



Environmental Experts.

Optimizing water usage footprint: Direct water recycling from abatements

Pascal Osten – Technical Director Water Treatment Global

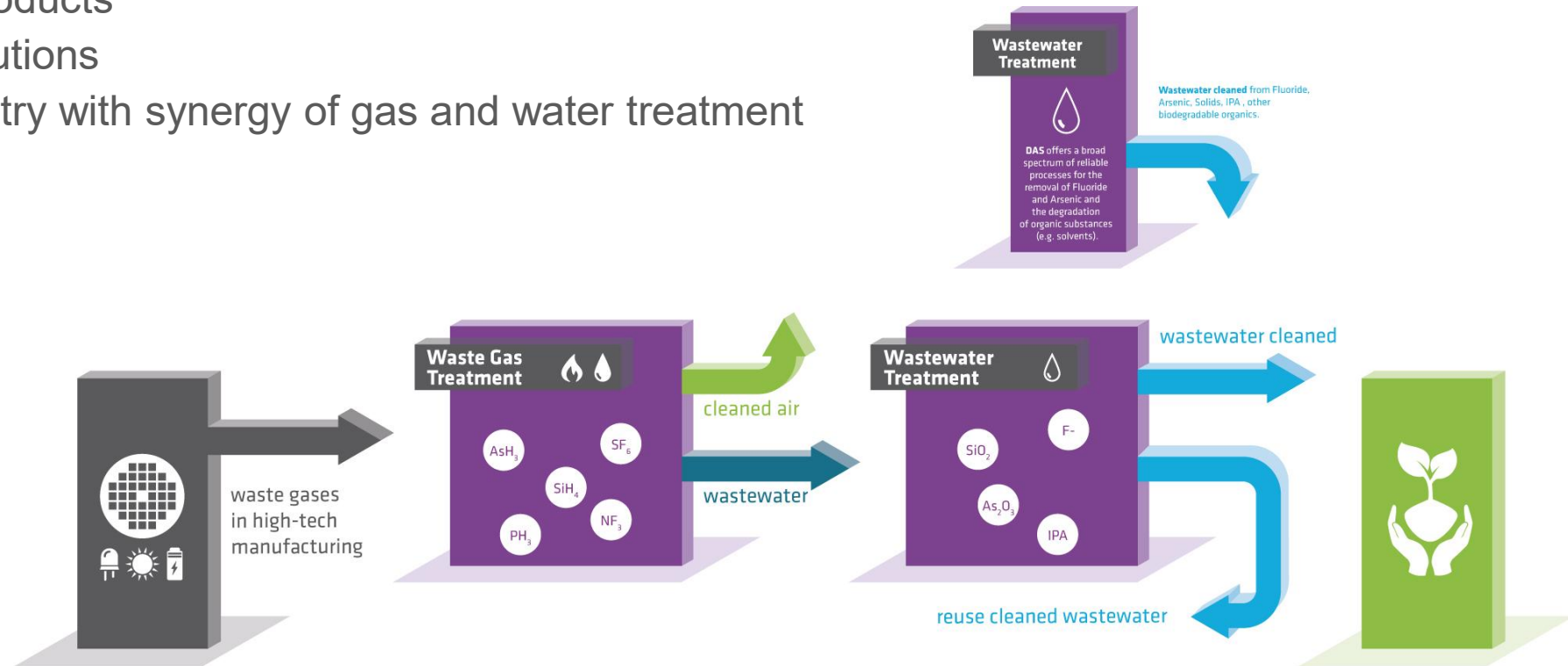
Germany based company, ~ 950+ employees worldwide

- 100 % German production

Waste Gas Abatement products

Waste water treatment solutions

Experts in High Tech Industry with synergy of gas and water treatment



GREEN QUESTIONS ... **PURPLE ANSWERS**

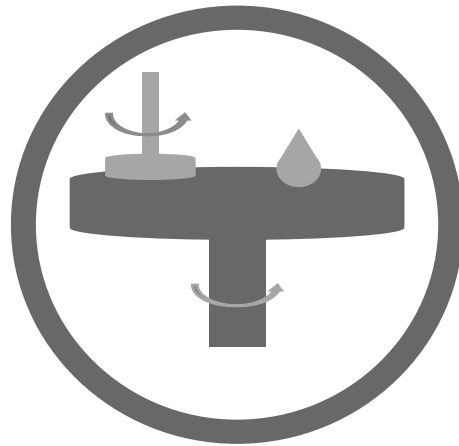
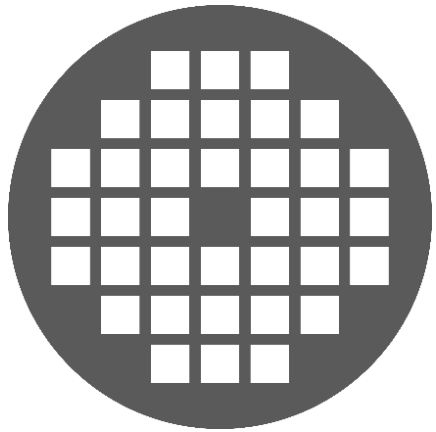
Why is POU Abatement wastewater reclaim reasonable?

What needs to be treated?

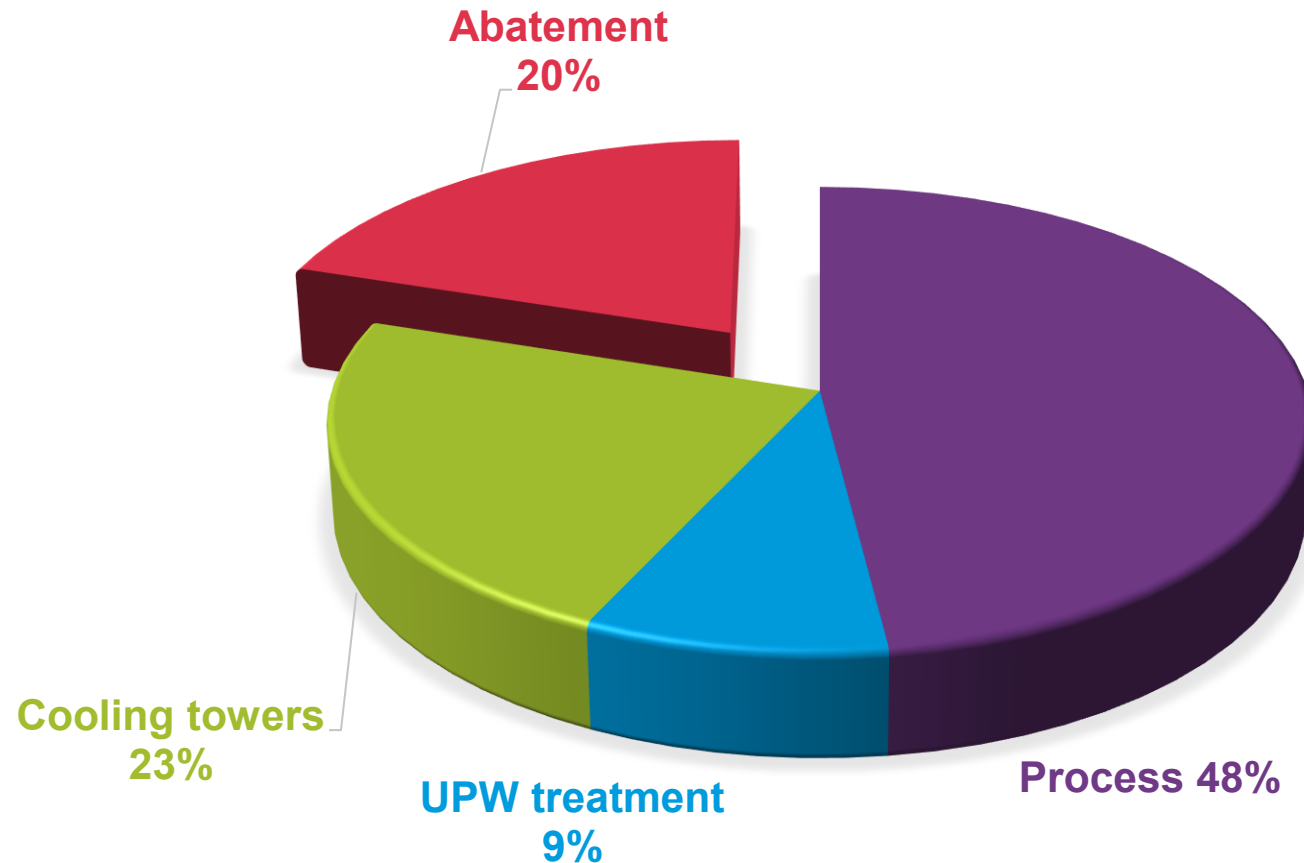
Why treating particles?

How much can be saved?

Other benefits?

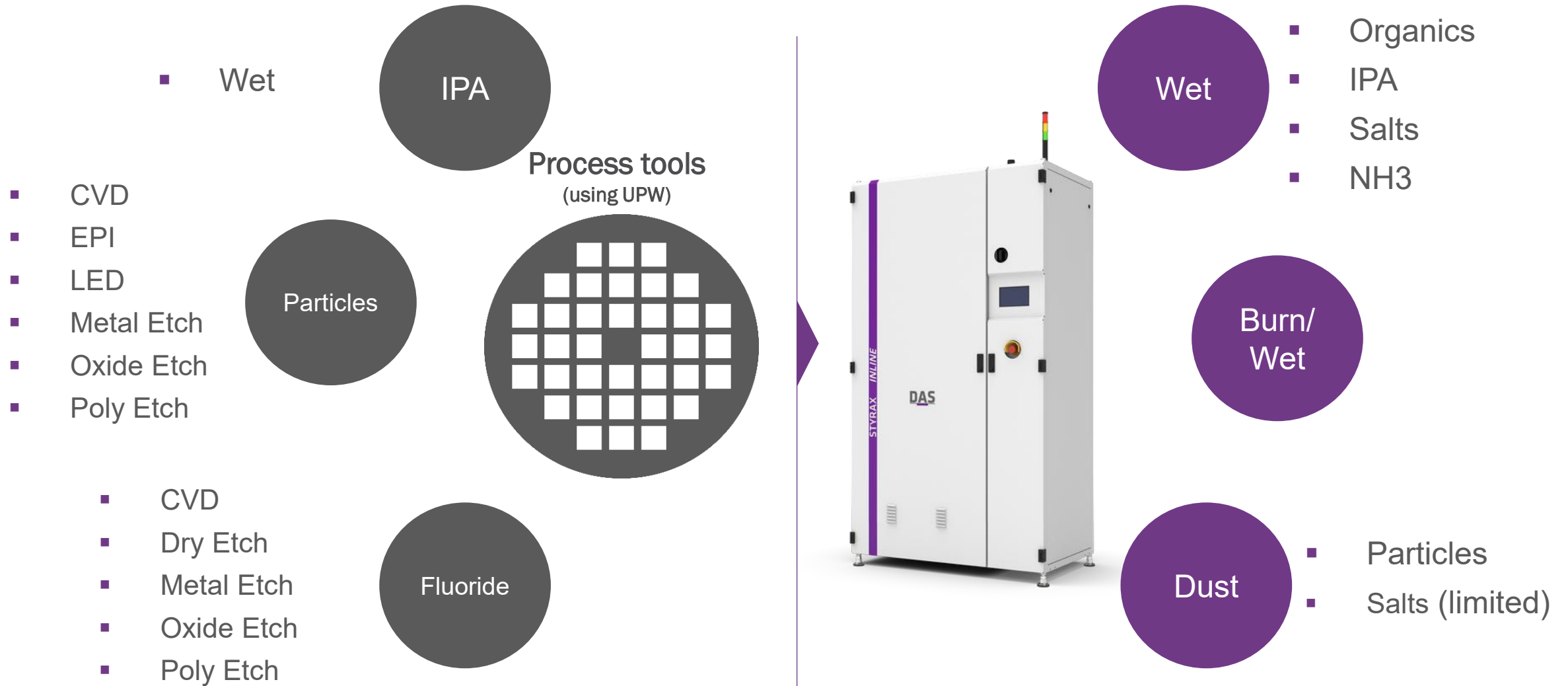


Why is POU Abatement wastewater reclaim reasonable?



Environmental Sustainability of the Semiconductor Facilities, Sub-Chapter of the IRDS EHS/S Roadmap

What needs to be treated?

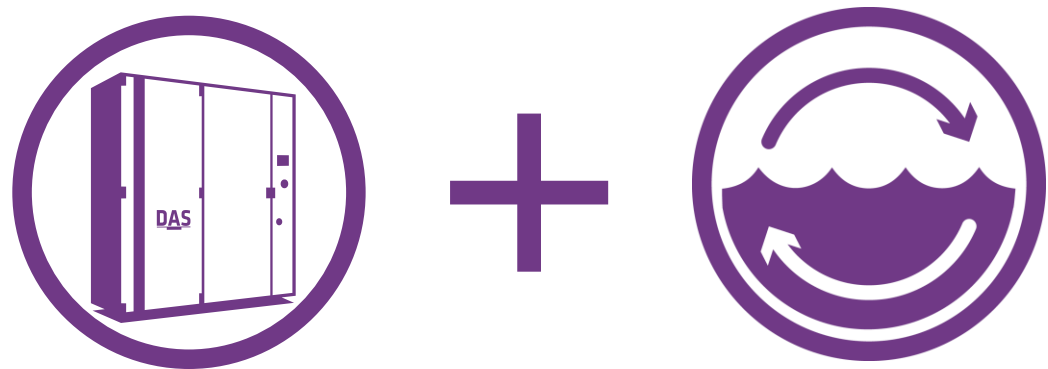


To name a few :

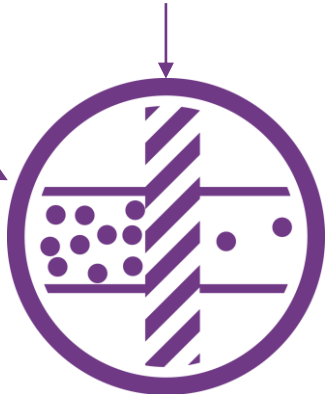


Gas	Products	Particles
AsH3	Na(As(OH)4) (s)/ K(As(OH)4) (s), NOx (g)	As2O3
B2H6	H3BO3 (aq), HCl(aq), HOCl (aq), NOx (g)	B2O3
BCl3		
C4F6	KF(s)/NaF(s)/HF (aq), NOx (g)	
C4F8		
...		
CL2	KCl (s)/NaCl(s)/ HCl (aq), NOx (g)	
HCl		
SiH4	SiO2 (s), NOx (g)	SiO2
...		
SiF4	Si + F	
SiCl4	Si + Cl	
DCS		
TCS		

Why treating particles?

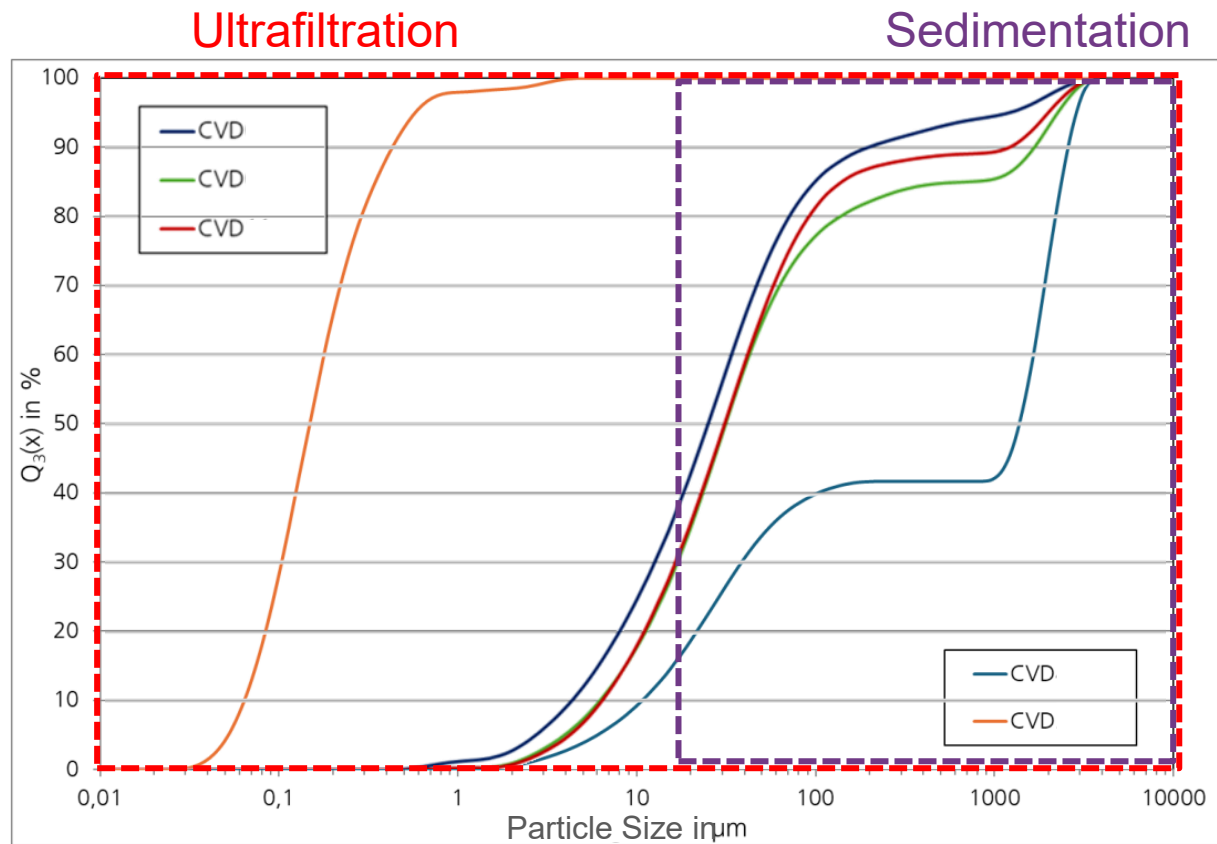


- Remove salts —→ RO → Particle removal needed
- **Remove particles**
- Remove organics
- Remove ammonia



Prozess	F_(theory) [mg/l]	F [mg/l]	Cond. [mS/cm]	pH
CVD	8970	1300	6.55	9.8
CVD	10170	176.2	4.93	8.6
W-CVD	1300	20.7	9.69	11.5
CVD	3880	3.45	3.98	7.5
	0	2.5	0.78	7.4
	-	480	3.56	9.4
Poly Etch	2600	876	23.20	9.6
W-CVD	10000	605	3.93	8.9
Oxide Etch	4300	474	8.50	9.8
CVD mit TEOS	7000	404	31.40	12.4

Why treating particles?



$$v_g = \frac{d^2 * \Delta\rho * g}{18\eta}$$

SiO_2

100 nm $\rightarrow$ 0.28 m/a

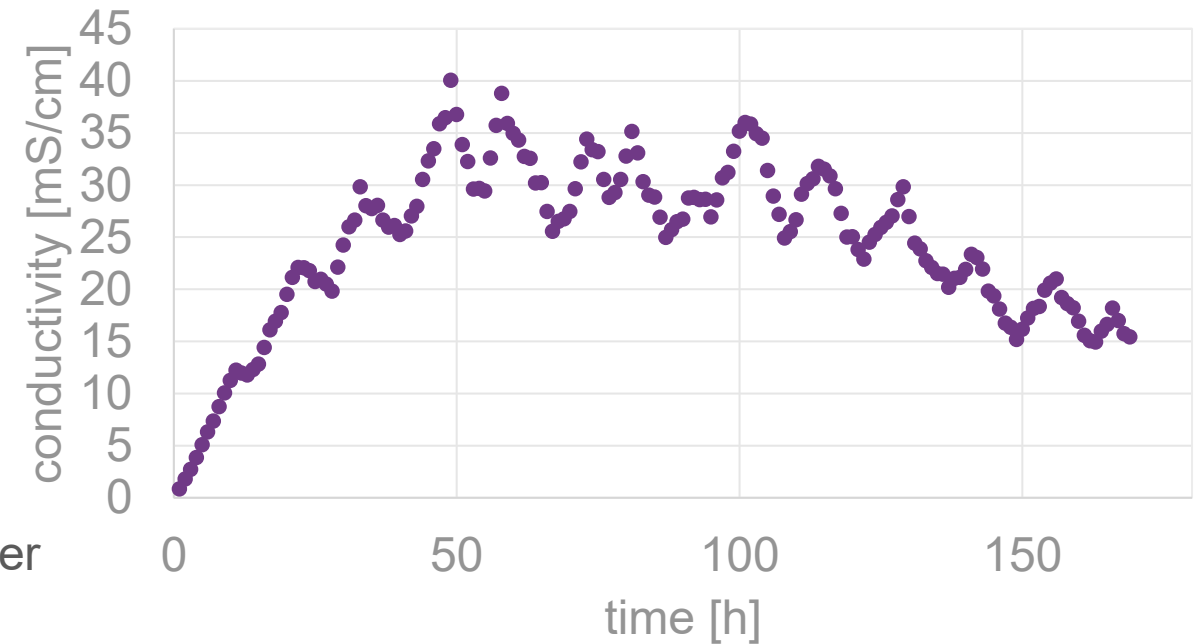
10 μm $\rightarrow$ 0.32 m/h

100 μm $\rightarrow$ 32 m/h

How much can be saved?

Two factors:

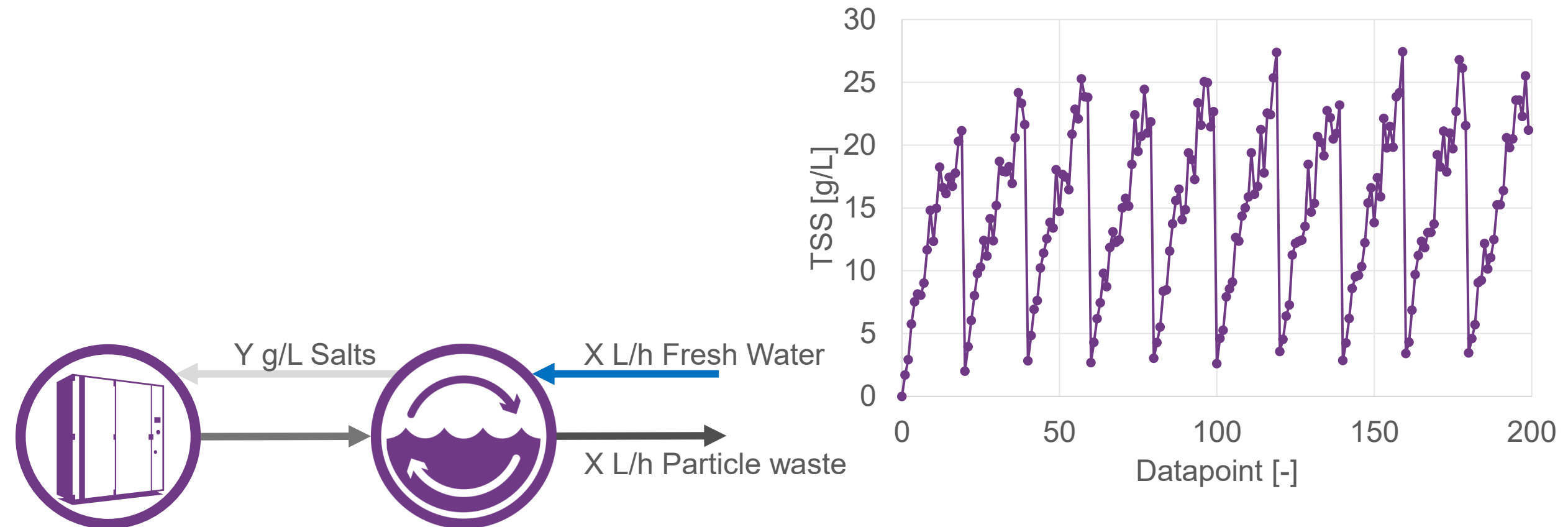
- How high can you concentrate the salts before corrosion
- How high can you concentrate the particle waste before disposal



How much can be saved?

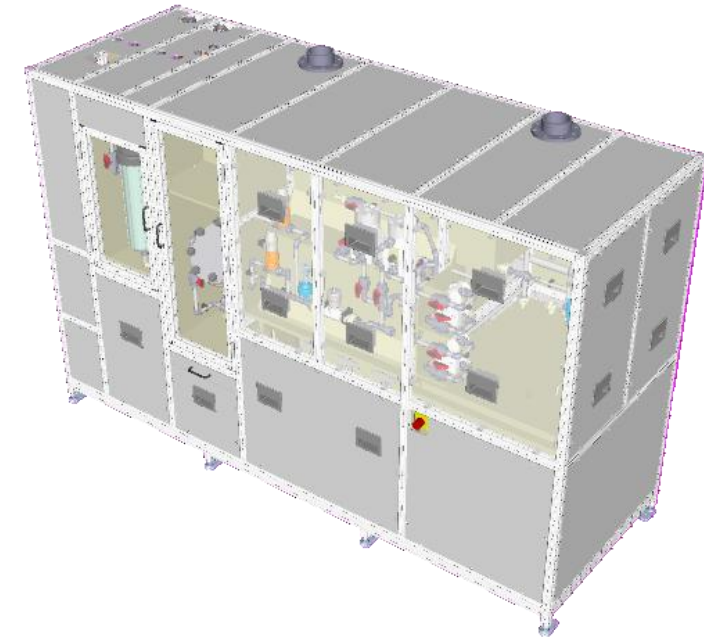
Two factors:

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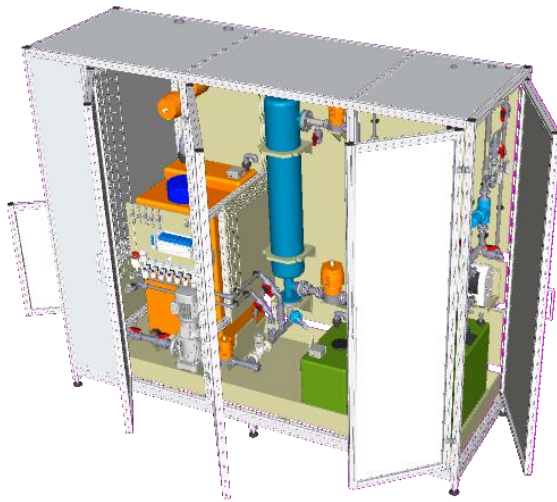
Sedimentation:

- Trials: Only Si and Cl products, NaOH neutralization in Abatement
- 95 % recovery
- 0.2 kWh/m³
- Limited by salt concentration back to abatement

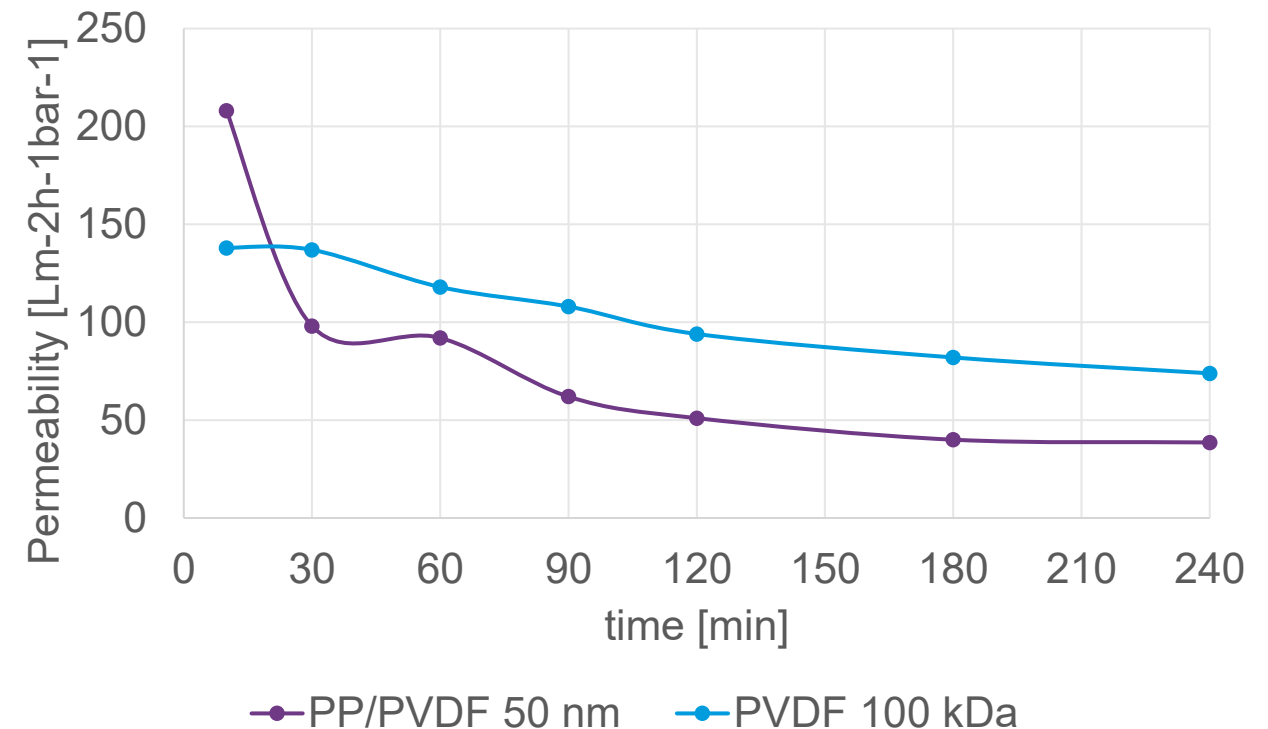


Ultrafiltration

- First test with 50 nm MF → pore blocking, high crossflow
- UF dead end outside-in
 - 3 g/L to 20 g/L → 85 % recovery
 - More possible
 - 0.5 kWh/m³



Membrane filtration EDC SiO₂ wastewater



POU or semi-centralized

- Lower hydraulic stress / new capacity for existing central treatment

Valuable resources

- W, Ga, Ge, ...
- Targeted concentration before mixing enables recovery

Gas	Products	Particles
WF6	WO3 (s), HF (aq), NOx (g)	WO3
TDMAT	TiO2 (s), NOx (g)	TiO2
GeH4	GeO2 (s), NOx (g)	GeO2

- Abatement wastewater amount is significant
- Particle treatment is the “low hanging fruit”
 - And can reduce water consumption > 80% with low energy demand
- Process type needs to be considered
- Planning ahead for targeted treatment of “easy” process gases/combinations is important
 - With consideration, targeted resource recovery is possible



Thank you.

Pascal Osten

Technical Director Water Treatment Global

p.osten@das-ee.com

DAS Environmental Expert GmbH

Goppelner Strasse 44

01219 Dresden, Germany



+49 (0)351 40494-000



contact@das-ee.com



www.das-ee.com



Environmental Experts.

PURPLE INNOVATIONS FOR
GREEN MANUFACTURING

DAS Environmental Expert GmbH
Goppelner Strasse 44
01219 Dresden, Germany

 +49 (0)351 40494-000
 contact@das-ee.com
 www.das-ee.com