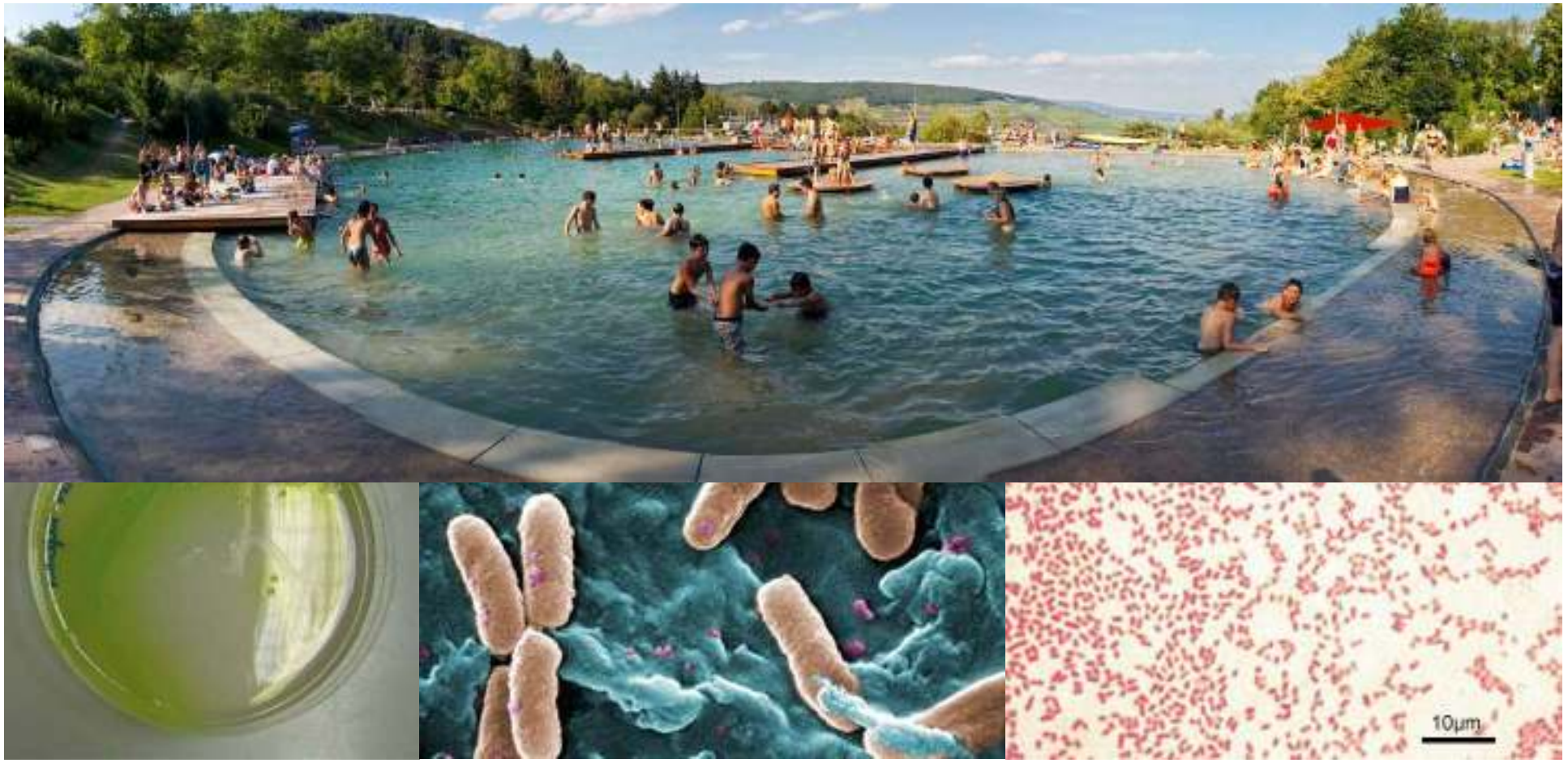
PSEUDOMONAS AERUGINOSA IN NATURAL POOLS

Causes, measures, relevance, test procedures and limits



POLYPLAN GmbH 29 years of water

>> LAKES AND URBAN WATERS – Design and Monitoring

>> **NATURAL POOLS** – Design and Monitoring

>> **RESEARCH AND DEVELOPMENT**

>> SHRIMPFARMING WITH BIOL. WATERTREATMENT

>> TECNICAL BUILDING EQUIPMENT

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ARCHIV DES BADEWESENS

04/07

Pseudomonas aeruginosa in Naturfreibädern

Ursachen, Maßnahmen, Relevanz, Testverfahren und Grenzwerte

Seit über zehn Jahren liefert der Indikatorparameter Pseudomonas aeruginosa (P. a.) bei der Überwachung der Wasserqualität in Naturfreibädern Anlass zu Diskussionen und Kontroversen. Hierbei geht es um mögliche Ursachen und Maßnahmen, die Bewertung der Relevanz des Keims, die Validität der Messverfahren und nicht zuletzt um die Einordnung und Festlegung von Grenzwerten.

Im Folgenden wird der aktuelle Stand dieser Diskussionen zusammengefasst und es wird die Frage aufgeworfen, ob der aktuell in Deutschland gültige Grenzwert von 10 KBE/100 ml zukünftig nach oben hin korrigiert werden sollte.

Für die hygienische Überwachung von Naturfreibädern werden gemäß der gültigen Empfehlung des Umweltbundesamtes (UBA)[1] und der aktuellen Richtlinie zum Bau und Betrieb von Naturfreibädern[2] drei Indikatorparameter herangezogen: Escherichia coli (E. coli), Intestinale Enterokokken und Pseudomonas aeruginosa (P. a.).

Für die Fäkalkeime E. coli und Intestinale Enterokokken liefern die gültigen Messverfahren[3] verlässliche Ergebnisse. Die Ursachen im Falle einer Überschreitung lassen sich in der Praxis zumeist leicht bestimmen und entsprechend können zielgerichtet Maßnahmen durchgeführt werden. Aus diesem Gründen sind absolut die Grenzwerte relativ eng gefasst sind[2] (E. coli: ≤ 100 KBE/100 ml; Enterokokken: ≤ 50 KBE/100 ml), kommt es im Betrieb von Naturfreibädern sehr selten zu Grenzwertüberschreitungen.

Eine Analyse der Daten von 41 Bädern aus der Datenbank Naturfreibäder DNA aus den Jahren 2005 bis 2018 (siehe Abbildung 1) ergab eine Überschreitungshäufigkeit im Referenzwert für E. coli von 3,54 % und für Intestinale Enterokokken von 2,83 %. Im Referenzwert kam es bei E. coli in 5,68 % der Messungen zu Überschreitungen und bei den Enterokokken bei 3,05 %.

Für P. a. sind die Messverfahren sehr störanfällig, die Ursachen vielschichtig und die Maßnahmen in der Praxis entsprechend herausfordernd. Zusätzlich existieren zu-

TOPICS

1. CHARACTERISTICS
2. HYGIENIC RELEVANCE
3. LIMITS
4. MEASURING METHODS
5. ENTRY SOURCES AND MEASURES
6. DANA EVALUATION: PSEUDOMONAS AERUGINOSA
7. CONCLUSION

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1. CHARACTERISTICS

>> **Rod bacteria**

>> occurs ubiquitously in **surface water**, in **ground water**, in **soil** and on **plants**

>> Optimal growth temperature: **15–30 °C**

>> It is considered a so-called "puddle bacteria" because it is often found in small remnants of **stagnant water**

>> Has the ability to form **biofilms** and can multiply in **very clean water**

Pseudomonas aeruginosa (https://de.wikipedia.org/wiki/Pseudomonas_aeruginosa)

2. HYGIENIC RELEVANCE

>> **indicator for water-associated pathogens** in hospital hygiene and bathing water

>> German Federal Environmental Agency “It is known that this **pathogen can occur in small nutrient-rich bathing lakes** and is not indicated by fecal indicators (E. coli and enterococci). With the installation of technical systems for water teratment in natural pools **potential growth opportunities for P. aeruginosa (biofilm formation**) are created "

>> Usually **no risk to the healthy population**. Critical for people with

- > **cystic fibrosis**
- > **open wounds**
- > **severely immunosuppressed persons treated with immunosuppressants**

>> The following diseases can be induced by P.a.:

- > **Auditory canal inflammation (otitis externa)**
- > **Hair follicles (folliculitis) /**
- > **Corneal inflammation (keratitis) (especially with contact lens wearers)**
- > **chronic wound infections**

>> In particular otitis externa and folliculitis / bath dermatitis are well documented as bathwater associated pseudomonas infections

>> Drinking contaminated water or contact with intact skin does not result in transmission

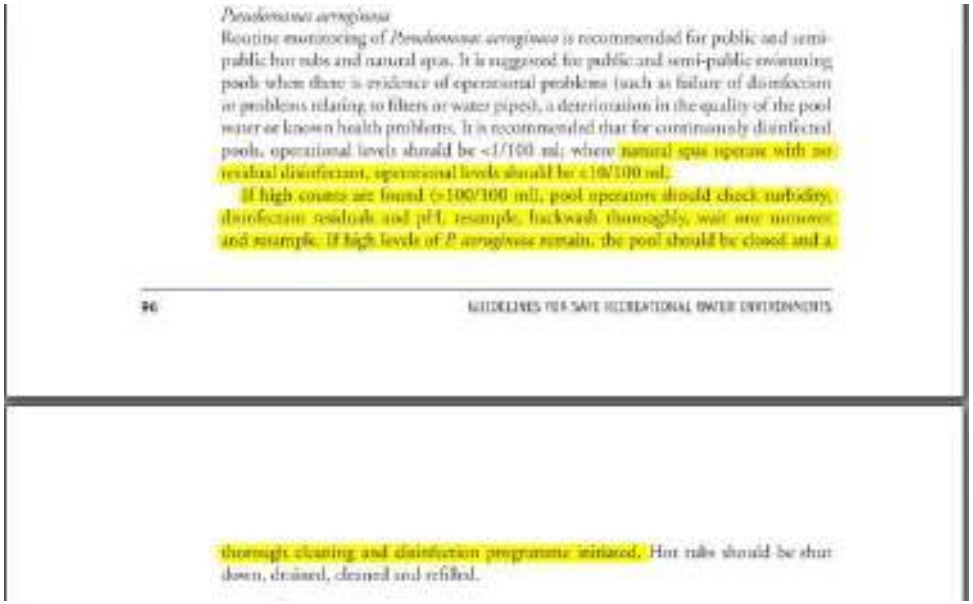
3. LIMITS

>> **Germany:** ≤ 10 CFU/100 ml

>> **Lower saxony** (Germany) ≤ 100 CFU/100 ml

>> **Denmark** ≤ 50 CFU/100 ml

>> **Worldwide** ≤ 100 CFU/100 ml (WHO recommendation)

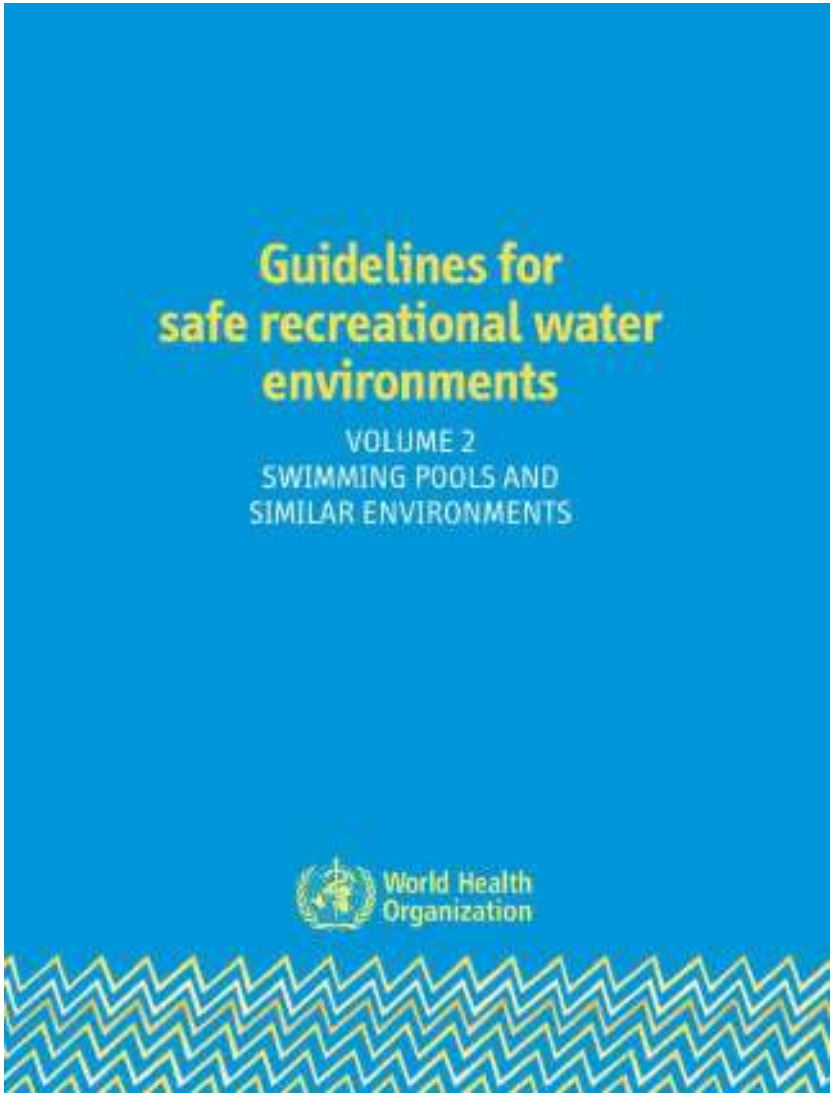


Pseudomonas aeruginosa

Routine monitoring of *Pseudomonas aeruginosa* is recommended for public and semi-public hot tubs and natural spas. It is suggested for public and semi-public swimming pools when there is evidence of operational problems (such as failure of disinfection or problems relating to filters or water pipes), a deterioration in the quality of the pool water or known health problems. It is recommended that for continuously disinfected pools, operational levels should be <1/100 ml; where natural spas operate with no residual disinfectant, operational levels should be ≤10/100 ml.

If high counts are found (>100/100 ml), pool operators should check turbidity, disinfectant residuals and pH, resample, backwash thoroughly, wait and recover and resample. If high levels of *P. aeruginosa* remain, the pool should be closed and a

thorough cleaning and disinfection programme initiated. Hot tubs should be shut down, drained, cleaned and refilled.



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4. MEASURING METHODS DIN Method

>> **DIN EN ISO 16266**

>> **Recommendation of the Swimming and Bathing Water Commission** (Germany) in the Bundesgesundheitsblatt (2009).

> DIN-method is prmarily for waters with little flora. This can cause measuring problems.

> Until better methods are developed the following methods are recomended:

1. Detection of all P. aeruginosa Colonies with additional measurement. Fluorescent colonies on cetrimide agar are first tested by the acetamide reaction. Ammonia-forming colonies are additionally incubated at 42 °C.

2. Counting of the blue-green (pyocyanin-forming) colonies on cetrimide agar.

NORM | 2008-05

DIN EN ISO 16266:2008-05

Wasserbeschaffenheit - Nachweis und Zählung von Pseudomonas aeruginosa - Membranfiltrationsverfahren (ISO 16266:2006); Deutsche Fassung EN ISO 16266:2008

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4. **MEASURING METHODS** Genetical testing

>> 2014: Quantitative measurements of Pseudomonas aeruginosa with gen probes (Cordes, ASA-Spezialenzyme)

> Greater accuracy of the gene probe method

- lower counts of P.a. were detected.

>> 2015: Field trial in Germany, Switzerland, Denmark and Poland.

> The original assumption that the gene probes detect lower bacterial counts by avoiding incorrect determinations could not be confirmed by the available data. However, it has been found that the gene probe test is less affected by the bacterial accompanying flora compared to the method DIN EN 16266.

> It has also been shown that the results obtained with the use of the modified DIN method can result in falsified results

> Too long or too warm storage of the samples can falsify the results.

Quantitative Bestimmung von Pseudomonas aeruginosa mittels Gensonden

Untersuchung eines neuen Nachweisverfahrens in Schwimmbädern mit biologischer Wasseraufbereitung

Fazit

Einleitung

5. ENTRY SOURCES AND MEASURES Fill water

Source

>> Waterworks

>> Water supply network

>> **In 5,2 % of die buildings studied P. a. was found in the tap water (**Kistemann, T. et al. (2010))

> Among other factors, iron pipes in particular were a risk factor.

Measures

>> Testing of filling water (almost never done)

>> Take appropriate action if necessary

5. ENTRY SOURCES AND MEASURES Filter

Source

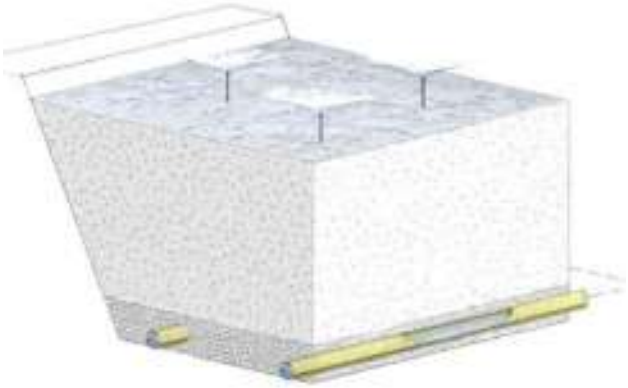
>> Colmated filters.

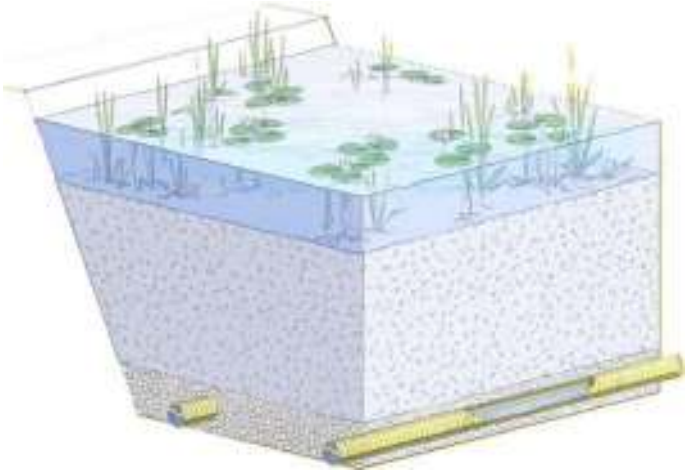
>> Anaerobic conditions in a filter

Measures

>> Check for puddles on filtersurface and check redox potential (filter infllow and outflow)

>> Adapt flowrate and remove colmations.





5. ENTRY SOURCES AND MEASURES Biofilm from pool walls

Source

>> Biofilm on the ground and the wall of the pool.

>> Tear off of biofilm fragments from the wall and the groud (during clenaing or if biofilm growth is high)

Measures

>> Regular cleaning of biofilm

>> Take samples with sufficiant lag to clenaing (fragments of biofilm should be cleaned manualy or by filter)




5. ENTRY SOURCES AND MEASURES Wind

Source

>> **Organic and anorganic particles with P.a. can enter the pool by the wind**

>> First hints were found during expermiments in a natural pool in Herrenberg (Germany) **P.a. was found in a control vessel**

>> **Expermients in a natural pool in Dortmund (Germany) showed no results** jet beacaus P.a. did not show up at all during the pahse of the expermient. The experiments will be continued.

Measures

>> High flowrate in filter.

>> Sufficient P.a. reduction by filter.

5. ENTRY SOURCES AND MEASURES Rain

Source

>> Rain can come in contact with air particles on which bacteria settle (leaching effect)

>> No studies avalable at the moment.

Measures

>> High flowrate in filter.

>> Sufficient P.a. reduction by filter

5. ENTRY SOURCES AND MEASURES Bathers

Source

>> Contaminated tab water → Shower → bather

>> Contaminated soil particles → (puddles) → bather

Measures

>> Check water supply net

>> Showering before swimming

5. ENTRY SOURCES AND MEASURES Swimming toys

Source

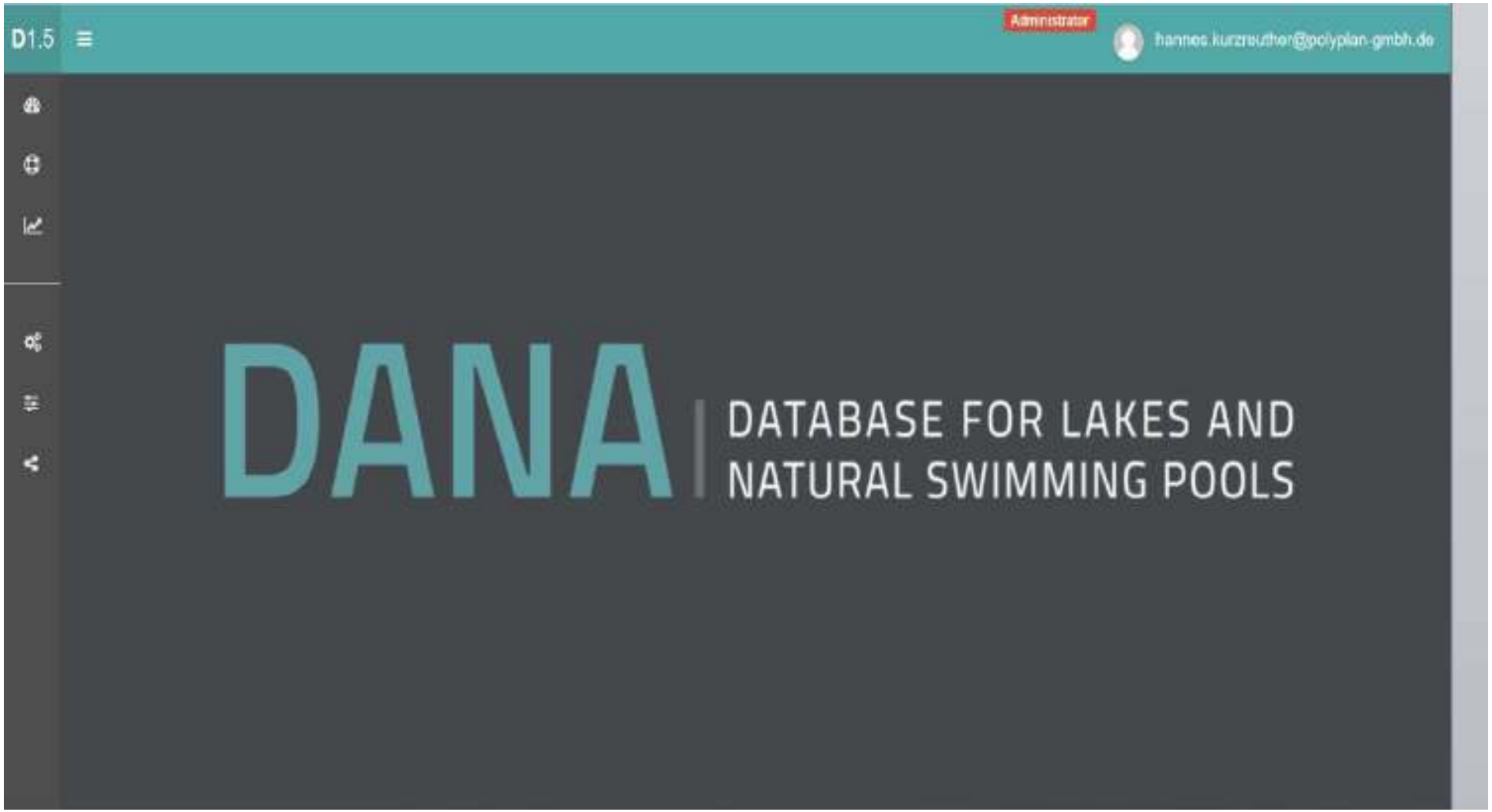
>> P.a. can be found on plastic swimming toys if not maintained well

Measures

>> Clean and dry properly

>> Store dry

6. DANA EVALUATION: PSEUDOMONAS AERUGINOSA



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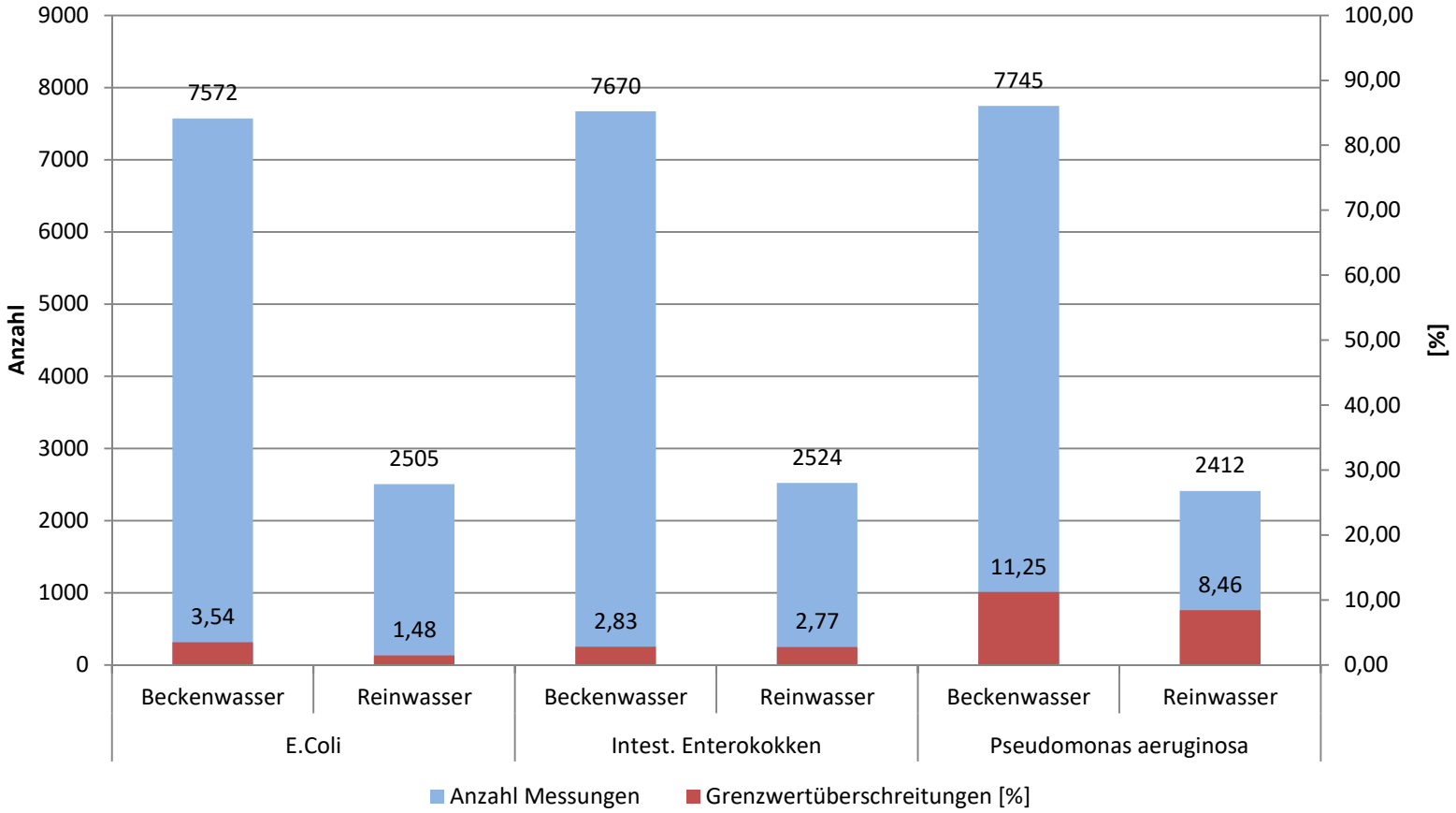

*Pool- and Clearwatervalues und Reinwasserwerte (*Number of measurements and percentage of limit violations*): E.coli, Intest. Enterokokken, Pseudomonas aeruginosa; Number of pools: 43; Years: 2005-2018; Source: Datenbank Naturfreibäder (DANA)*

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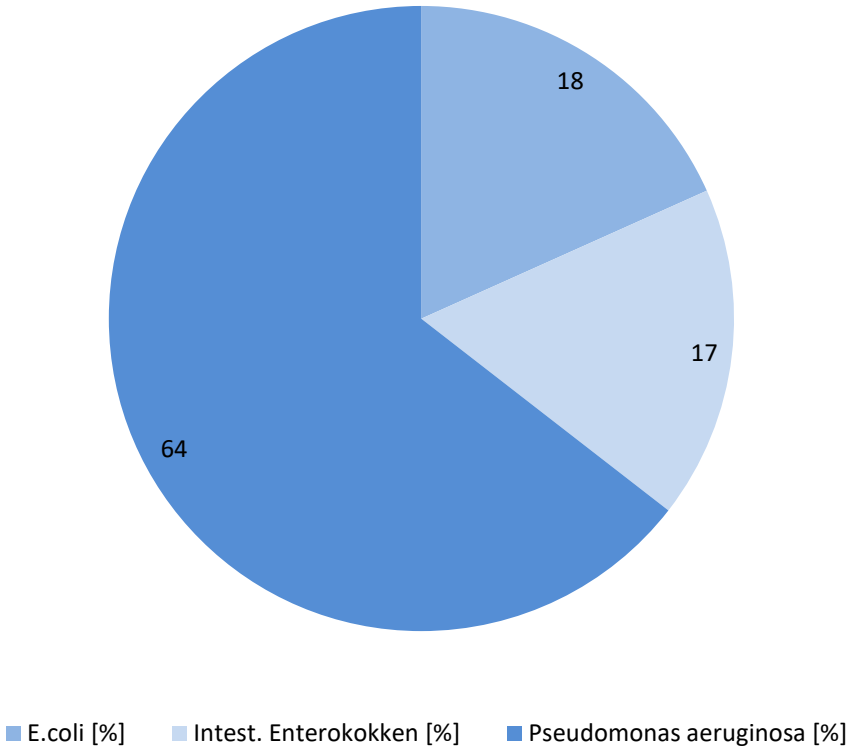

Percentage of limit exceedances for pool water and pure water values : E.coli, Intest. Enterokokken, Pseudomonas aeruginosa; Number of pools: 43; Years: 2005-2018; Source: Datenbank Naturfreibäder (DANA)

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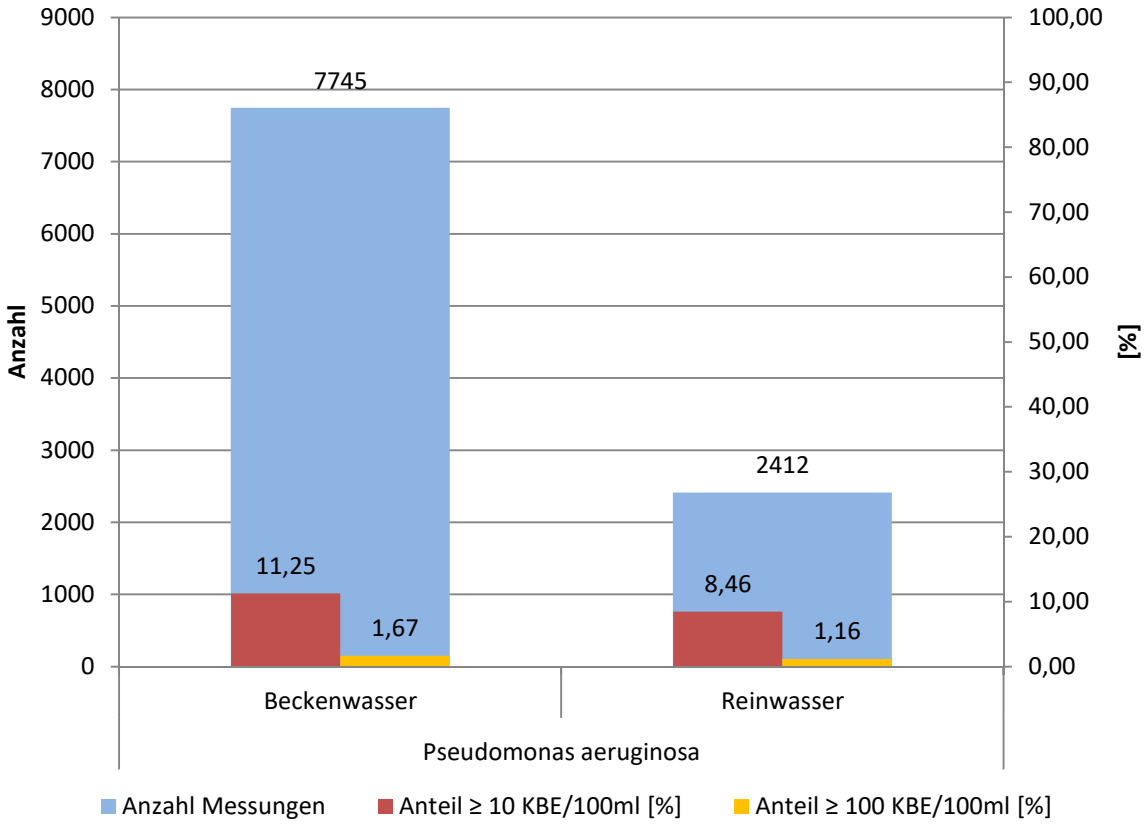

Becken- und Reinwasserwerte Pseudomonas aeruginosa (Anzahl der Messungen und prozentualer Anteil der Messwerte ≥10KBE/100ml + ≥100KBE/100ml); Anzahl Bäder: 43; Zeitraum: 2005-2018; Quelle: Datenbank Naturfreibäder (DANA)

7. CONCLUSION

>> Looking at

>The difficulties in measuring P.a.

>The difficulties in finding the causes for P.a. and accordingly to find propper measures

>The different assessments regarding the limits

…it seems reasonable to question the limit of the German Federal Environmental Agency /FLL of 10 CFU/100ml.

>> An addoption of the maximum limit proposed by the WHO (100 CFU/100ml) would eliminate 85% of the limit-overruns of P.a.. This would mean a lot less trouble for natural pool operators.

>> **Assuming that the limit values specified by the WHO are harmless, the majority of the limit value exceedances would be hygienically irrelevant.**

>> It would be necessary to examine what determines the different limits and whether an adaption to the international WHO standard is justifiable from a hygienically perspective.

>> Additionally it should be examined whether a different assessment of pool and pure water, as well as first, second and third sampling is to be made.

THANK YOU FOR YOUR ATTENTION!







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