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Treatment of soil contaminated by PFAS: feedback from two large-scale remediation projects

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ZÜBLIN
WORK ON PROGRESS

Our PFAS treatment plants for water and soil

- Efficient and economical
- Over 50 plants since 2009



Former refinery – hydraulic barrier, 200 m³/h



Airport – Soil washing, 2.000 t/day

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- 4 Recirculating water & sludge treatment
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Chapter 1

Project data



Project data



Southern Germany

- Private client
- General contractor contract
- Excavation, air sparging, hydraulic barrier, soil washing, land levelling



- Construction time 5 months
- Trial operation 4 months
- Washing operation 3 years



Northern Germany

- Public contracting authority
- Delivery contract
- Soil washing



- Construction time 3 months
- Trial operation 2 months
- Washing operation 4 years (planned)

Project data



Southern Germany

Predominantly gravel

- 430,000 t of soil
 - 70.000 t PFAS
 - 360.000 t HC, BTEX

INPUT

- PFAS < 20 µg/l (10:1 eluate)

OUTPUT

- PFAS < 0,3 µg/l (10:1 eluate)

COST

- 50 €/T



Northern Germany

Predominantly fine sand

- Approx. 800,000 t of soil
 - PFAS only
 - (HC and PAHs subordinate)

INPUT

- PFAS < 150 µg/l (2:1 eluate)

OUTPUT

- PFAS < 1,0 µg/l (2:1 eluate)
< 0,1 µg/l (2:1 eluate)

COST

- Approx. 60 €/T

Chapter 2

Treatment unit Southern Germany



Feeding station



Receiving hall



Throughput up to 180 t/h

- Separation > 100 mm
- Magnetic separator

Wet classification & multistage spray system

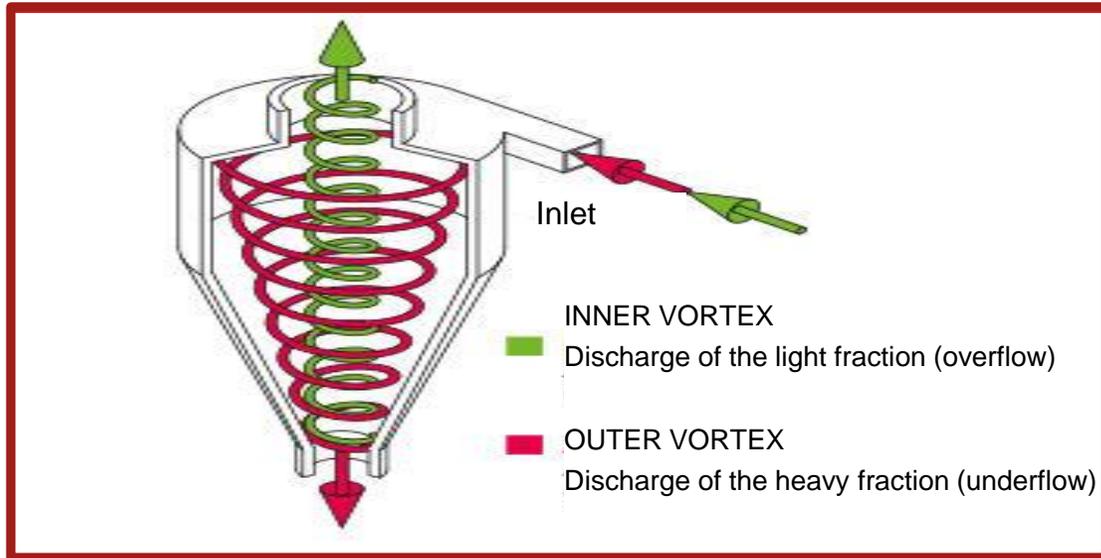


**Classification
with sprinkling of fresh water in several stages**



Fine sand: 0/0.5 mm
Sand: 0.5/4 mm
Fine gravel: 4/16 mm
Coarse gravel: 16/45 mm

Separation and dewatering of sand



Hydrocyclone

Separation of fine sand from muddy water



Drainage screens

Conditioning the evacuation of materials

Utilisation of the OUTPUT material



Grain fraction

Filter cake > Z 2* (Landfill)
35.000 t

Fine sand (0/0.5 mm) Z 0* (Reuse)

Sand (0.5/4 mm) Z 0* (Reuse)

Gravel(4/16 mm) Z 0* (Reuse)

Coarse gravel(16/45 mm) Z 0* (Reuse)
395.000 t

Refilling rate 92%

Z 0* : Uncontaminated soil, installation possible without restrictions

Z 2* : installation only permitted to a very limited extent

Chapter 3

Treatment unit Northern Germany

Overview



Throughput

Soil: 2.000 t/day

Feeding station



Receiving and feeding area



- Screening of coarse materials not required
- Magnetic separator not required
- Pre-screening on site up to 100 mm

Multi-stage washing process



Material feed

Mashing

Oversize sieve

Pre-separation > 3 mm

Upstream classification

Separation of fine components < 63 μm

Drainage sieve

Conditioning to water content $\approx 20\%$.

Classification to separate the fines



Overflow sludge water

Finest components $< 63 \mu\text{m}$ and organic matter
Transfer to sludge water treatment



Discharge of washed sand

Grain size: $63 \mu\text{m}$ to 3mm
Load on drainage sieve

Drainage and stockpiling



Dewatering screen

For conditioning the OUTPUT material
to water content $\approx 20\%$



Discharge belt

Stockpiling of OUTPUT material for sampling
(batch size approx. 1,000 m³/d)

Utilisation of the OUTPUT material



Grain fraction

Filter cake > Z 2* Landfill (approx. 10%)

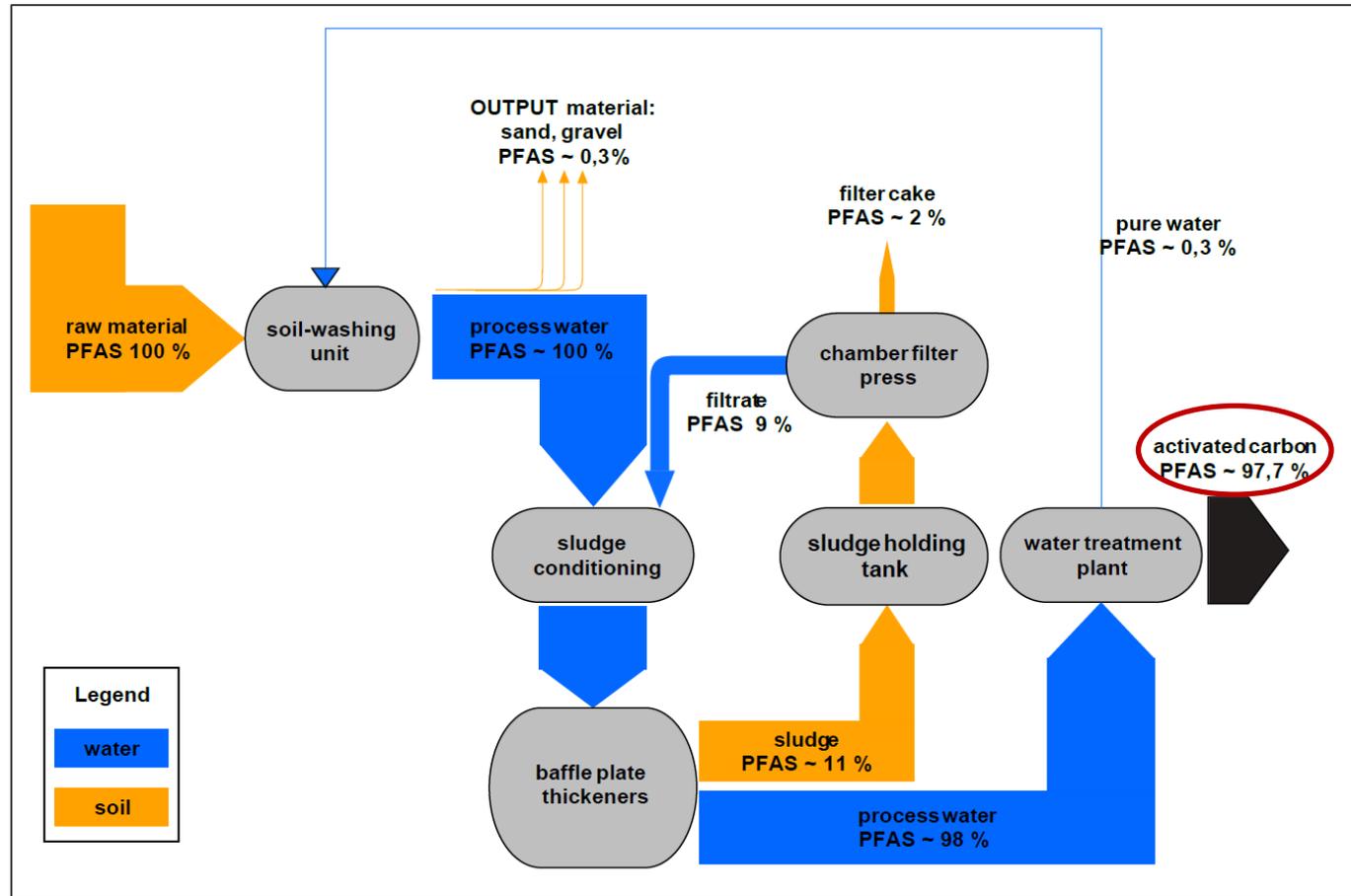
Oversize Sand
Reuse (3%)
Reuse (87%)
of which $\frac{3}{4}$ unrestricted

Refilling rate 90%

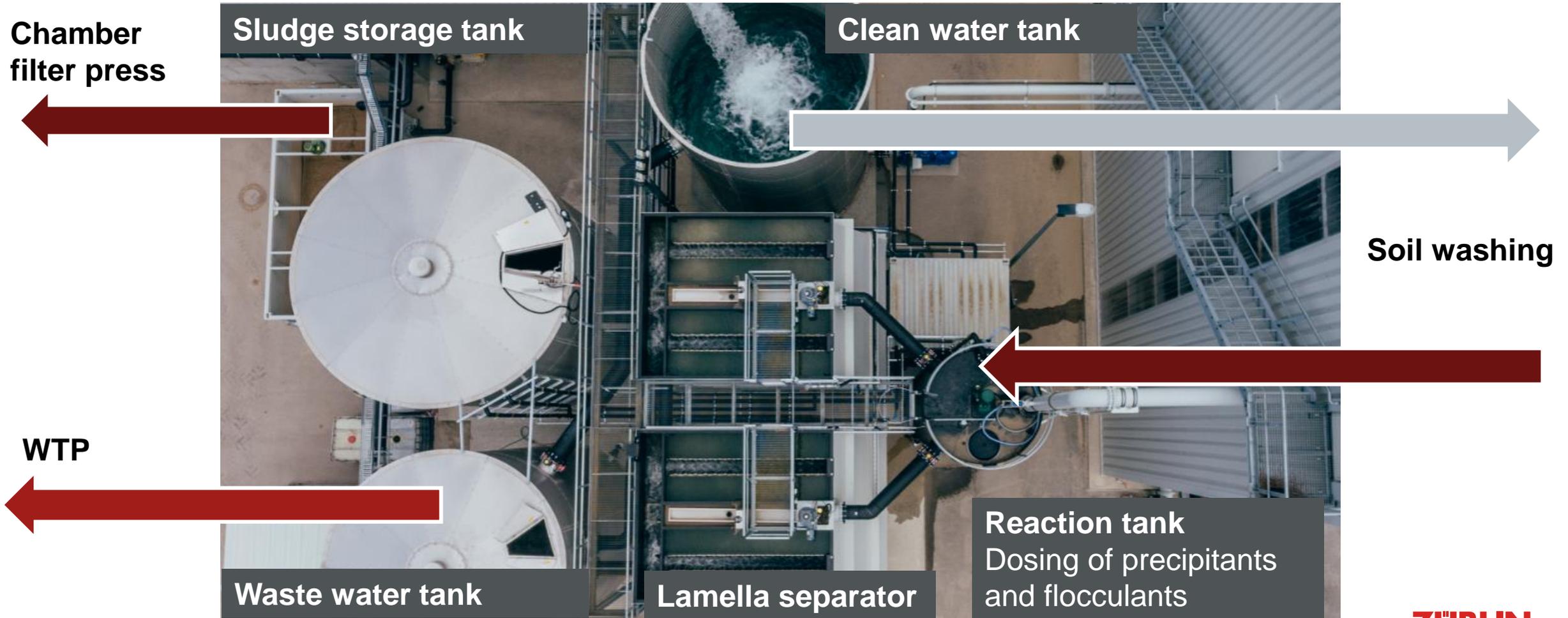
Chapter 4

Recirculating water & sludge treatment

Washing water: pollutant sink



Sludge and process water treatment



Sludge conditioning



Filtration by means of chamber filter presses in batch operation

for the production of a material that can be reinstalled or transported



Filter cake, 70-75 % DM

- under cover until declared
- disposal in landfill or backfilled if target values are met

Treatment of washing water



Water activated carbon filter system, 4 lines

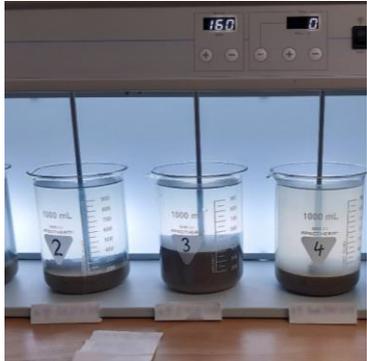
- Total capacity:
 $Q = 200 \text{ m}^3/\text{h}$
- 4 purification lines
- 3 purification stages
- Buffer volume of clean or waste water,
 $3,000 \text{ m}^3$ each

Chapter 5

Outlook and challenges

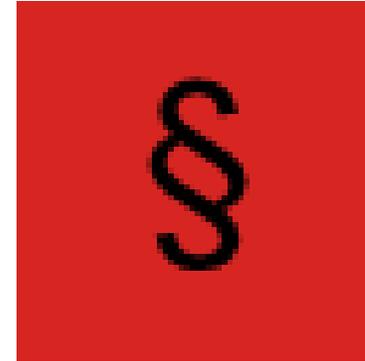


PFAS are basically easy to elute, but



Reduce water consumption!

- a lot helps a lot
- but also costs a lot



Framework

- Adjustments to the assessment criteria



Transferability?

- High organic content
- Other grain structure
- High proportion of fines



Waste vs. product

- Certification of residual materials as a product and return to the material cycle

Any Questions ?

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