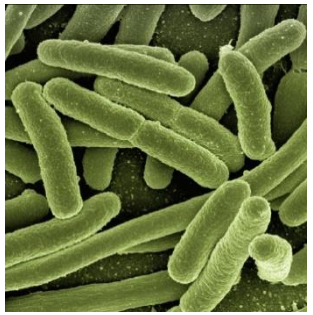
https://poolcraftinc.com/spring-cleaning-for-your-pool/;

Quelle: pixabay.com

3.2.1 Microbiological parameter

parameter	unit	pool water	filtrate	pure water	detection method	remark
P. aeruginosa	cfu/100 ml	0	0	0	DIN EN ISO 16266	health relevance, indicator for insufficient disinfection efficacy
E. coli	cfu/100 ml	0	0	0	DIN EN ISO 9308-1	indicates possible fecal contamination
Legionella spec.	cfu/100 ml	*see next slides*			DIN EN ISO 11731	health relevance, indicator for insufficient disinfection efficacy
colony count	cfu/1 ml	100	100	20	DIN EN ISO 6222 and drinking water ordinance	general indicator for the total microbiological situation

Quelle: UBA-Broschüre Rund um das Badewasser



Quelle: pixabay.com

3.2.2 Selected measures by exceedance of microbiological parameters

parameter	findings point to	possible reason	mitigation
P. aeruginosa	environmental contamination	freshwater, surroundings	filter back flush*, disinfection (1,2 mg/l chlorine)
E. coli	fecal contamination	bathers, birds	filter back flush*, disinfection (1,2 mg/l chlorine)
Legionella spec.	specific pathogen	freshwater, surroundings	measures according to tables 7 and 8 of DIN 19643-1, see next slides
colony count	microbial contamiantion	often unknown	intens filter back flush*

* if necessary additional cleansing of filter material, see appendix

3.2.3 *Legionella species*

Measures upon detection of Legionella in pool water

cfu/100 mL	>10000	>1000	>100 - 1000	>2 - 100	<2
ban on use (re-opening if cfu < 1000, but without attractions)	x				
switch off areosol forming unit	x	x	x		
immediate filter disinfection	x	x	x		
high dose chlorination (10 mg/L) of the pool water circuit	x	x	x		
examination of the treatment systemn and filter back flush	x	x	x		
further troubleshooting, involvement of professionals	x	x	x		
Re-examination of the filtrate >7 days after filter disinfection, but with 4 weeks	x	x	x		
re-examination of filtrate and pool water within 4 weeks				x	
notification of helath authorities	x	x	x	x	
further handling, e.g. in cases of anew or repeated detections					
examination of the pool water in all pools connected to the circuit	x	x	x		
examination of the treatment systemn and filter back flush	x	x	x	x	
disinfective filter back flush	x	x	x	x	
further troubleshooting, involvement of professionals	x	x	x	x	

taken from: Dr. D.P Dygutsch, Schwimmbadampel („the swimming pool traffic lights“), Dr. Nüsken Chemie

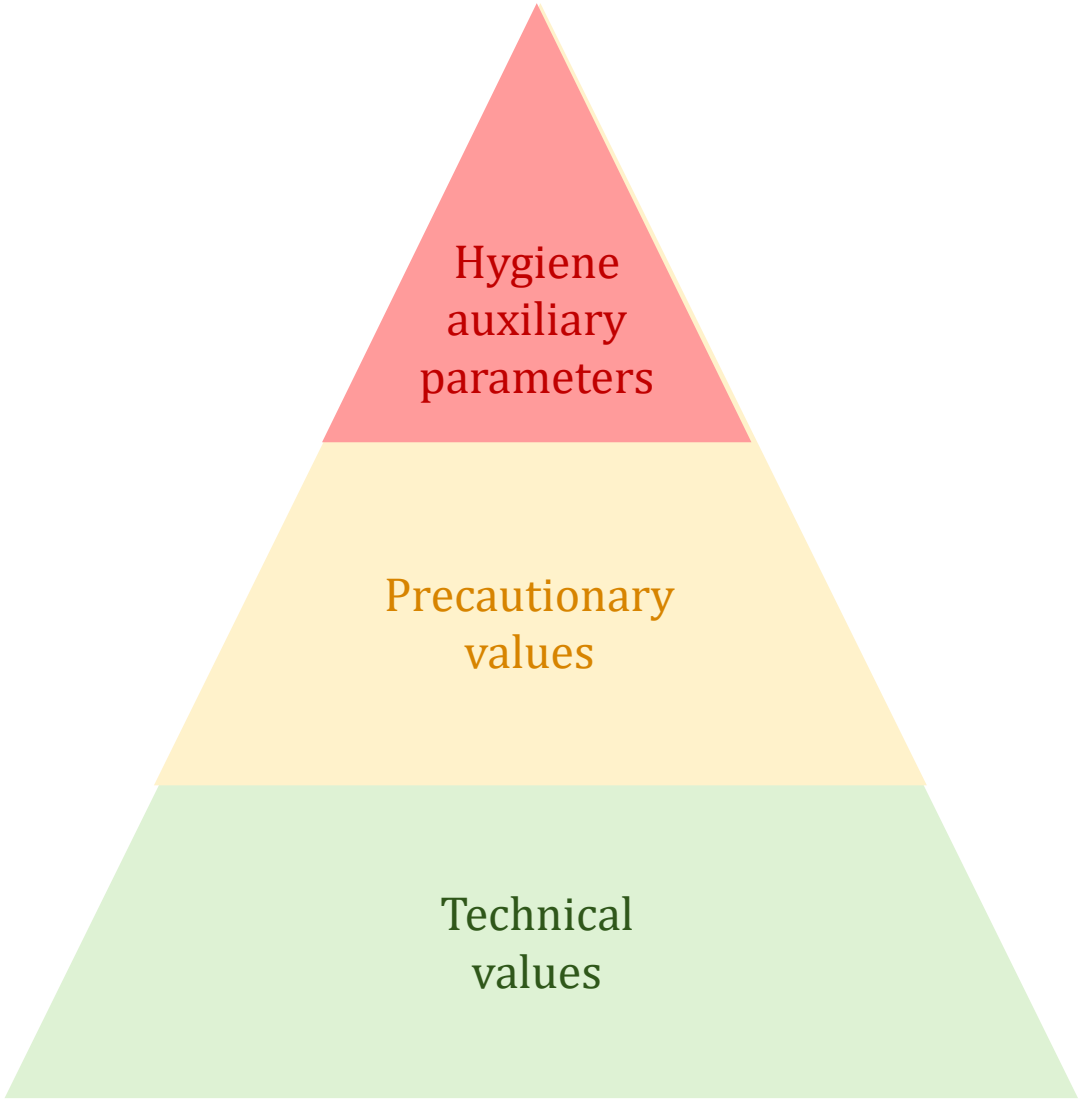
3.2.3 *Legionella species*

Measures upon detection of Legionella in filtrate

cfu/100 mL	>1000	>100 - 1000	>10 - 100	>2 - 10	<2
if necessary restrictions in use, e.g. switch off aerosol forming units	x				
immediate filter disinfection, if necessary after filter cleansing	x	x			
examination of the treatment systemn and filter back flush	x	x			
further troubleshooting, involvement of professionals	x	x			
notification of helath authorities	x	x			
re-examination of filtrate and pool water within 4 weeks			x		
monthly re-examinations				x	
further handling, e.g. in cases of anew or repeated detections					
examination of the pool water in all pools connected to the circuit	x	x			
Re-examination of the filtrate >7 days after filter disinfection, but with 4 weeks	x	x			
examination of the treatment systemn and filter back flush	x	x	x	x	
disinfective filter back flush (DIN 19643-2:2023-06, 5.4.2.3)	x	x	x	x	
further troubleshooting, involvement of professionals	x	x	x	x	
notification of helath authorities	x	x	x		

taken from: Dr. D.P Dygutsch, Schwimmbadampel („the swimming pool traffic lights"), Dr. Nüsken Chemie

3.3 Assessment of chemical and physical parameters



redox-potential
free chlorine
pH

Need of (immediate) action

combined chlorine
trihalogenmethanes
chlorite + chlorate
bromate
arsenic

Need for minimization

colouration, turbidity, clearness,
Al + Fe
acid capacity
nitrate
permanganate index, TOC

Need for optimization

3.3.1 Hygiene auxiliary parameters with immediate need of action upon non-compliance with DIN 19643:2023-06 Table 2

parameter	unit	pool water	filtrate	pure water	detection method	remakrs
redox-potential against Ag/AgCl 3.5 M KCl					DIN 38404-6	Hygiene auxiliary parameter, measure for oxidation capability or disinfection capacity, respectively, and therefore a measure for disinfektion efficacy. To low values point to high bather loads, insufficient flocculation/filtration, and/or to low concentrations of free chlorine. Correlates with complience of microbial requiremnets
for freshwater						
a) 6.5 < pH < 7.3	mV	>750				
b) 7.3 < pH < 7.5	mV	>770				
for seawater and other waters with c[bromide] > 10 mg/L						
a) 6.5 < pH < 7.3	mV	>700				
b) 7.3 < pH < 7.5	mV	>720				
free chlorine					DIN EN ISO 7393-1 DIN EN ISO 7393-2	Hygiene auxiliary parameter, essential for water disinfection and compulsory according to Infection Protection Act. For maintainig hygiene a maximum level of 1.2 mg/L is acceptable.
a) in general	mg/L	0.3 to 0.6		>0.1		
b) hot tubs	mg/L	0.7 to 1.0		>0.1		
pH					DIN 38404-5	Hygiene auxiliary parameter of essential influence on the efficacy of disinfection and flocculation
in case of flocculation with Al or Al+Fe		6.5 to 7.2				
in case of flocculation with Fe						
a) freshwater		6.5 to 7.5				
b) seawater		6.5 to 7.8				

3.3.2 Precautionary values with need for minimization upon non-compliance with DIN 19643:2023-06 Table 2

parameter	unit	pool water	filtrate	pure water	detection method	remakrs
combined chlorine	mg/L	<0.2	<0.2	<0.2	DIN EN ISO 7393-1 DIN EN ISO 7393-2	measure for nitrogene containing DBPs
trihalogenmethanes	mg/L	<0.02	<0.02	-	DIN 38407-30 DIN EN ISO 15680 DIN EN ISO 10301 (Verfahren 2)	substitute measure for organic DBPs
sum chlorite + chlorate	mg/L	<30	-	-	DIN EN ISO 10304-4	measure for decay products of hypochlorite
bromate	mg/L	<2.0	-	-	DIN EN ISO 15061 DIN EN ISO 11206	results from oxidation processes in bromide rich waters
arsenic	mg/L	<0.2	-	-	DIN 38405-35 DIN EN ISO 11969 DIN EN ISO 11885 DIN EN ISO 17294-2	may originate from arsenic containig well waters (thermal springs)

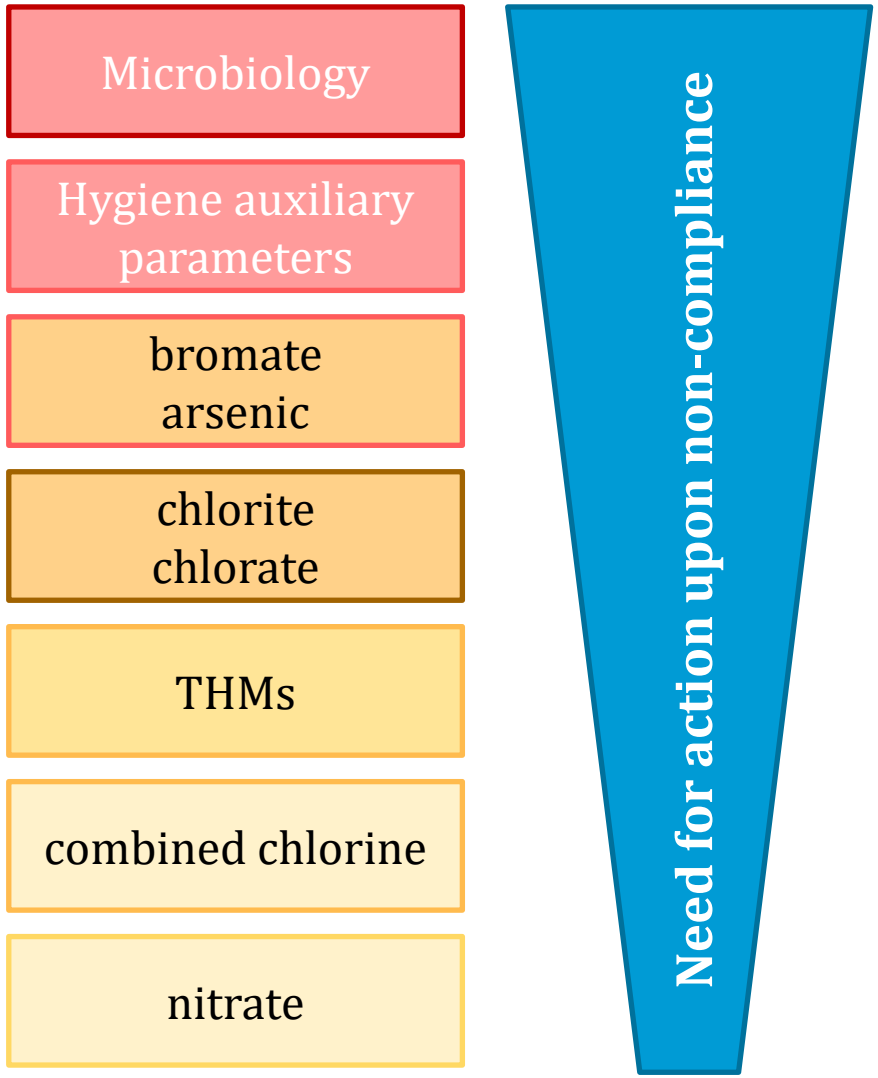
3.3.3 Technical values I with need for optimization upon non-compliance with DIN 19643:2023-06 Table 2

parameter	unit	pool water	filtrate	purified water	detection method	remakrs
colouration (λ = 436 nm)	1/m	<0.5	-	<0.4	DIN EN ISO 7887	points to the presence of colouring substances, e.g. humic acids, iron or copper ions
turbidity	FNU	<0.5	<0.1	<0.2	DIN EN ISO 7027-1	e.g. from high bather loads, falsely applied flocculants
clearness		undisturbed sight				Important for safety issues (lifeguards)
aluminum	mg/L	<0.05	<0.05	-	DIN EN ISO 12020 DIN EN ISO 11885 DIN EN ISO 17294-2	elevated Al-concentrations in filtrate and/or pool water may have various reasons: either to high or to low dosages as well as boundary conditions like pH, acid capacity and process handling do have an influence and should be checked
iron	mg/L	<0.02	<0.02	-	DIN 38406-1 DIN 38406-32 DIN EN ISO 11885 DIN EN ISO 17294-2	see aluminum

3.3.3 Technical values II with need for optimization upon non-compliance with DIN 19643:2023-06 Table 2

parameter	unit	pool water	filtrate	purified water	detection method	remakrs
acid capacity Ks 4.3 if flocculation is applied with products of basicity <65%					DIN 38409-7	describes the ability of an aqaeuos solution to stabilize ist pH (buffer), important for effective flocculation
a) all but b)	mmol/L	>0.7	-	-		
b) hot tubs with own treatment	mmol/L	>0.3	-	-		
if flocculation is applied with products of basicity >65% as well as without flocculation	mmol/L	>0.3				
nitrate above nitrate of freshwater	mg/L	<20	-	-	DIN 38405-9 DIN 38405-29 DIN EN ISO 10304-1 DIN EN ISO 13395	difference, measure for the aging of used water and for possible insufficient dilution and freshwater dosing, indicades possible enrichment of other substances
oxidizability MnVII-->II above value of freshwater	mg/L	<0.75	<0.5	<0.5	DIN EN ISO 8467	difference, measure for bather loads and oxidizable organic substances in the pool water, correlates with chlorine consumption by organic pollutants
permanganate index above value of freshwater	mg/L	<3	<2	<2		
total organic carbon (TOC)	mg/L	<2.5	-	-	DIN EN 1484	measure for the presence of organic substances

3.4 Gradation of the need for action upon non-compliance



Indicator for (other) pathogenes and for possible hygienic deficiencies within the treatment system or during disinfection

Indicator for hygienic deficiencies within the treatment system or during disinfection

Unwanted due to health hazards and carcinogenic potential

Unwanted due to health hazards and carcinogenic potential

Indicator for other not determined disinfection by-products and their precursors

Indicator for unwanted disinfection by-products and high strain situations

Parameter for the aging of used water and for possible insufficient dilution and freshwater dosing

4 Conclusion

Hygiene in public baths must comply with § 37 paragraph 2 Infection Protection Act – principle of the absence of sorrow.

Due to an unissued ordinance on pool water quality a recommendation of the Federal Environment Agency (Umweltbundesamt, UBA) together with technical rules and standards are of pronounced importance.

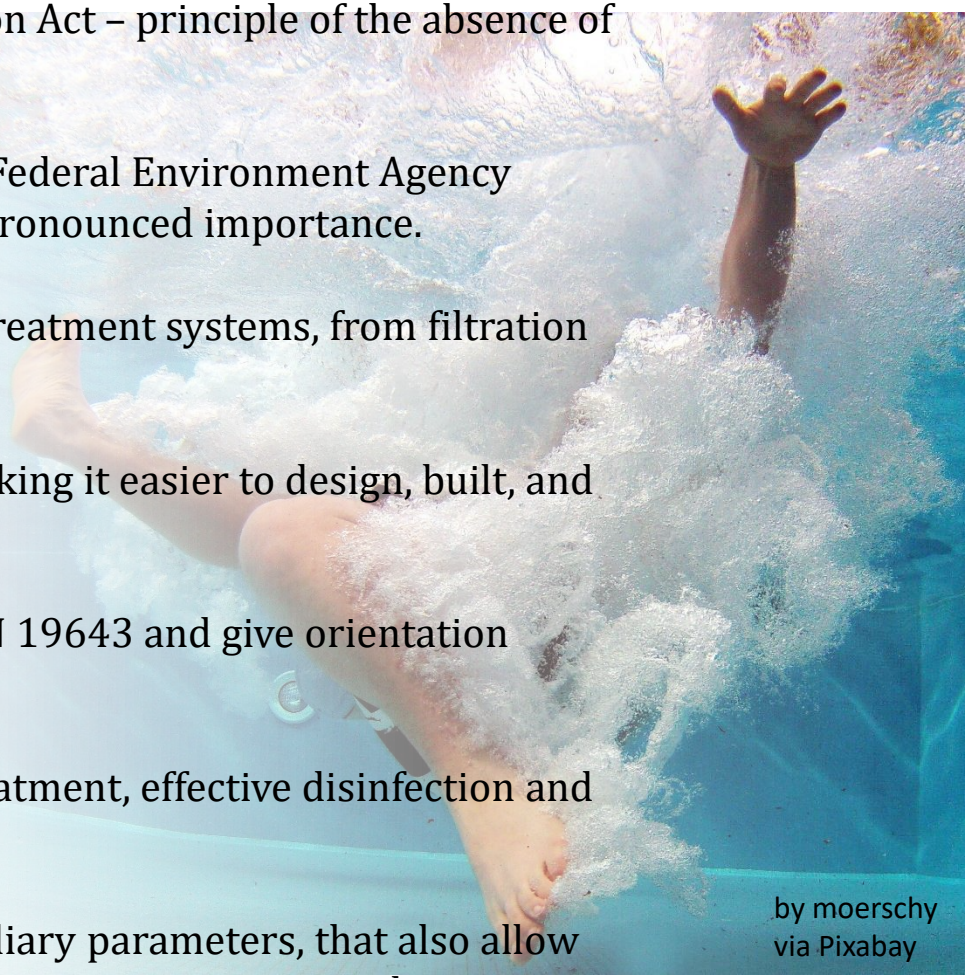
Standard DIN 19643 defines clear requirements and guidance for pool water treatment systems, from filtration and disinfection to measurement, monitoring, and operational routines.

DIN 19643 provides a modular framework devided into manageable steps, making it easier to design, built, and operate pools with consistently safe and clear water.

Quality requirements taken from UBA‘s recommendation are confirmed by DIN 19643 and give orientation either for pool operators or health authorities.

Achievement of good hygiene conditions depents on interaction of efficient treatment, effective disinfection and maintained pool hydraulics.

Assessment of hygienic conditions rely on continously monitored hygiene auxiliary parameters, that also allow for propriate action. Parameters are differenciated by the urgence of need for action upon non-complience.



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Thank you very much for your kind attention!

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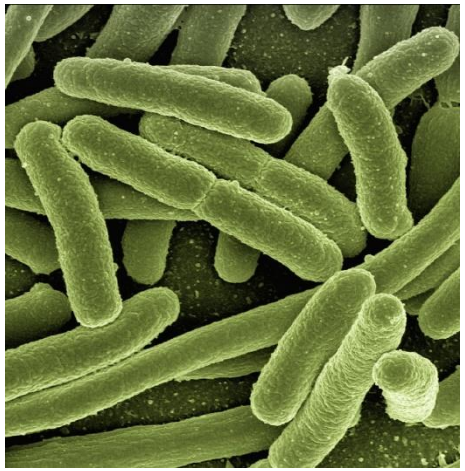
https://www.umweltbundesamt.de/themen/wasser/schwimmen-baden

50 Jahre Umweltbundesamt 1974–2024

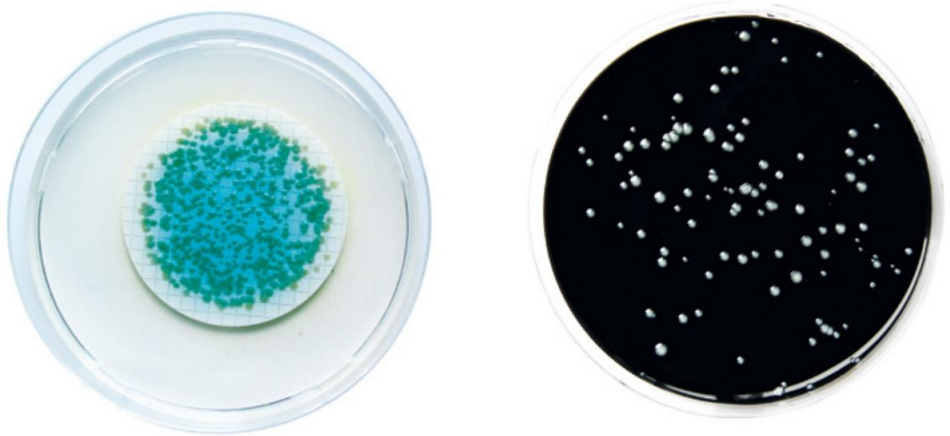
Umwelt Bundesamt

A Frequences of investigations for microbiological parameters

parameter	pools	
	indoor pools	Outdoor pools
Pseudomonas aeruginosa	monthly	Minimum three times duroing opening season, in case of high bather load (e.g. in good weather) twice a month
Escherichia coli	monthly	
Legionella species	monthly*	
Koloniezahl 36 °C	monthly	
	* If concentrations did not exceed the upper value within the course of one year, the investigation intervall may be extented to three months.	



Quelle: pixabay.com



Quelle: UBA-Broschüre Rund um das Badewasser

A Cleansing of filter materials

- filter materials according to DIN 19643 Part 2

- reasonable especially directly before a high dose chlorination
- removes *breeding ground* for microorganisms
- makes the subsequent use of chlorine much more efficient

Result of cleaning of a used filtration material
left with water only, right with a special alkaline product

Source: Dr. Nüsken Chemie GmbH