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***Leachate Collection and Treatment***

***Seventh interregional exchange of  
experience meeting of COCOON***

# *Part B*

# *Leachate Storage and Treatment*

## **Content**

- 1. *Design principles***
- 2. *Leachate storage***
- 3. *Leachate treatment***

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# *1. Design principles*

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## Basic data for dimensioning of a leachate treatment plant:

- **Meteorological data (→ leachate quantity)**
- **Leachate quantity**
- **Variation of leachate quantity (→ capacity of leachate storage pond)**
- **Concentration of relevant parameters (e.g. BOD<sub>5</sub>, COD, NH<sub>3</sub>-N, NH<sub>4</sub>-N, total N, Conductivity, AOX)**
- **Requirements on treated water (effluent limits)**

## Leachate quantity depends on:

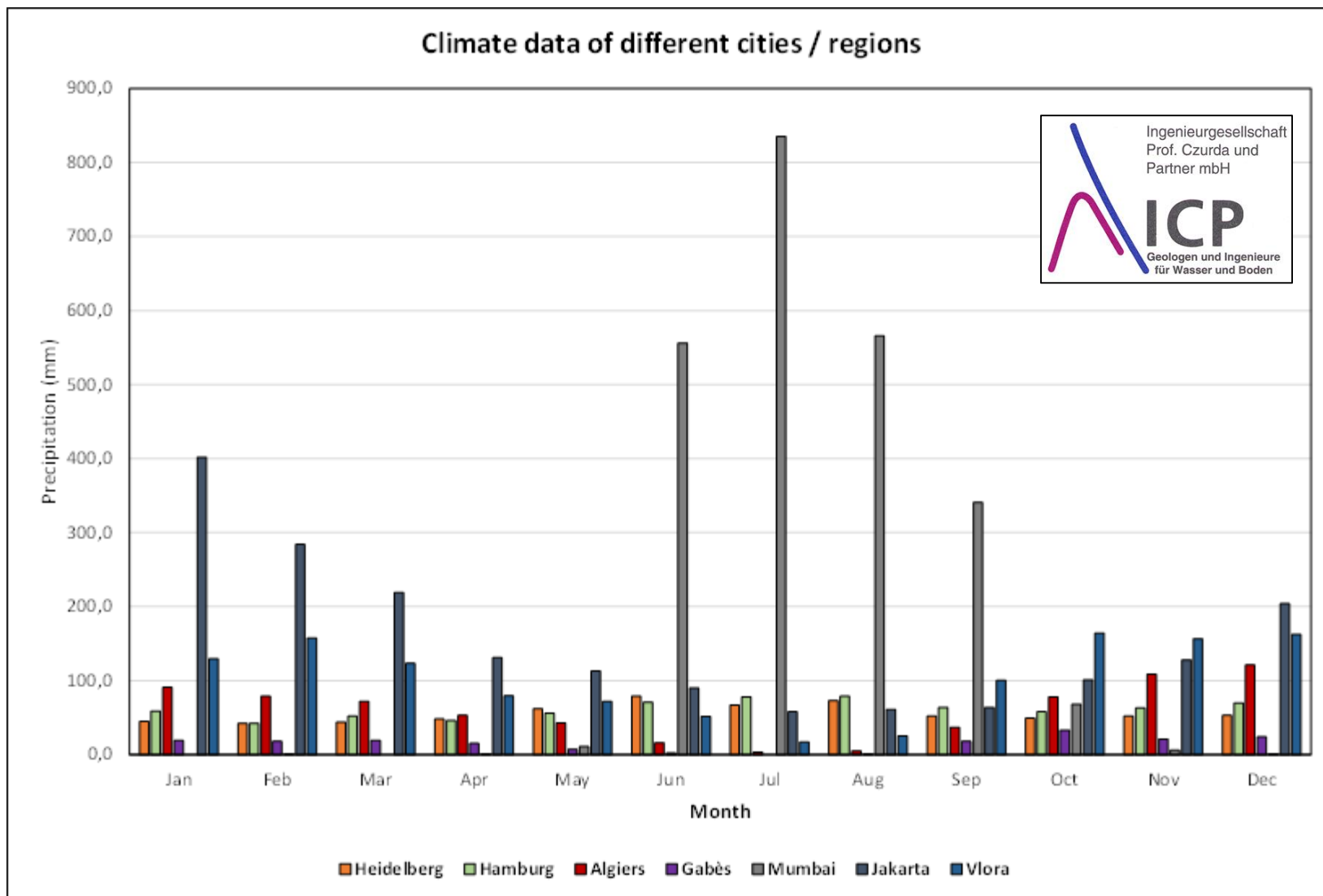
- **Precipitation**
- **Waste types to be disposed of (are sludges or other wastes containing a lot of water to be disposed of?)**
- **Composition of waste (waste with a high organic content is generating a lot of water by consolidation and anaerobic biological decomposition)**
- **Waste water input by other sources like waste treatment facilities**
- **Water input by fire fighting etc.**
- **The area(s) and the state of the landfill cells**

## Precipitation – some examples

Month	Total	Average	Minimum	Maximum	Standard deviation
	mm/a	mm/month	mm/month	mm/month	mm/month
Heidelberg, Germany	666,0	55,5	42,0	79,0	12,01
Hamburg, Germany	738,0	61,5	42,0	79,0	11,71
Vlora, Albania	1.239,2	103,3	17,3	164,3	53,81
Algiers, Algeria	707,0	58,9	3,0	121,0	39,28
Bizerte, Tunisia	527,0	43,9	3,0	101,0	30,56
Gabès; Tunisia	177,0	14,8	0,0	33,0	10,20
Mumbai, India	2.386,0	198,8	0,0	835,0	297,47
Jakarta, Indonesia	1.855,0	154,6	58,0	402,0	104,83

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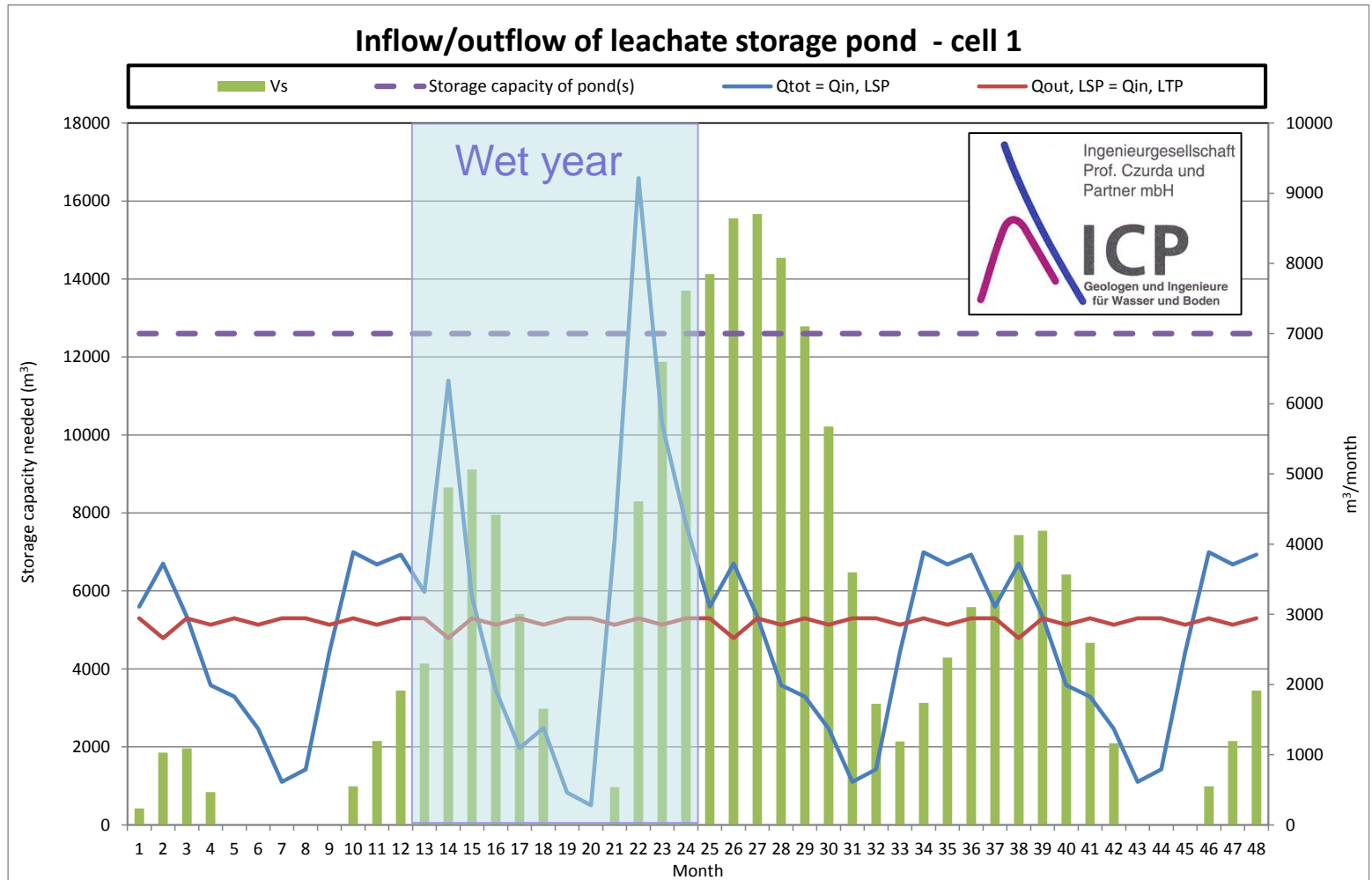
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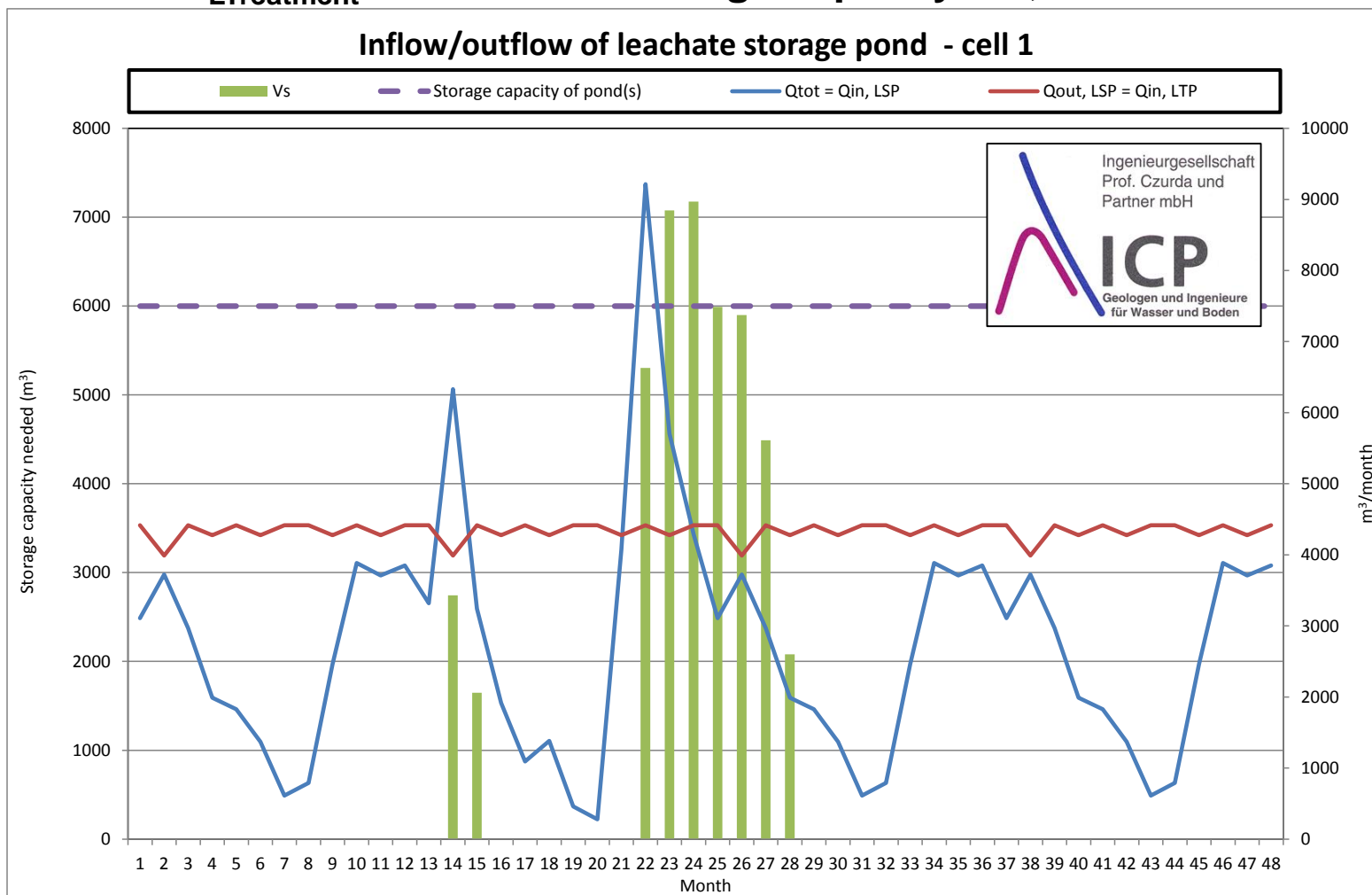
## Dimensioning of a leachate treatment plant – case 1:

$$Q_{LTreatment} = 100 \text{ m}^3/\text{d} / \text{Storage capacity} = 12,600 \text{ m}^3$$



## Dimensioning of a leachate treatment plant – case 2:

$$Q_{LTreatment} = 150 \text{ m}^3/\text{d} / \text{Storage capacity} = 6,000 \text{ m}^3$$



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## Leachate quality depends on:

Like the leachate quantity, the leachate composition strongly depends on the type and composition of the waste disposed of. Another factor is the quantity of precipitation on the landfill, possibly leading to a certain diluting effect.

In addition, leachate changes according to the age of the waste disposed of. Whereas leachate with high but easily degradable organic substances (BOD/COD = 0.5 – 0.8) is produced in younger landfill parts, the organic load decreases in older landfills: Older landfills are mostly having a lower degradability of the substances (BOD/COD  $\leq$  0.1) and higher ammonium concentrations.

As mentioned before, in regions with high organic waste content, relevant leachate quantities may be produced also in months without precipitation. The leachate produced (= press water) has high organic concentrations (COD approx. 20,000 to > 40,000 mg O<sub>2</sub>/l) and high salt content, especially in young landfills or, respectively, landfill parts.

## Leachate quality

Region	COD [mg/l]	NH4-N [mg/l]
Northern Europe	< 5,000	< 1,200
Southern Europe	< 15,000	< 2,000
Turkey	< 20,000	< 2,500
Northern Africa	< 70,000	< 2,500
Southern East Asia	< 25,000	< 3,000

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## Requirements on effluent limits (examples)

Region	COD Discharge		NH <sub>4</sub> -N Discharge	
	indirect	direct	indirect	direct
	[mg/l]	[mg/l]		[mg/l]
Germany (northern Europe)	400	200	Reduction > 95 %	10
Spain (southern Europe)	1,500	160		10
Turkey	-	500		15
China (Asia)	1,000	100		10

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# ***2. Leachate storage***

## Leachate storage:

- A leachate storage pond, basin or tank must be absolutely water tight because leachate is stored with a certain water head. This means the lining system of a leachate pond has to be minimum as good or better than the lining system of the landfill → double liner, composite liner or a liner with leak detection system!
- A leachate storage pond or basin has to be dimensioned matching actual site conditions
- It is better to design two leachate ponds or basins. In this case there is an option to clean or repair one of the ponds / basins during dry season
- A leachate pond should be fenced in

## Dimensioning of a leachate storage pond (for meteorological conditions of Middle Europe):

- The volume of the pond should be as big as 20 times of the average daily leachate quantity  
Volume of pond = 20 x average  $Q_{LA}$  m<sup>3</sup>/d  
or
- The volume of the pond should be as big as 5 times of the maximum daily leachate quantity  
Volume of pond = 5 x maximum  $Q_{LM}$  m<sup>3</sup>/d

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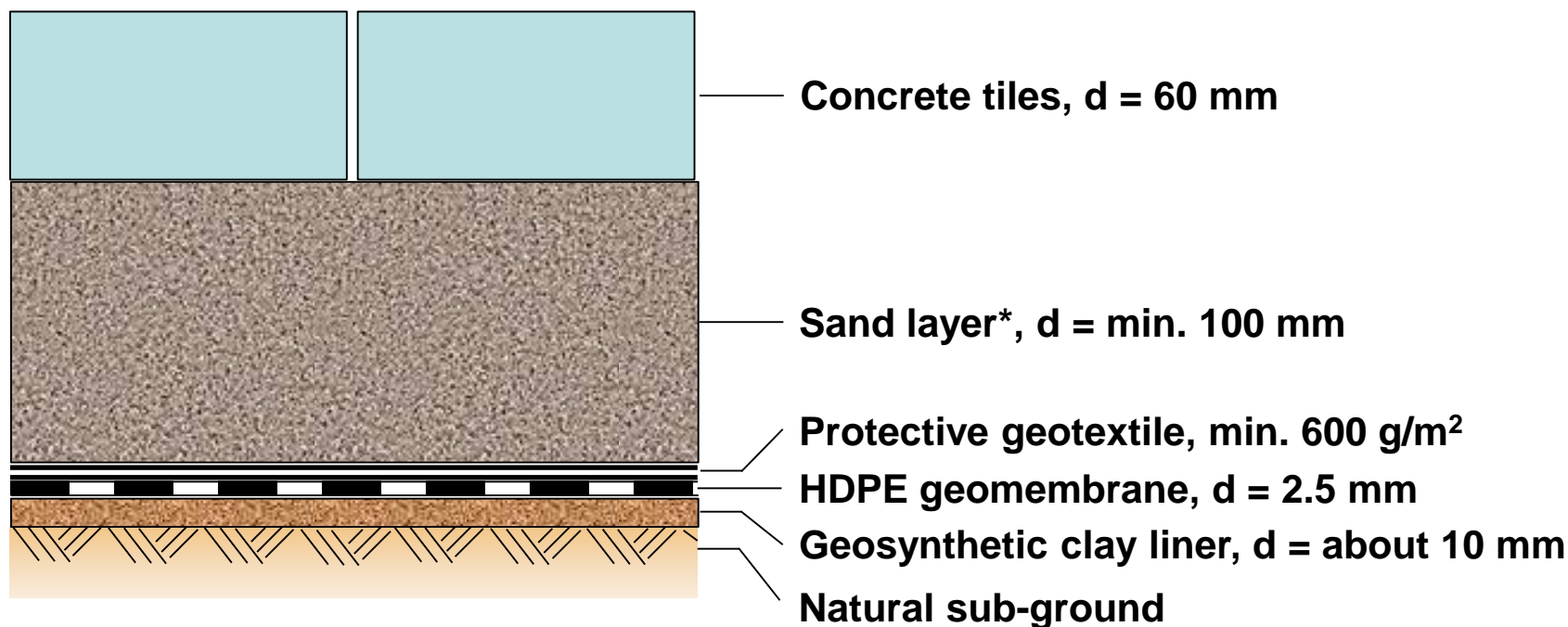
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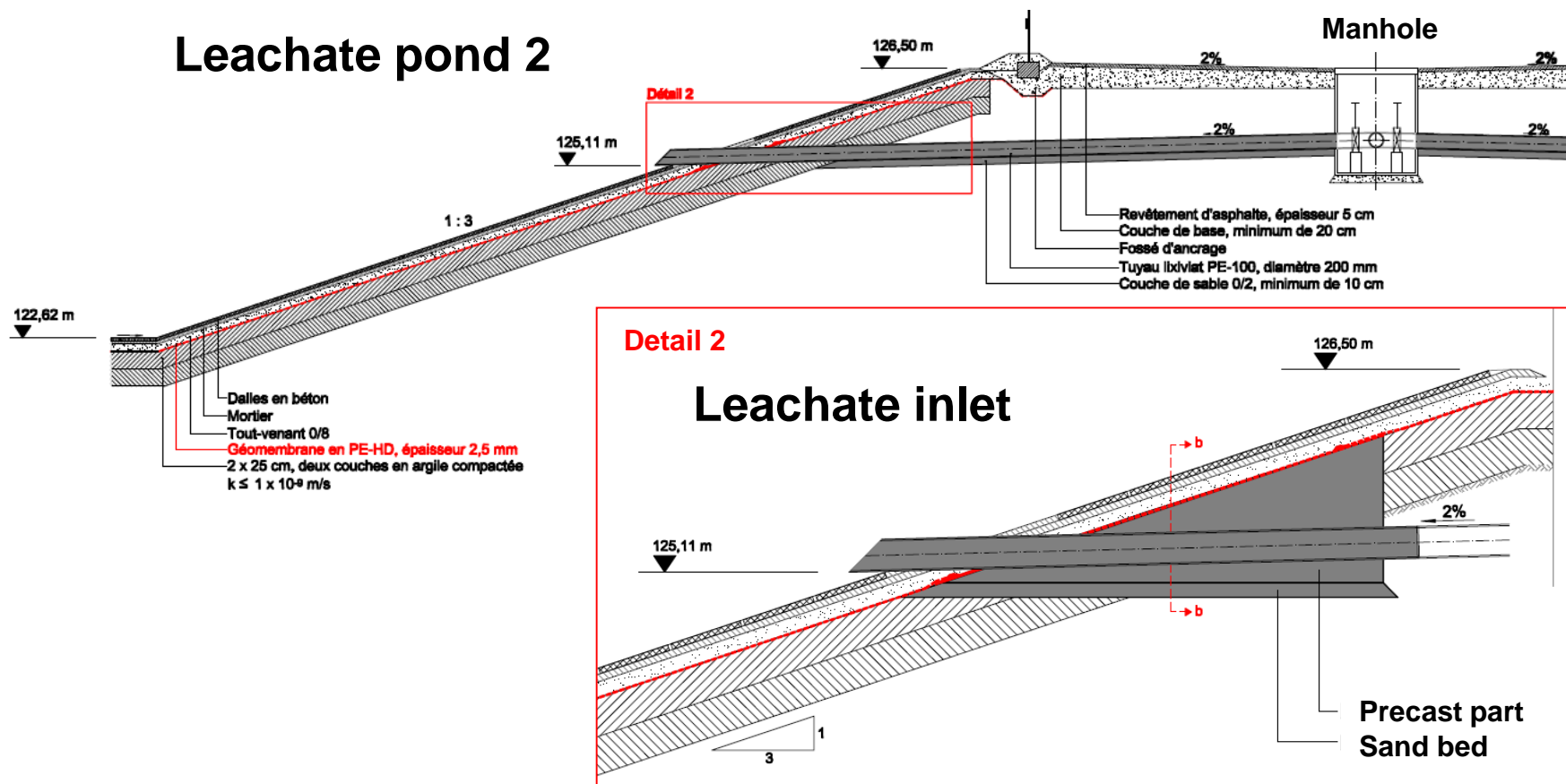
## Simple example for the lining system of a leachate storage pond:



**\*Sand layer up to a slope of 1 : 4, for steeper slopes use a mortar bed for concrete tiles**

## Example for the lining system of a leachate storage pond (at landfill Kabouti, Tunisia):

Leachate pond 2



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## Example: leachate storage pond of landfill Deir el Balah



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# ***3. Leachate treatment***

## Leachate Treatment Options:

- **Evaporation (only in arid and semi-arid regions, not in Europe)**
- **Recirculation or sprinkling (only in arid and semi-arid regions, if permitted)**
- **Constructed wetlands**
- **Anaerobic biological treatment**
- **Aerobic biological treatment**
- **Chemical and/or physical treatment (O<sub>3</sub>, UV-treatment, adsorption, flocculation + chemical precipitation etc.)**
- **Filtration (e.g. ultra filtration, reverse osmosis)**
- **Thermal treatment (concentration)**

## In Germany often used treatment options:

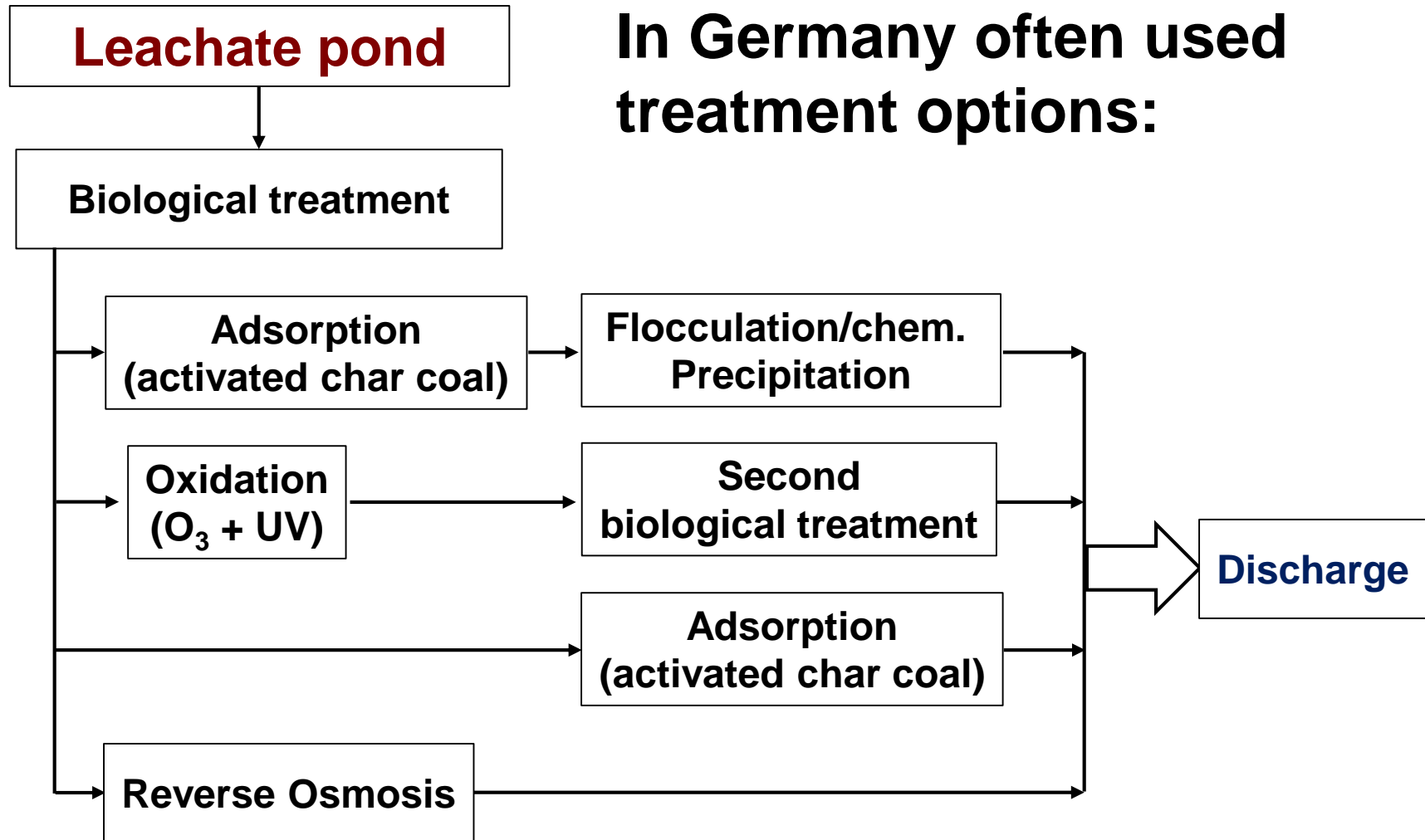
- **Biological treatment + ultra filtration**
- **Biological treatment + UV and active oxygen (Ozone /O<sub>3</sub>) treatment + adsorption**
- **Biological treatment + adsorption**
- **Biological treatment + reverse osmosis**
- **Reverse osmosis**

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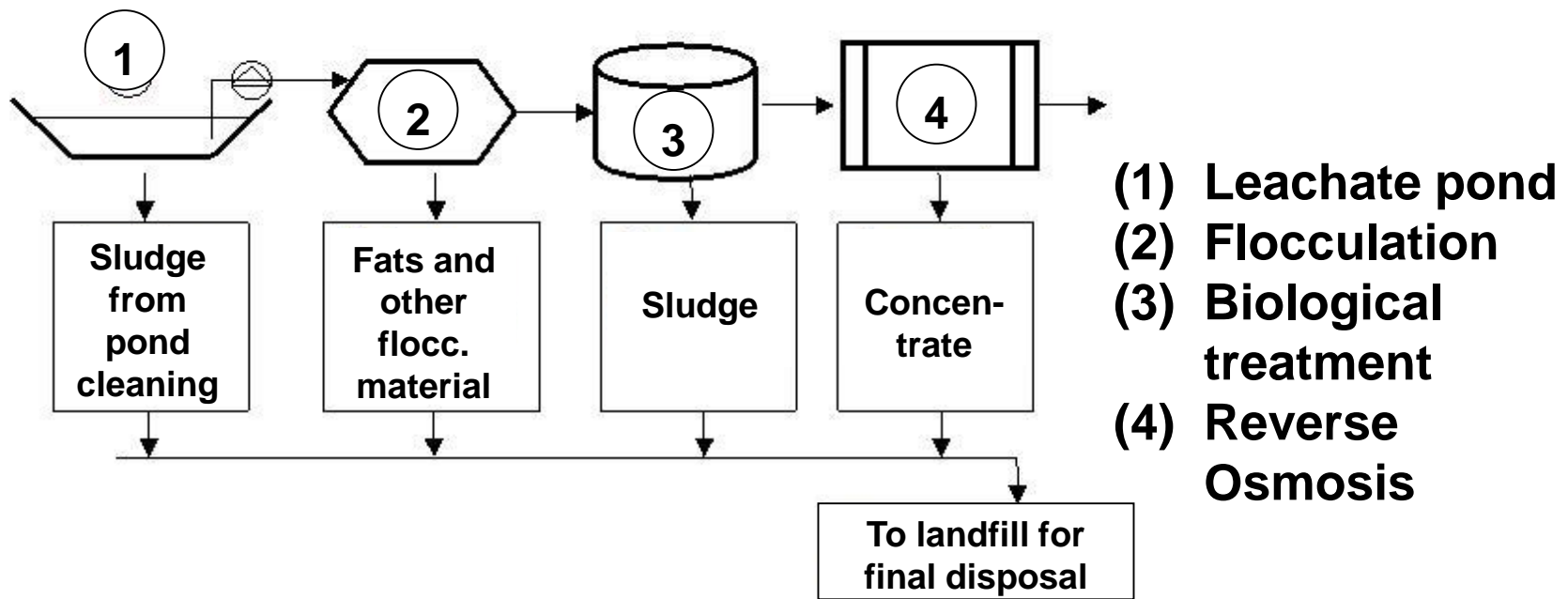
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In Germany often used  
treatment options:



Source: Krümpelbeck & Ehrig 2001

## Leachate treatment processes in Tunisia



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## Leachate treatment processes in Tunisia

### Lessons learned:

**The recirculation of concentrate of the RO is leading to increasing concentrations of the pollutants. In some of the treatment facilities a treatment is no longer possible because of high concentrations (of salt and organic pollutants)**

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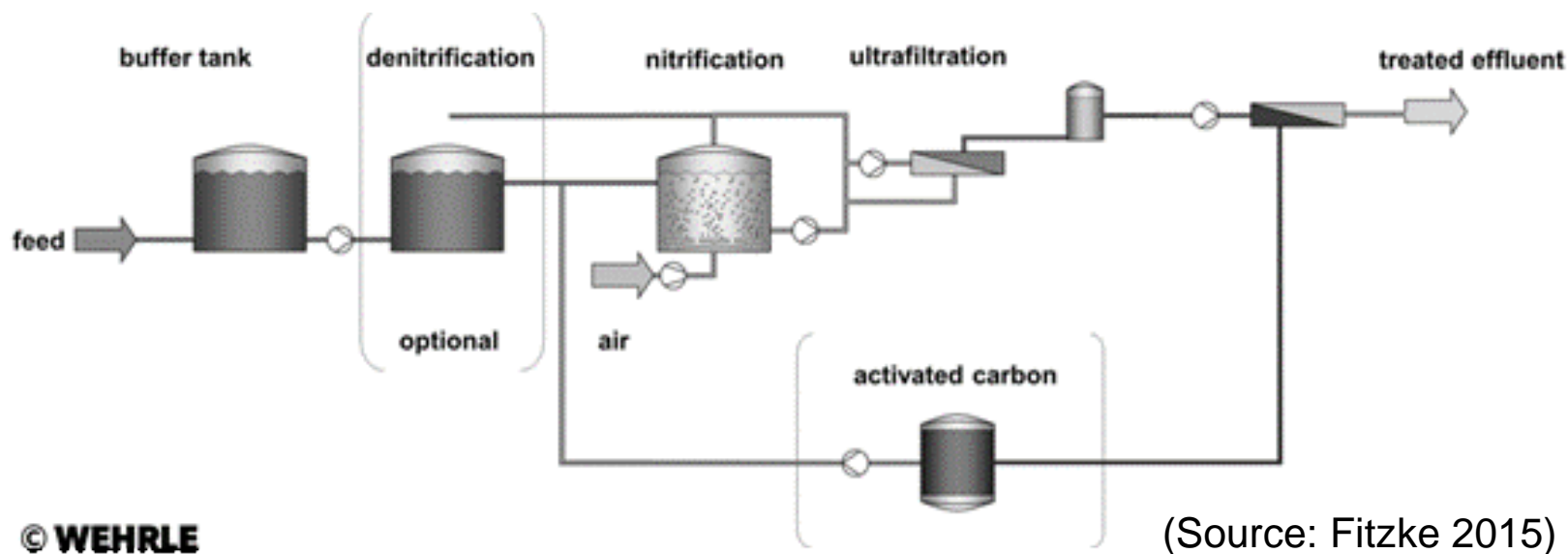
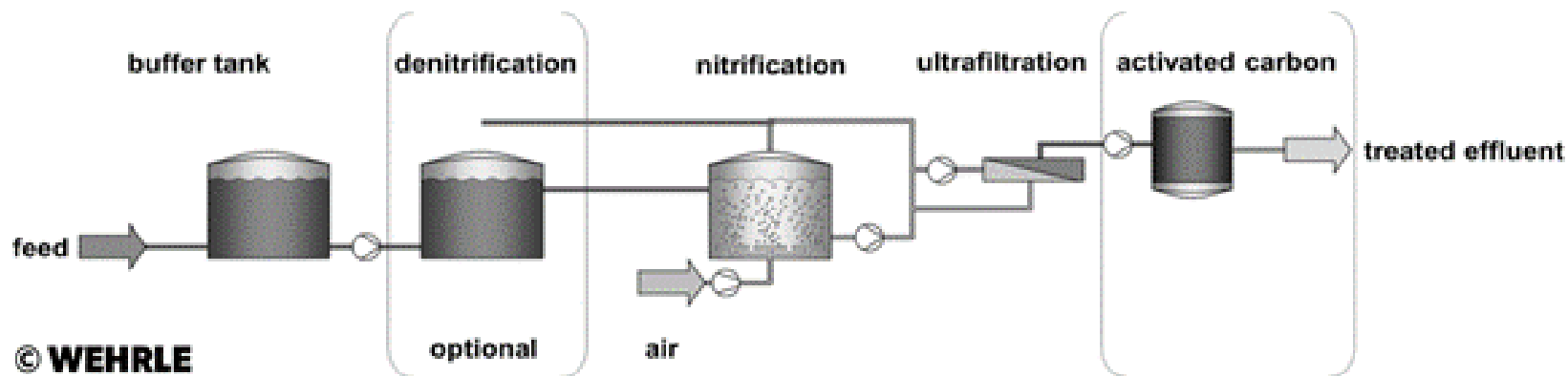
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## General recommendations on leachate treatment

	Low requirements	Medium requirements	High requirements
<b>Pollution</b>	COD < 500 mg/l Indirect discharge	COD < 200 mg/l Direct discharge	COD < 200 mg/l Direct discharge + salt reduction
<b>Small loads</b> COD < 1,500 mg/l NH <sub>4</sub> -N < 500 mg/l	SBR (+ sand filter + AC)	MBR + AC	Reverse Osmosis (RO)
<b>Medium loads</b> COD < 5,000 mg/l NH <sub>4</sub> -N < 1,500 mg/l	MBR + AC	MBR + NF/AC	
<b>High loads</b> COD > 5,000 mg/l NH <sub>4</sub> -N > 1,500 mg/l			MBR + RO

## General recommendations on leachate treatment



(Source: Fitzke 2015)

*Thank you very much  
for your attention*



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