

# Micropollutant removal on municipal WWTPs – Current situation in Baden-Württemberg, Germany

M. Sc. Lilia Acosta

05. November 2019

Aquatech Amsterdam 2019

KomS Baden-Württemberg – dreifach gut



Universität Stuttgart



# State of Baden-Württemberg in Germany



Source: www.geology.com

Source: www.ontheworldmap.com

- State of BW located in south west Germany
- State Capital: Stuttgart
- Area of 35,751 km<sup>2</sup>
- 11 million inhabitants
- Density: 310/km<sup>2</sup>
- **Wastewater treatment in BW:**
- 906 WWTPs (2019)
- Almost 60% of WWTPs discharge into a water body with a wastewater content of more than 10%.

## Water quality in Baden-Württemberg:

- Of the approx. 700 million m<sup>3</sup> of drinking water per year, approx. 75% comes from ground and spring water, approx. 25% from surface waters.
- Lake Constance is a drinking water reservoir for approx. 5 million people (approx. 172 million m<sup>3</sup> per year)
- The state water supply takes from the Danube near Ulm approx. 40 million m<sup>3</sup> drinking water for approx. 3 million inhabitants per year
- Approx. 7% of WWTPs discharge treated wastewater into Lake Constance or the process seeps into the karst (Upper Danube, Swabian Alb)



Source: [www.geo.com](http://www.geo.com)

## Initiative of Ministry of the Environment BW



Ministry of the Environment, Climate  
Protection and the Energy Sector  
Baden-Württemberg

## Two pillars:

- **Source- and user-oriented approach:**
  - Dialogue with stakeholders: Doctors and pharmacists, environmental associations, pharmaceutical industry
  - Flyer for information of the population about correct disposal of old medicines
  - Measures at Hot Spots
- For precautionary reasons: promotion of **upgrade of municipal WWTPs with targeted removal of micropollutants**
  - Sensitive water bodies (drinking water source, high wastewater proportion in receiving water)







## Micropollutants Competence Centre BW

The Micropollutants Competence Centre Baden-Württemberg is dedicated to the build-up and transfer of knowledge regarding the subject of micropollutants and their removal from wastewater. In addition, it considers itself a platform for the exchange of information and experiences regarding the process-technical implementation. KomS is a cooperation between the University of Stuttgart, Biberach University of Applied Sciences and the Baden-Württemberg chapter of the DWA and is funded by the Ministry of the Environment, Climate Protection and the Energy Sector of the federal state of Baden-Württemberg.

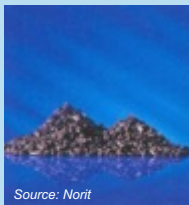
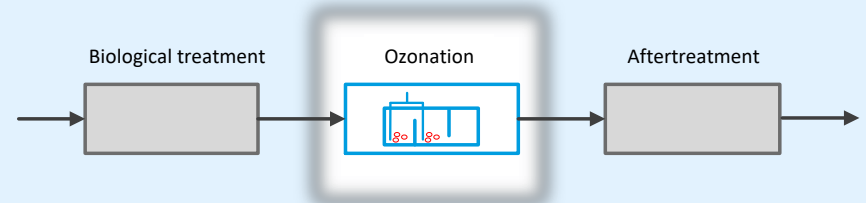
- KomS was created in 2012
- Team of 7 research engineers
- Main activities:
  - Advice and support for WWTP operators, planners and authorities
  - Implementation and monitoring of projects
  - Bundling of experience and results
- Recommendations for action (2018)
- Website: [www.koms-bw.de/en](http://www.koms-bw.de/en)

## 15 full scale plants in operation



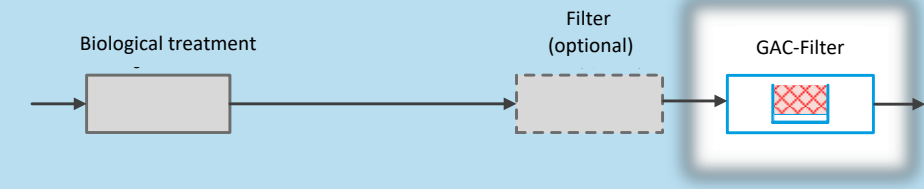
### Ozonation

→ Chemical oxidation by ozone



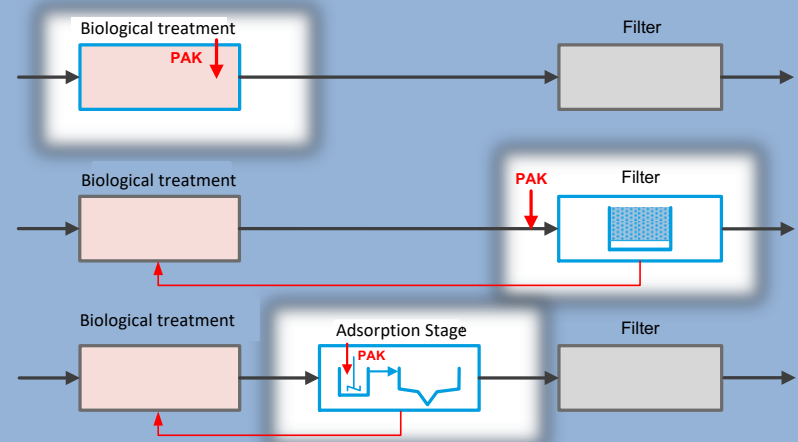
### Granular activated Carbon → Adsorption

2 x



### Powdered activated Carbon → Adsorption

13 x

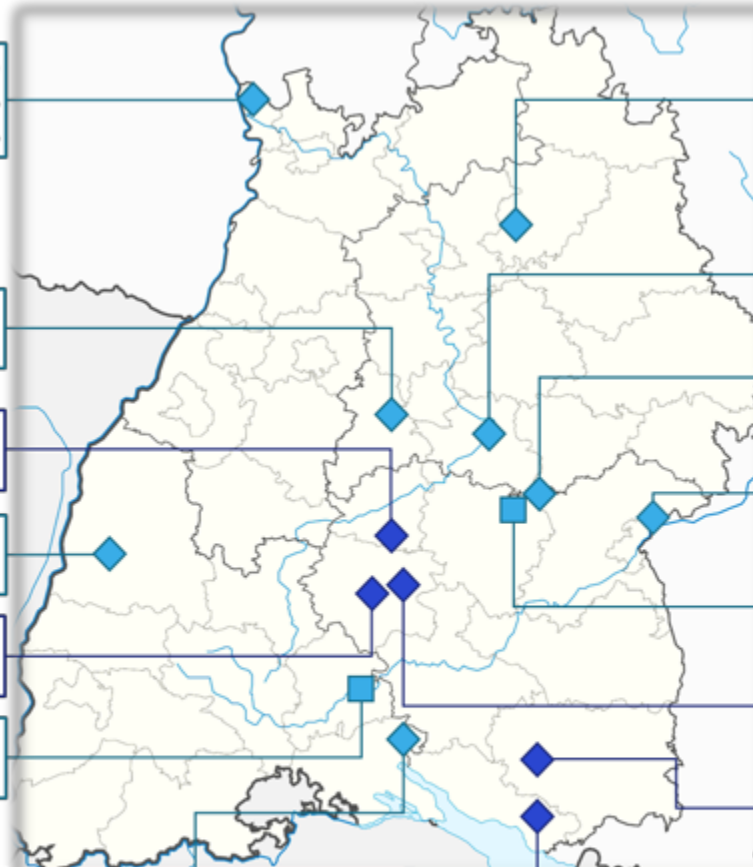


# Advanced treatment on WWTPs – Situation in Baden-Württemberg



October 2019

**15 full scale plants in operation**



**Mannheim (725.000 EW)**  
 aktuell:  $Q_{\max, ads.} = 2.000 \text{ L/s}$  | behandelte JAM > 90 %  
 zukünftig:  $Q_{\max, ads.} = 4.000 \text{ L/s}$  | behandelte JAM = 100 %

**Öhringen (49.500 EW)**  
 $Q_{\max, ads.} = 270 \text{ L/s}$  | behandelte JAM > 85 %

**Böblingen-Sindelfingen (250.000 EW)**  
 $Q_{\max, ads.} = 1.000 \text{ L/s}$  | behandelte JAM > 85 %

**Wendlingen (170.000 EW)**  
 $Q_{\max, ads.} = 700 \text{ L/s}$  | behandelte JAM > 85 %

**Hechingen (57.200 EW)**  
 $Q_{\max, ads.} = 400 \text{ L/s}$  | behandelte JAM = 100 %

**Laichingen (35.000 EW)**  
 $Q_{\max, ads.} = 100 \text{ L/s}$  | behandelte JAM > 90 %

**Lahr (100.000 EW)**  
 $Q_{\max, ads.} = 350 \text{ L/s}$  | behandelte JAM > 90 %

**Ulm „Steinhäule“ (440.000 EW)**  
 aktuell:  $Q_{\max, ads.} = 1.700 \text{ L/s}$  | behandelte JAM > 90 %  
 zukünftig:  $Q_{\max, ads.} = 2.600 \text{ L/s}$  | behandelte JAM = 100 %

**Lautlingen (36.000 EW)**  
 $Q_{\max, ads.} = 225 \text{ L/s}$  | behandelte JAM = 100 %

**Westerheim (5.500 EW)**  
 $Q_{\max, ads.} = 22 \text{ L/s}$  | behandelte JAM > 90 %

**Emmingen-Liptingen (7.500 EW)**  
 aktuell:  $Q_{\max, ads.} = 25 \text{ L/s}$  | behandelte JAM > 70 %

**Albstadt (125.000 EW)**  
 $Q_{\max, ads.} = 980 \text{ L/s}$  | behandelte JAM = 100 %

**Ravensburg „Mariatal“ (184.000 EW)**  
 $Q_{\max, ads.} = 1.100 \text{ L/s}$  | behandelte JAM = 100 %

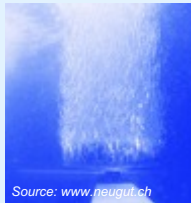
**Stockacher Aach (43.000 EW)**  
 $Q_{\max, ads.} = 250 \text{ L/s}$  | behandelte JAM > 85 %

**Kressbronn (24.000 EW)**  
 $Q_{\max, ads.} = 250 \text{ L/s}$  | behandelte JAM = 100 %

**Process**  
 □ GAC (2x)  
 ◇ PAC (13x)

# Advanced treatment on WWTPs – Situation in Baden-Württemberg

## 17 further full scale plants in planning or under construction



### Ozonation

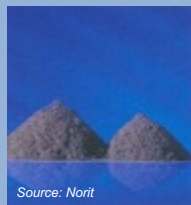
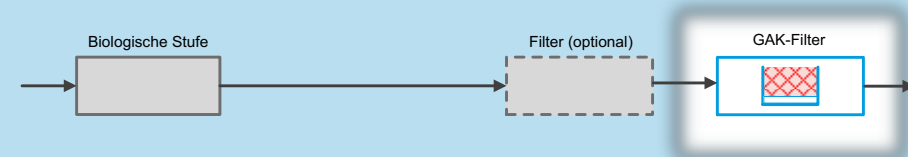
→ Chemical oxidation by ozone

4 x



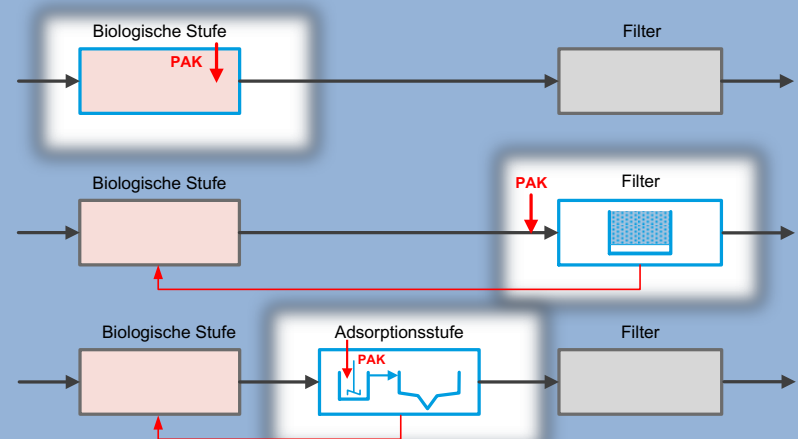
### Granular activated Carbon → Adsorption

5 x



### Powdered activated Carbon → Adsorption

8 x





## Framework for the implementation of procedures for micropollutant removal

### Arbeitspapier

Spurenstoffelimination auf kommunalen Kläranlagen in Baden-Württemberg

20. Nov. 2018



- Working paper „Micropollutant removal in WWTPs“ of Ministry of Environment BW
- Specifies technical criteria for prioritisation of WWTPs with upgrade
- Defines requirements for removal efficiency of targeted treatment



Guideline for the procedure of the investigations to be carried out



## Criteria for upgrade of WWTPs with targeted micropollutant removal:

- Discharge into Lake Constance or Lake Constance catchment area incl. Upper Danube in front of the infiltration point
- Discharge into groundwater
- Discharge into a body of water which seeps away temporarily or all year round in unfavorable subsoil conditions (e.g. karst)
- WWTPs with a capacity of 500,000 p.e. or more
- WWTP effluent flow in receiving water greater than half (50%) of the total river flow
- WWTPs with capacity of < 10,000 p.e. are excluded for reasons of efficiency
- **approx. 125 WWTPs fall under these clear criteria**

Source: Ministry of Environment BW, 2019

>> NEW recommendations on March 2018 (PDF online: [www.koms-bw.de](http://www.koms-bw.de))



## KomS – Recommended course of action for comparative checks and operational monitoring of the advanced treatment

### BERECHNUNG DER ELIMINATIONSLEISTUNG

Für die gezielte Spurenstoffelimination auf Kläranlagen in Baden-Württemberg gilt<sup>5</sup>:

Eine ausreichende Spurenstoffelimination liegt vor, wenn das gleitende Mittel, gebildet aus den Spurenstoffeliminationsraten der letzten 6 Messkampagnen an Tagen mit Abflüssen zur Kläranlage bis zu maximal  $Q_{\text{Spur, max}}$  mindestens 80 % beträgt.

Der Spurenstoffeliminationsumfang einer jeden Messkampagne errechnet sich als Mittelwert aus den Eliminationsraten der folgenden Einzelsubstanzen:

! Carbamazepin, Diclofenac, Hydrochlorothiazid, Irbesartan, Metoprolol, Benzotriazol,  $\Sigma$  4- und 5 Methylbenzotriazol

Bei der Berechnung des Mittelwertes ist folgendes zu beachten:

! Die Berechnung des Mittelwertes ist für die Substanz zu berücksichtigen, die die Eliminationsleistung mindestens 5-mal so groß ist wie die Bestimmungsgrenze für die Ablaufkonzentration der Substanz (vgl. Tabelle 6).  
! Die Berechnung des Mittelwertes ist für die Substanz zu berücksichtigen, die eliminiert werden kann, ist mit der Bestimmungsgrenze abzusummen, inwieweit die geforderte höhere Eliminationsleistung ein anderer Umfang als 80 % festzulegen ist.

Für die Berechnung der Eliminationsrate einer Substanz sind die gemessenen Konzentrationen im Zu- und Ablauf der Kläranlage heranzuziehen. Bei der Berechnung ist folgendes zu beachten:

! Bei Unterschreitung der Bestimmungsgrenze (BG) im Ablauf ist für die Berechnung des Eliminationsumfangs dieser Substanz die halbe BG anzusetzen.  
! Sollte sich für eine Substanz eine negative Eliminationsrate ergeben, so ist der Eliminationsumfang für diese Substanz bei der Berechnung des Mittelwertes mit 0 % anzusetzen.

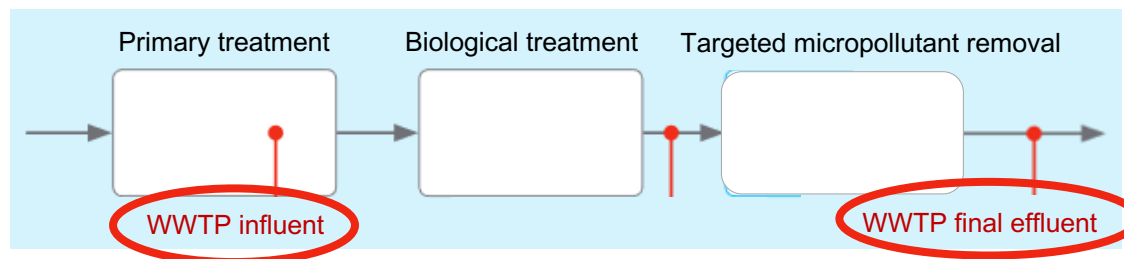
Im Anhang ist beispielhaft die Berechnung des Spurenstoffeliminationsumfangs einer Messkampagne sowie die Ermittlung der Spurenstoffeliminationsleistung über das gleitende Mittel dargelegt.

is available in German and will have to be translated independently if required.

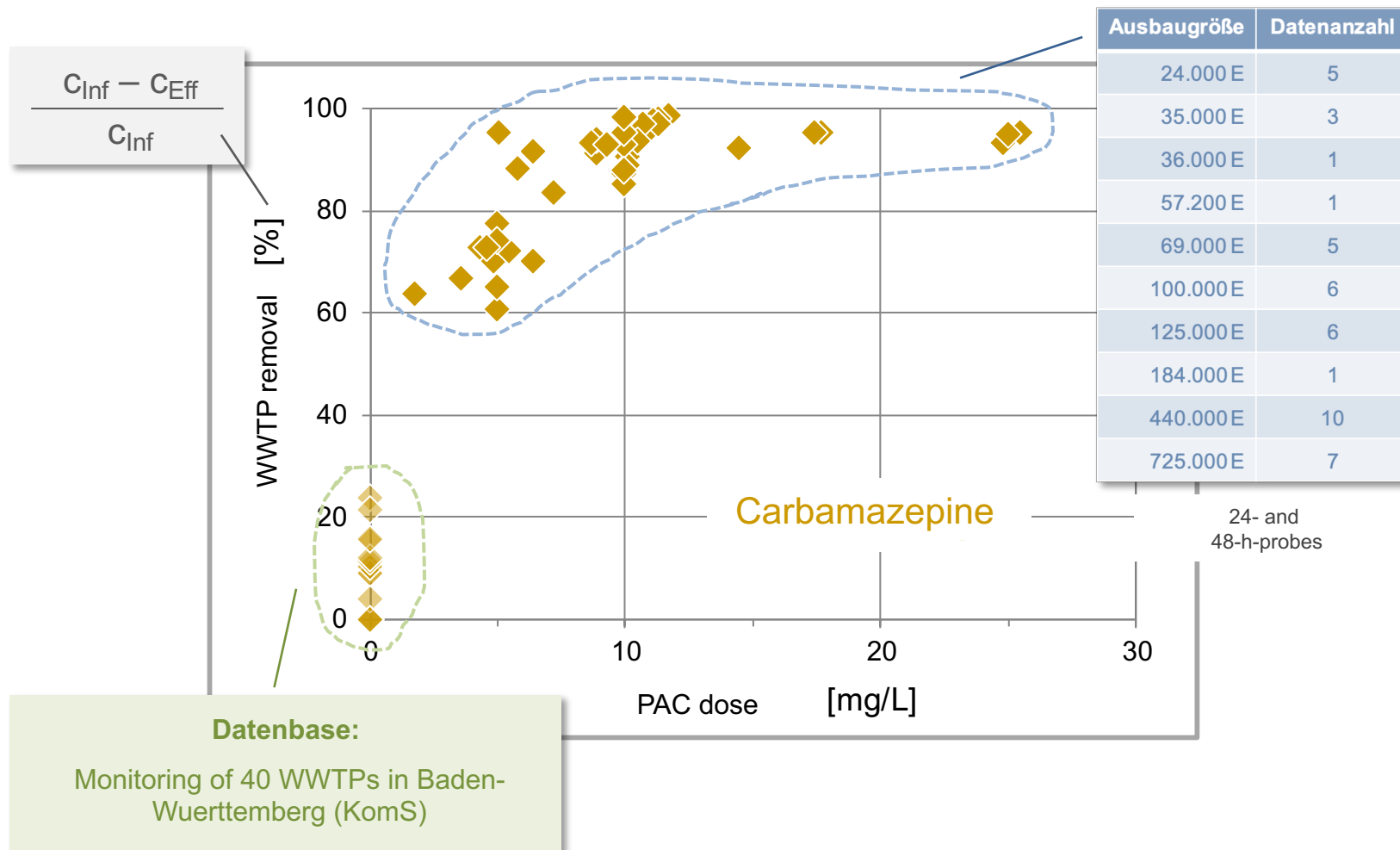
## Required micropollutant removal in WWTPs in BW:

- Normal and continuous operation of advanced treatment plant
- **Sufficient micropollutant removal if the sliding agent, formed from removal rates of last 6 measurement campaigns on days with discharges to the WWTP up to a maximum of  $Q_{\text{WWTP-MP,max}}$  is at least 80%.**
- Micropollutant removal efficiency of each measurement campaign is calculated as the mean value from the elimination rates of the following 7 substances:

**Carbamazepine, Diclofenac, Hydrochlorothiazide, Irbesartan, Metoprolol, Benzotriazole,  $\Sigma$  4- und 5-Methylbenzotriazole**

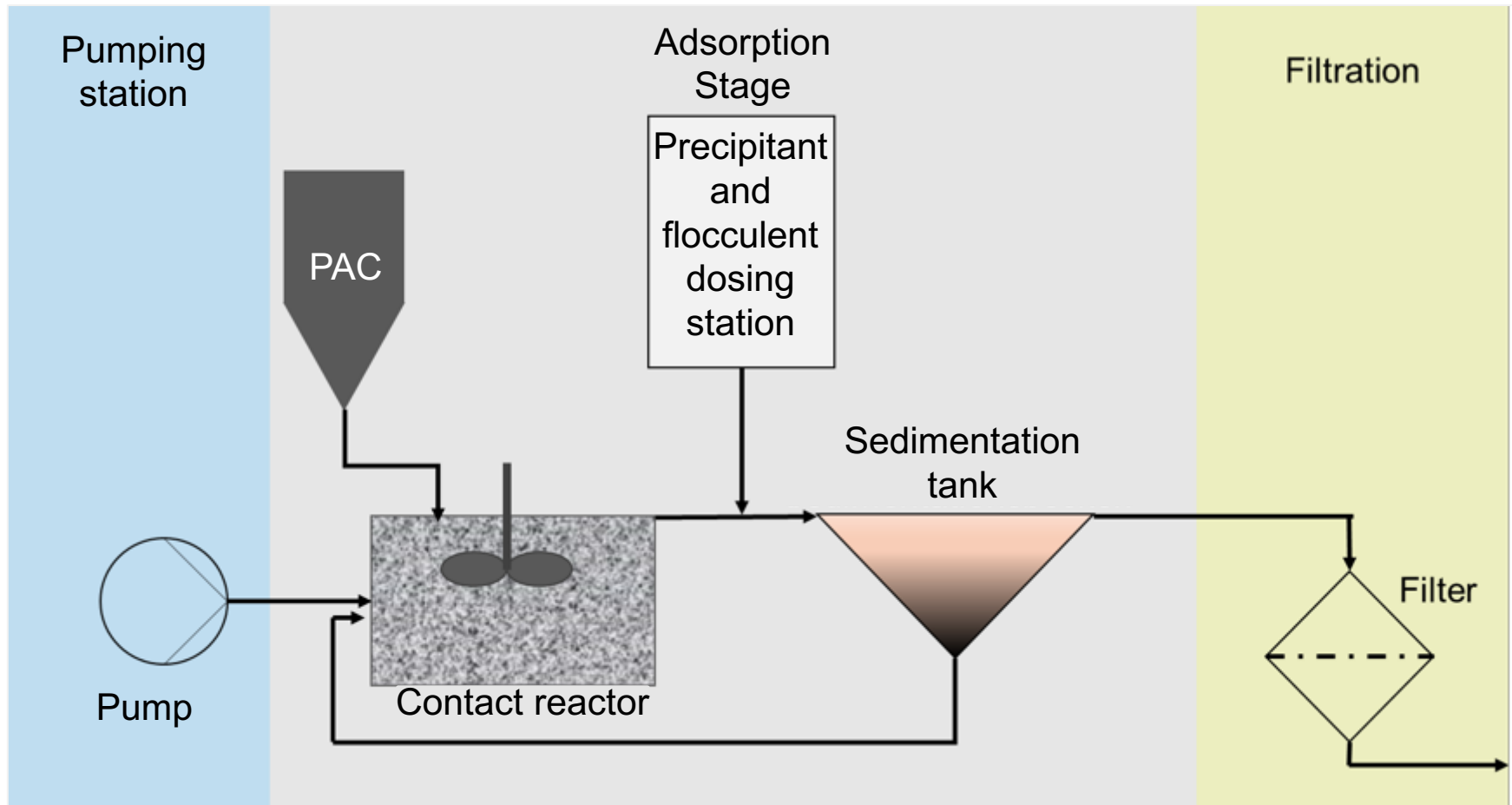


## >> Results from different WWTPs in BW





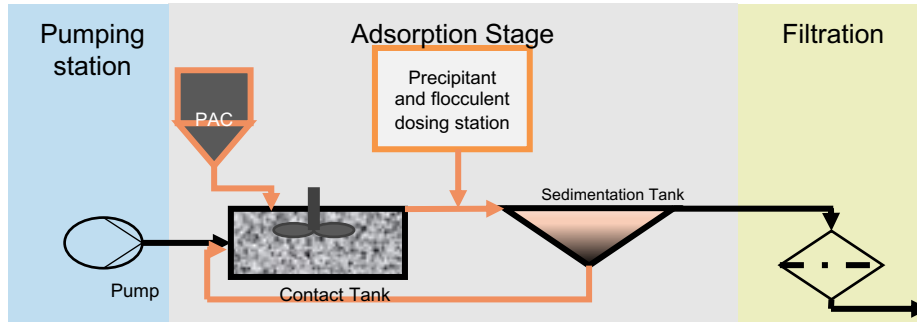
## Plant components for the treatment with PAC



Source: KomS-Langzeitbetrachtung zu Kosten der Pulveraktivkohlebehandlung

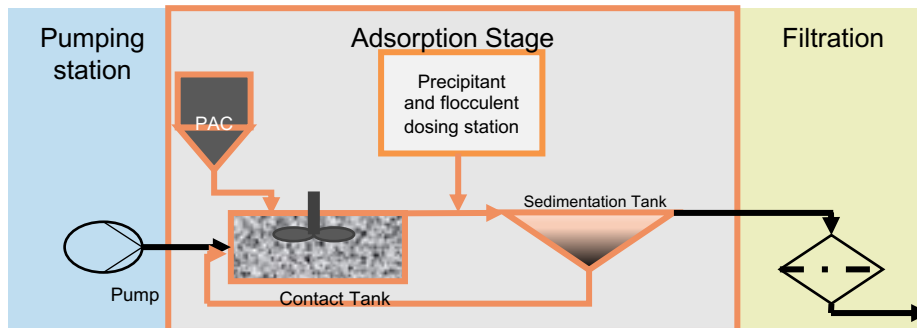
# Long-term cost review of PAC treatment

## New investment

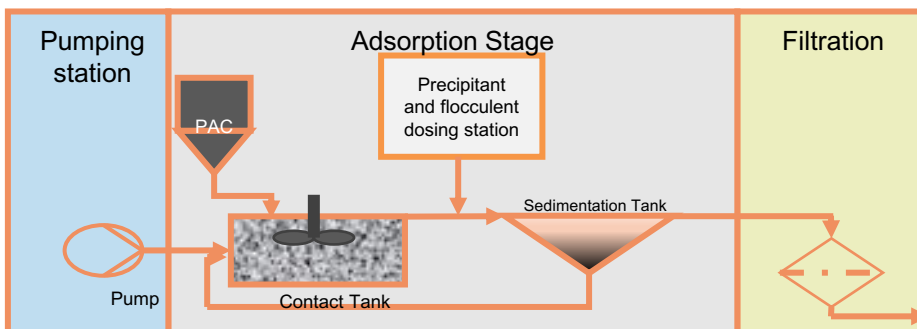


— New investment

Adsorption stage plant (without tanks):  
Mannheim



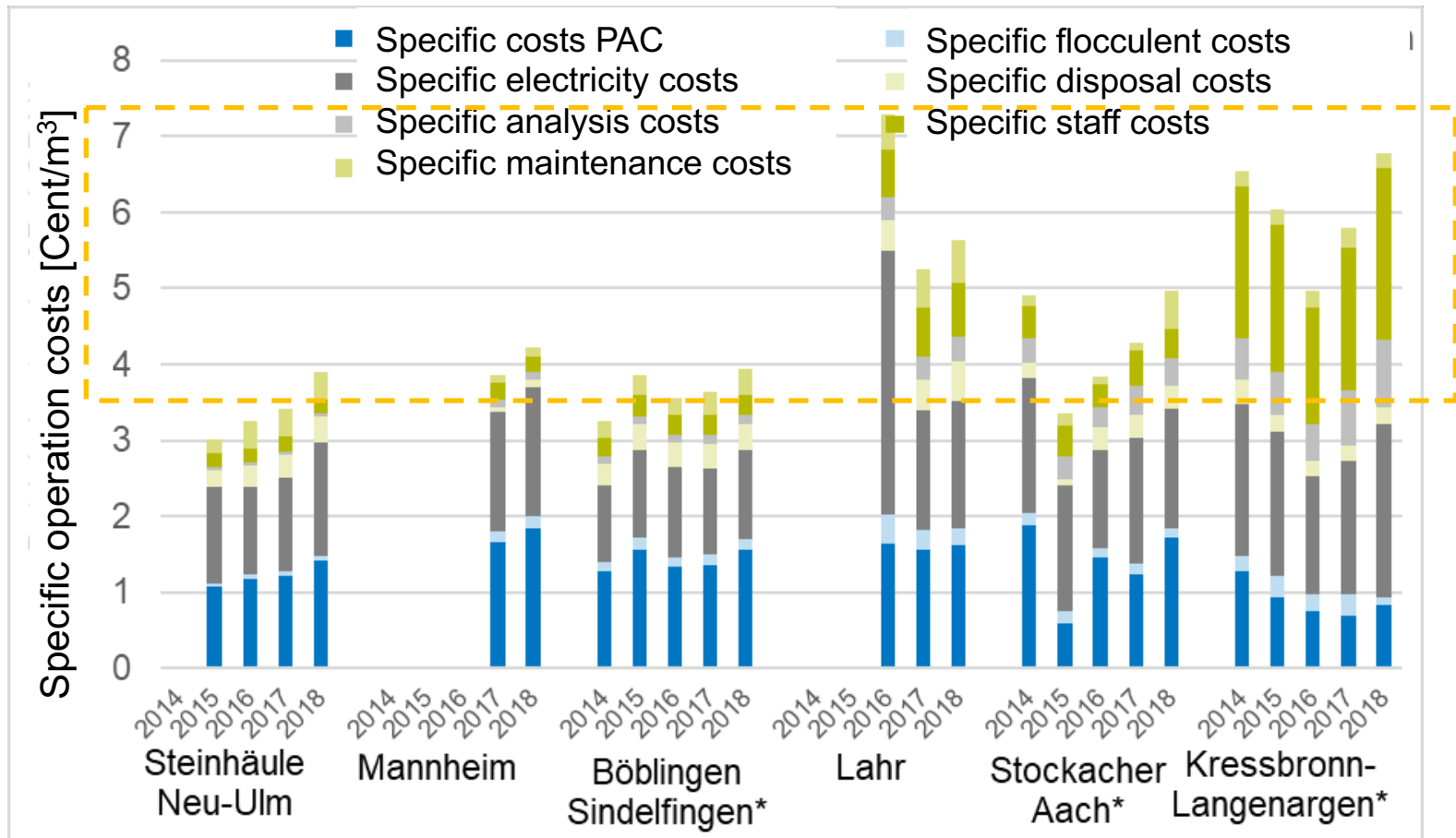
Complete Adsorption stage:  
Böblingen-Sindelfingen,  
Kressbronn-Langenargen,  
Stockacher Aach



Complete PAC treatment:  
Lahr,  
Steinhäule Neu-Ulm

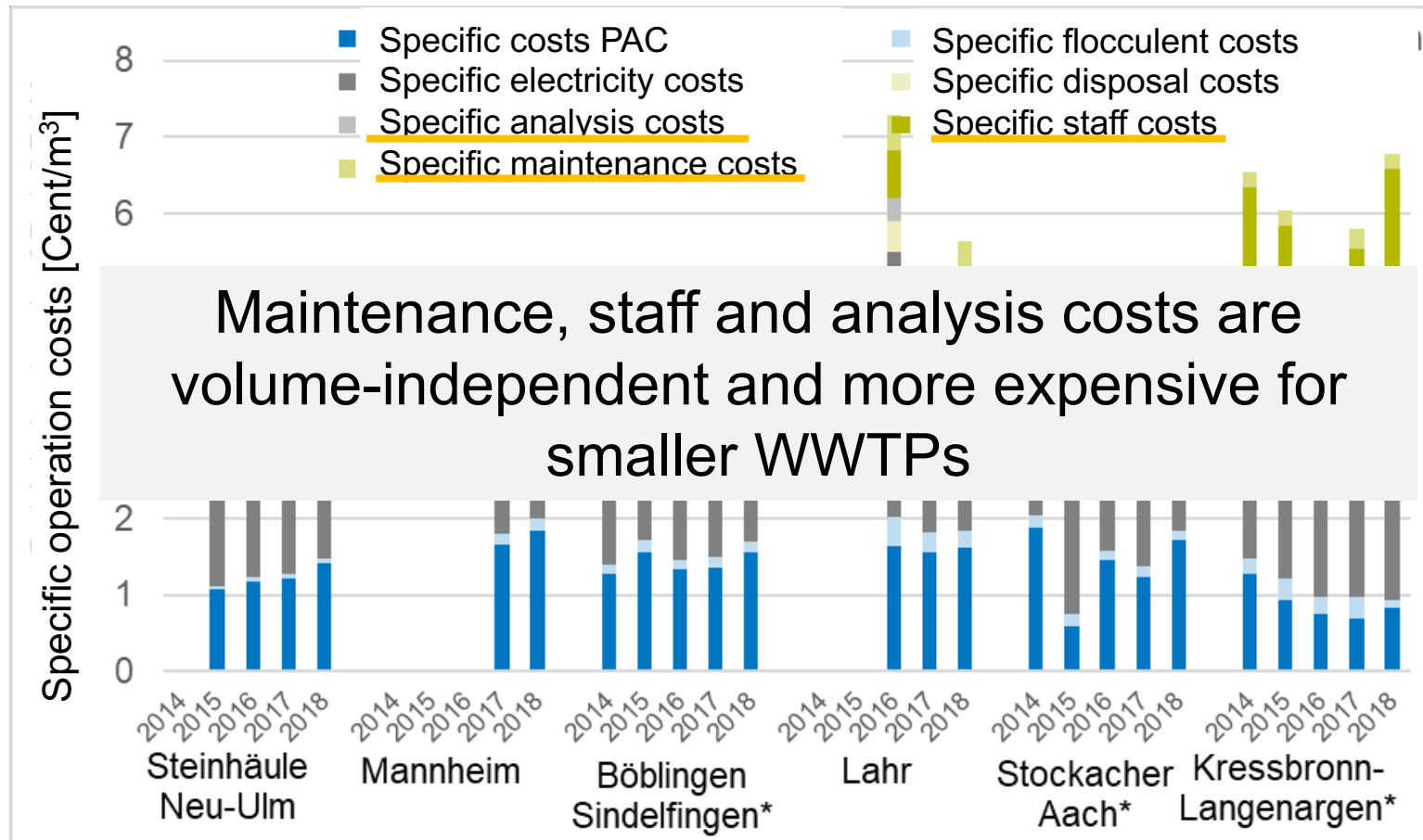
# Long-term cost review of PAC treatment

## Specific operating costs , 2014-2018



\* Use of statistical averages for operating cost types without information

## Specific operating costs , 2014-2018



\* Use of statistical averages for operating cost types without information

# THANK YOU FOR YOUR ATTENTION

M. Sc. Lilia Acosta  
lilia.acosta@koms-bw.de  
Phone: +49 711 685-65531

[www.koms-bw.de/en](http://www.koms-bw.de/en)

KomS Baden-Württemberg – dreifach gut



Universität Stuttgart

