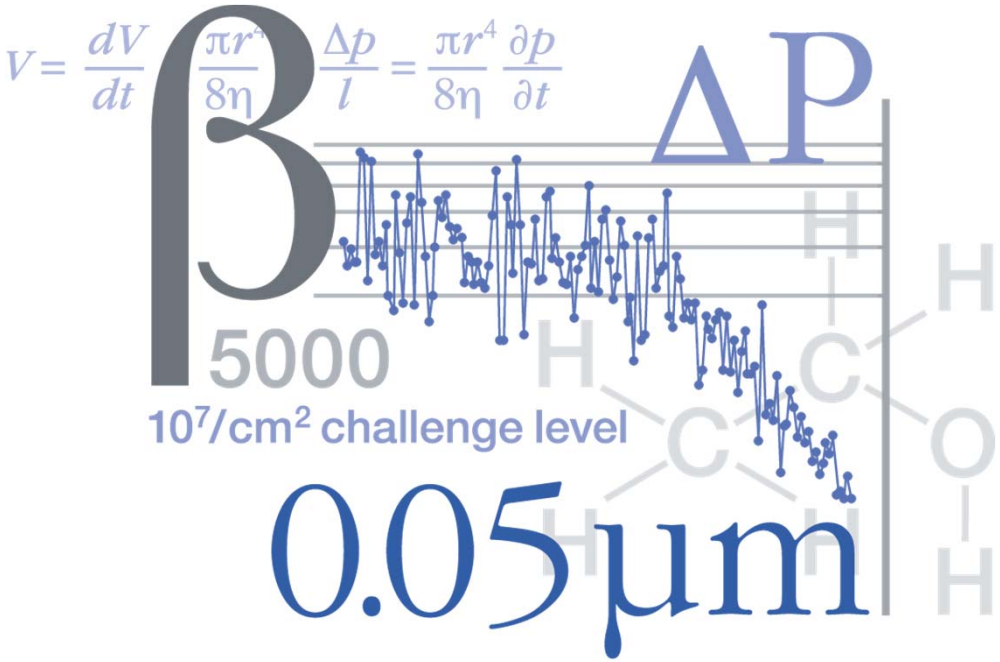
Pall Corporation

*Better Lives. Better Planet.*SM



SLS Global Technical Support

*The Formula for your Success*SM

CMP – quo vadis?

Post use options for CMP waste

Jochen Ruth

32nd CMP User Meeting
October, 10th, Grenoble

Disclaimer

This presentation is the Confidential work product of Pall Corporation and no portion of this presentation may be copied, published, performed, or redistributed without the express written authority of a Pall corporate officer.

Content

- Motivation
- General concepts
- CMP wastewater – a valuable resource?
- Prerequisites for re- or downcycling
- State of the art solutions

Motivation

CMP, Dicing and Grinding operations

- use very large quantities of high purity water (up to 200 000 m³ per year and site)
- cause large quantities of wastewater containing slurry particles, Si particles, dissolved stabilizers and oxidizers and sometimes heavy metals

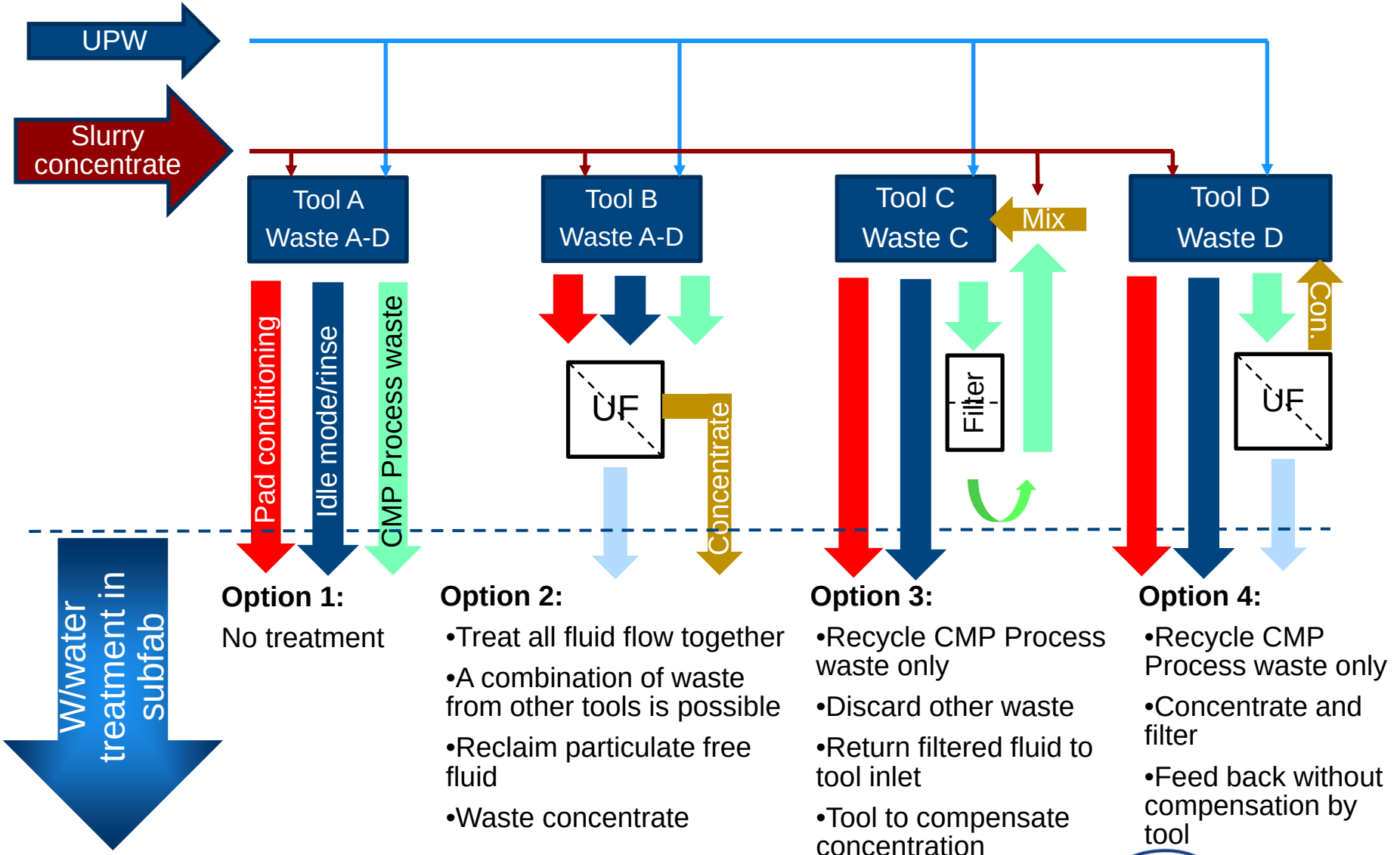
→ Targets for w/water treatment:

a) Purify w/water to meet discharge limits.... *or*

b) Water reclaim... *and probably*

c) Slurry reclaim

Fluid flow schematic for related CMP processes



Option 1:

No treatment

Option 2:

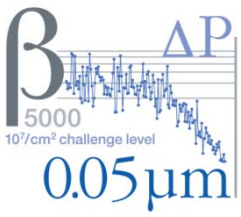
- Treat all fluid flow together
- A combination of waste from other tools is possible
- Reclaim particulate free fluid
- Waste concentrate

Option 3:

- Recycle CMP Process waste only
- Discard other waste
- Return filtered fluid to tool inlet
- Tool to compensate concentration

Option 4:

- Recycle CMP Process waste only
- Concentrate and filter
- Feed back without compensation by tool



Focus area today: Option 2

- Can be implemented in existing fabs
- Needs minor hardware adjustments
- Provides many options for expansion, upgrade and savings
- Well proven references worldwide
- Very flexible
- Medium to large flow rates preferred

Option 2:

- Treat all fluid flow together
- A combination of waste from other tools is possible
- Reclaim particulate free fluid
- Waste concentrate

Typical waste water specifications

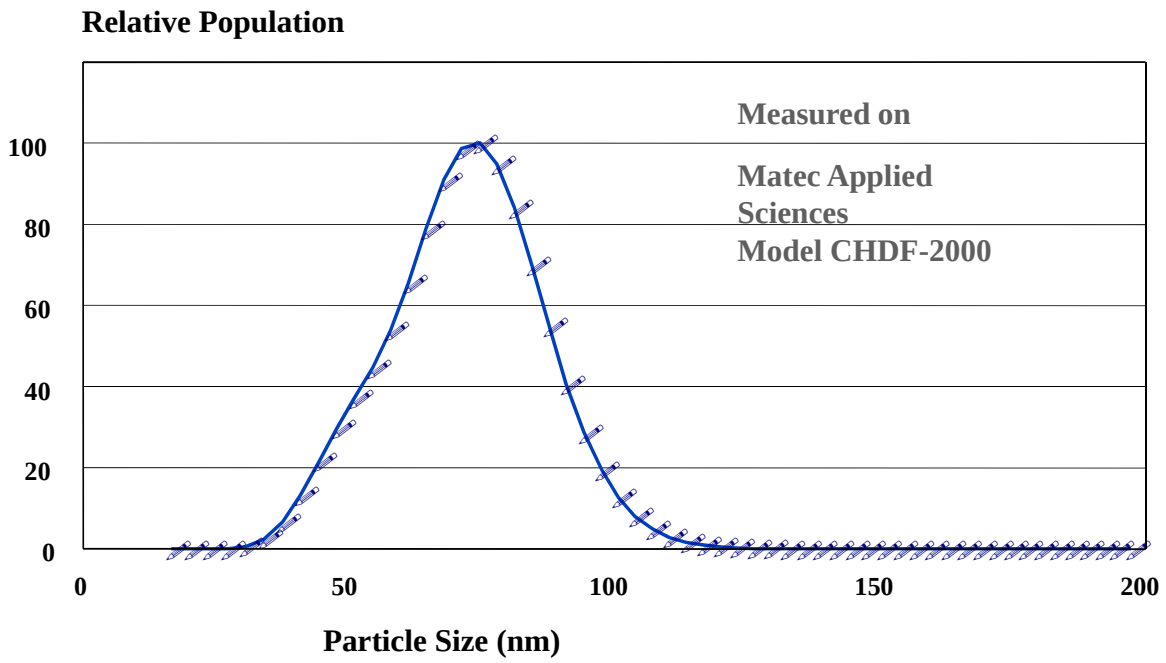
W/water from	Si Back-grinding	Si Dicing	GaAs Back-grinding	CMP
Suspended Solids	Si	Si	GaAs	SiO_2 (colloidal or fumed) Al_2O_3 (colloidal or fumed) CeO_2
TSS mg/l	100…500	10…50	100…500	200…2000
Mean Particle Size/ nm	200	150	200	50…300
pH	6…7	5…7	6…7	3…11
Conductivity µS/cm	< 5	< 5	< 10	< 500
Oxidizers	-	-	-	$Fe(NO_3)_3$, H_2O_2

W/water may be disposed of after clarification/ neutra-lization. Reclaim generally possible. Valuable!

Typical PSD of a CMP Slurry

Example:

Klebosol™ 30N50pHN



Tendency of Slurry Development:

- Smaller particles (down to 10 nm peak size)
- More dilute
- Complex chemistry

Klebosol is TM of AZ Electronics

Separation of Sub-micron Particles –

A Prerequisite for Economical Disposal and Reclaim of Wastewater from Polishing, Grinding and Dicing Operations

Conventional Process to remove sub-micron particles:

Three process steps

1. Destabilization through pH shift and by addition of inorganic coagulants (e.g. ferric or aluminum salts)

   → Coagulation generates small aggregates, sometimes simultaneous precipitation of dissolved matter

2. Agglomeration by addition of polymeric flocculents (e.g. polyacrylates)

   → Formation of large, stable agglomerates

3. Concentration of agglomerates by sedimentation or crossflow microfiltration, followed by sludge dewatering through filters or centrifuges

Principles of W/water treatment

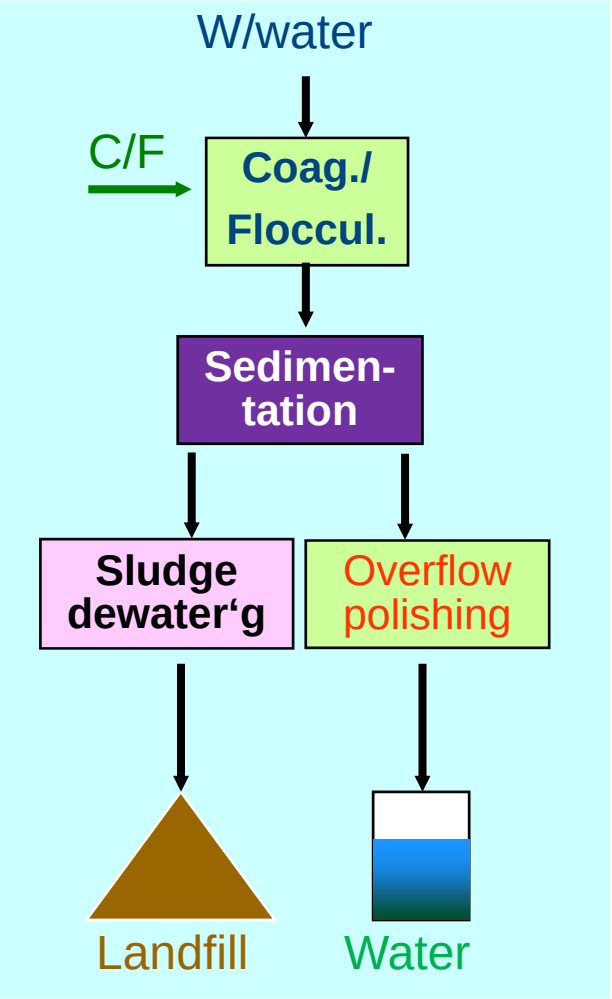
1) Coagulation/ Floccu-lation/ Sedimentation

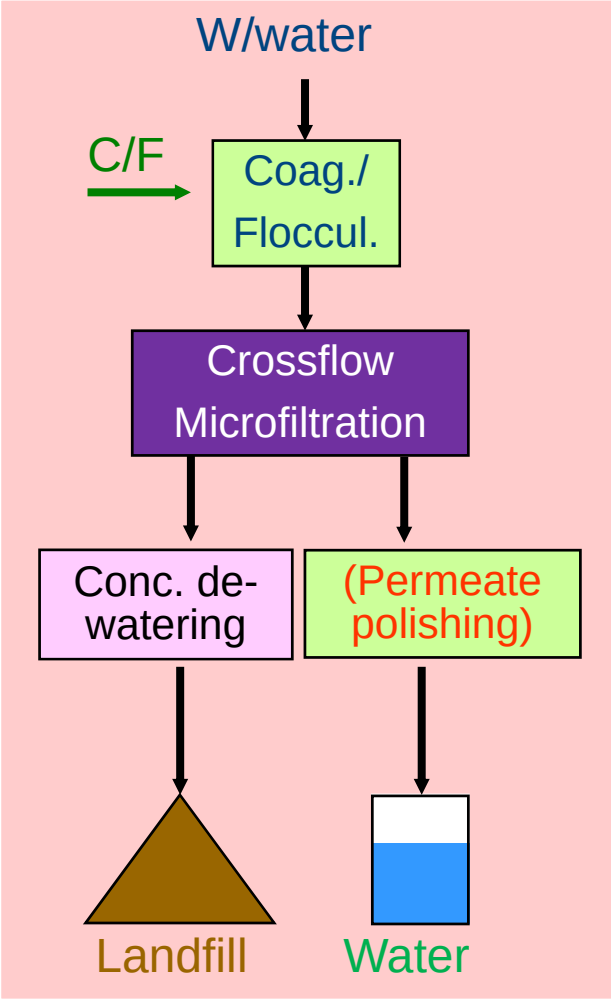
(large consumption of chemi-cals, space and landfill area, rather poor water quality)

2) Coagulation/ Flocccula-tion/ Xflow **Microfiltration**

(large consumption of chemi-cals, space and landfill area, fairly good water quality)

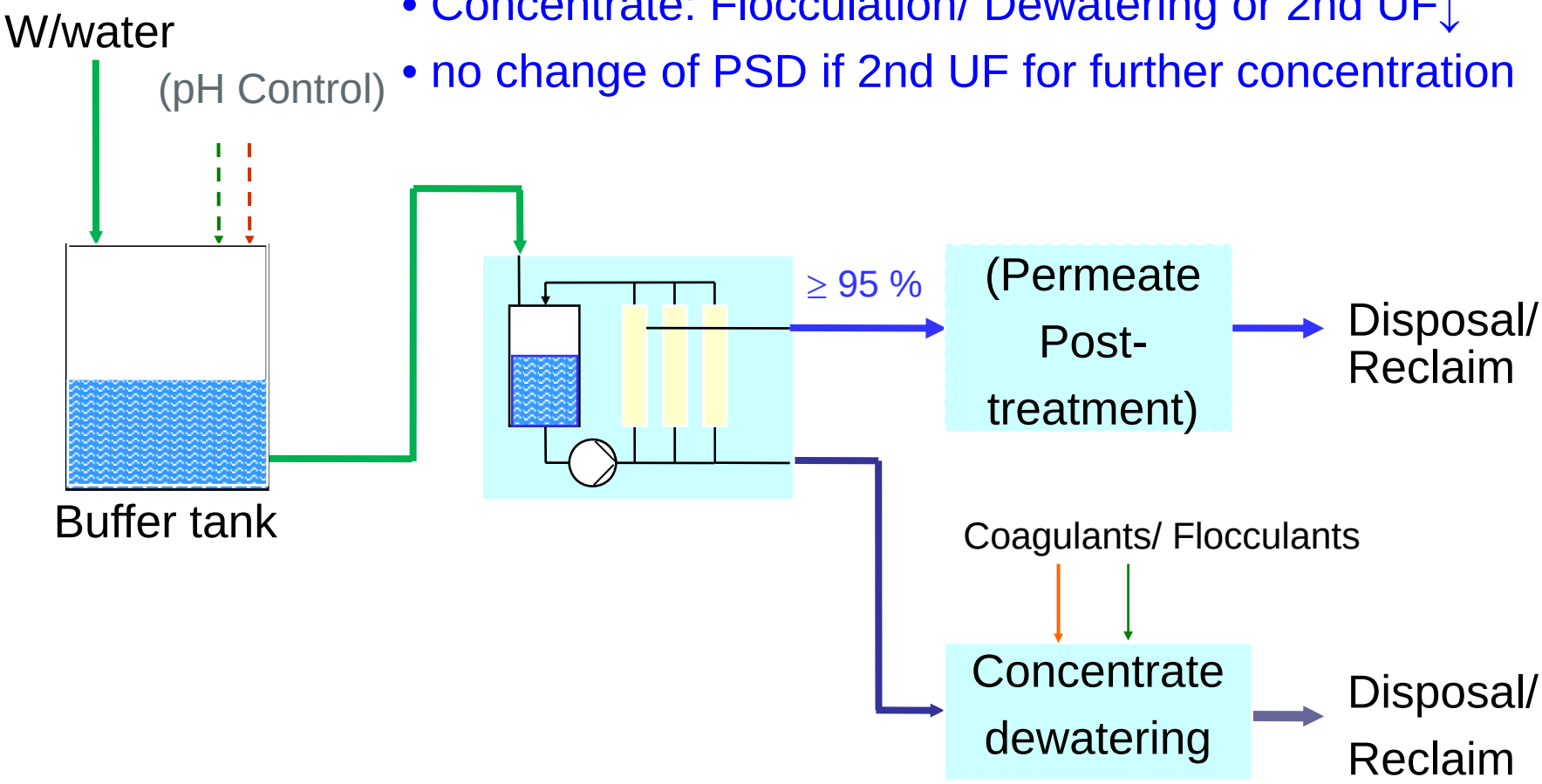
Flocculation of the full feed stream is generally neces-sary in case of conventional MF membranes!

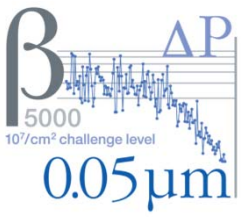




Solution 3: Direct Ultrafiltration

- Water is not polluted by coagulants/ flocculants
- Permeate Post-treatment: easy by RO, EDI, IEx...
- Concentrate: Flocculation/ Dewatering or 2nd UF↓
- no change of PSD if 2nd UF for further concentration



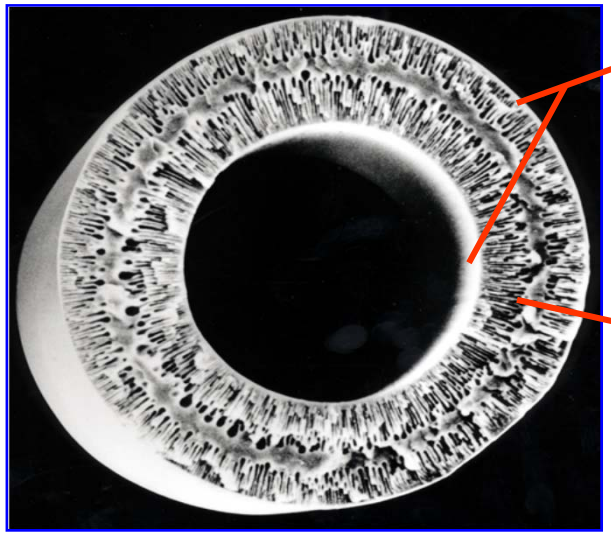


Pall Technology for CMP W/water

- Membranes: - polymeric hollow fibers (PAN, PE, PVDF, depending on w/water spec)
  - ceramic multi-channel elements for special cases
- Process: - Continuous Fed-Batch, inside-out
- References: - 14 systems in Europe, among them 3 sold to end users and 11 to system integrators
- Capacities: - 1 m^3/hr to 30 m^3/hr (majority > 10 m^3/hr)

The removal of particles < 100 nm needs UF membranes with ~ 10 nm pore size

Asymmetrical membrane structure helps to avoid uneconomically large membrane resistance:



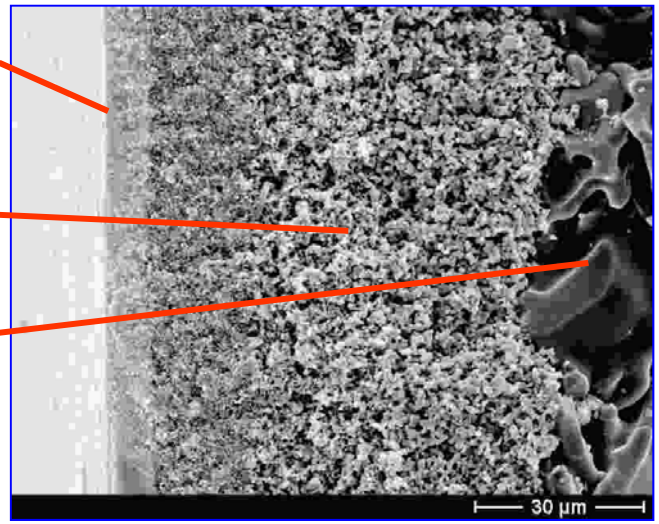
Pall Microza®

UF hollow fiber membrane (PAN)

active membr. layer

transition layers

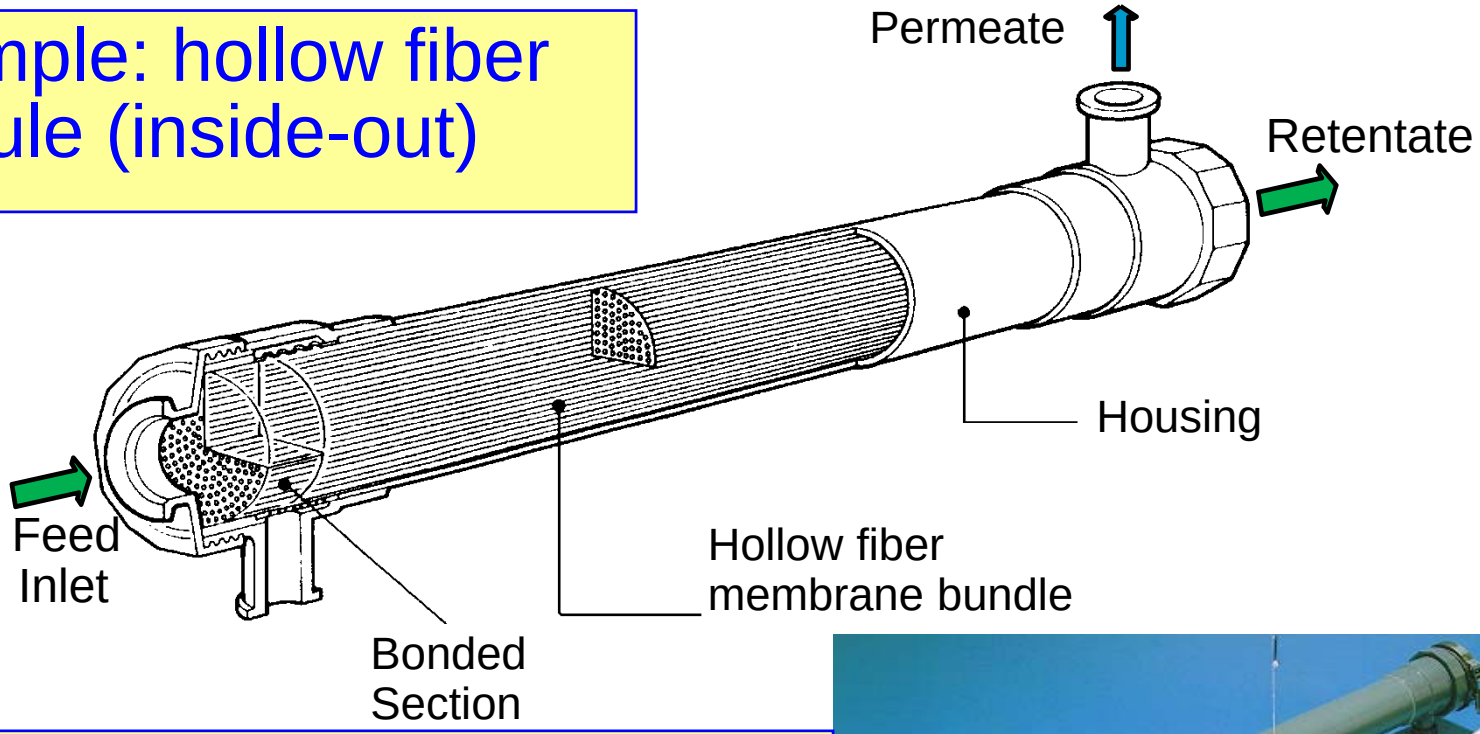
support structure



Pall SCHUMASIV®

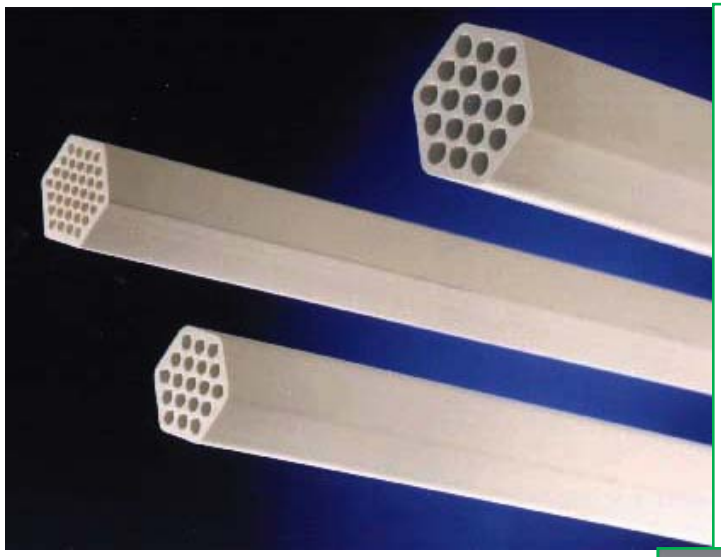
UF ceramic membrane

Example: hollow fiber module (inside-out)



- various housing materials and housing styles (industrial, sanitary)
- several membrane grades, geo-metries and membrane materials
- membrane area 0.01…12.3 m²

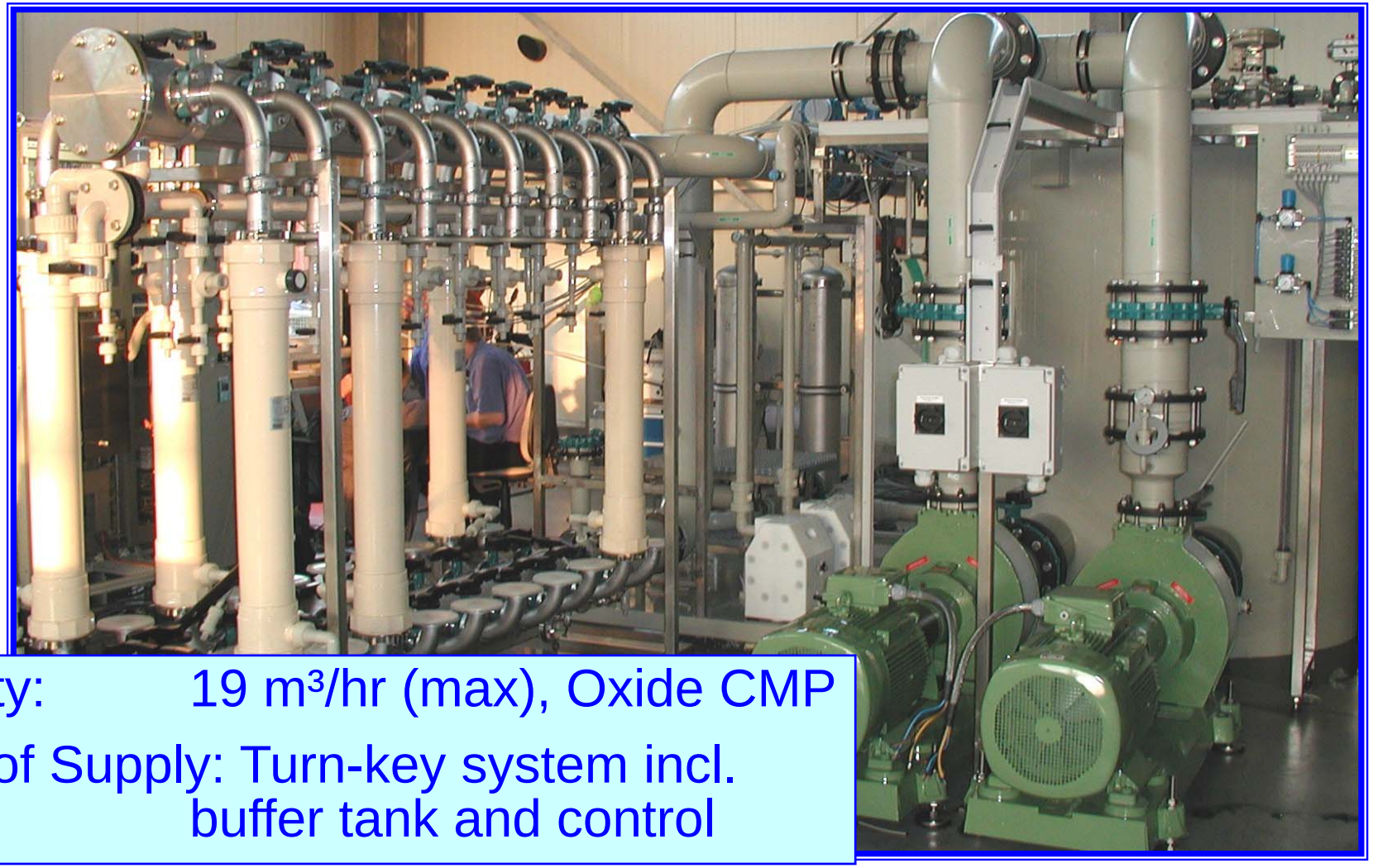
Example: Ceramic elements/ modules



- various housing materials and housing styles (industrial, sanitary)
- several membrane grades, geometries and membrane materials
- membrane area

  0.2…21 m²

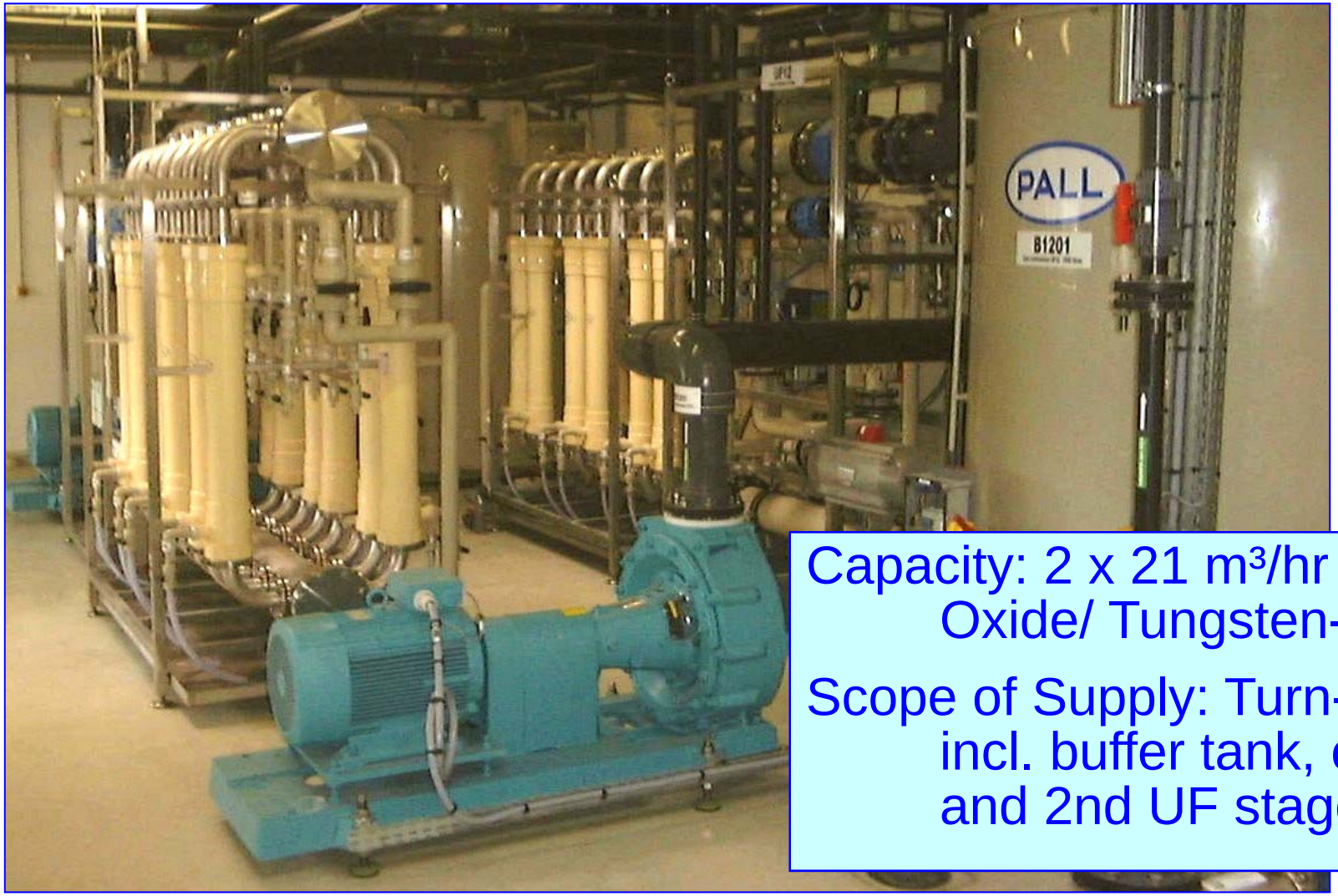
Example 1: German fab System



Capacity: 19 m³/hr (max), Oxide CMP

Scope of Supply: Turn-key system incl. buffer tank and control

Example 2: French fab system



Capacity: 2 x 21 m³/hr (max), Oxide/ Tungsten-CMP

Scope of Supply: Turn-key, incl. buffer tank, control and 2nd UF stage

Example 3: Concentrate stage CMP

2nd stage

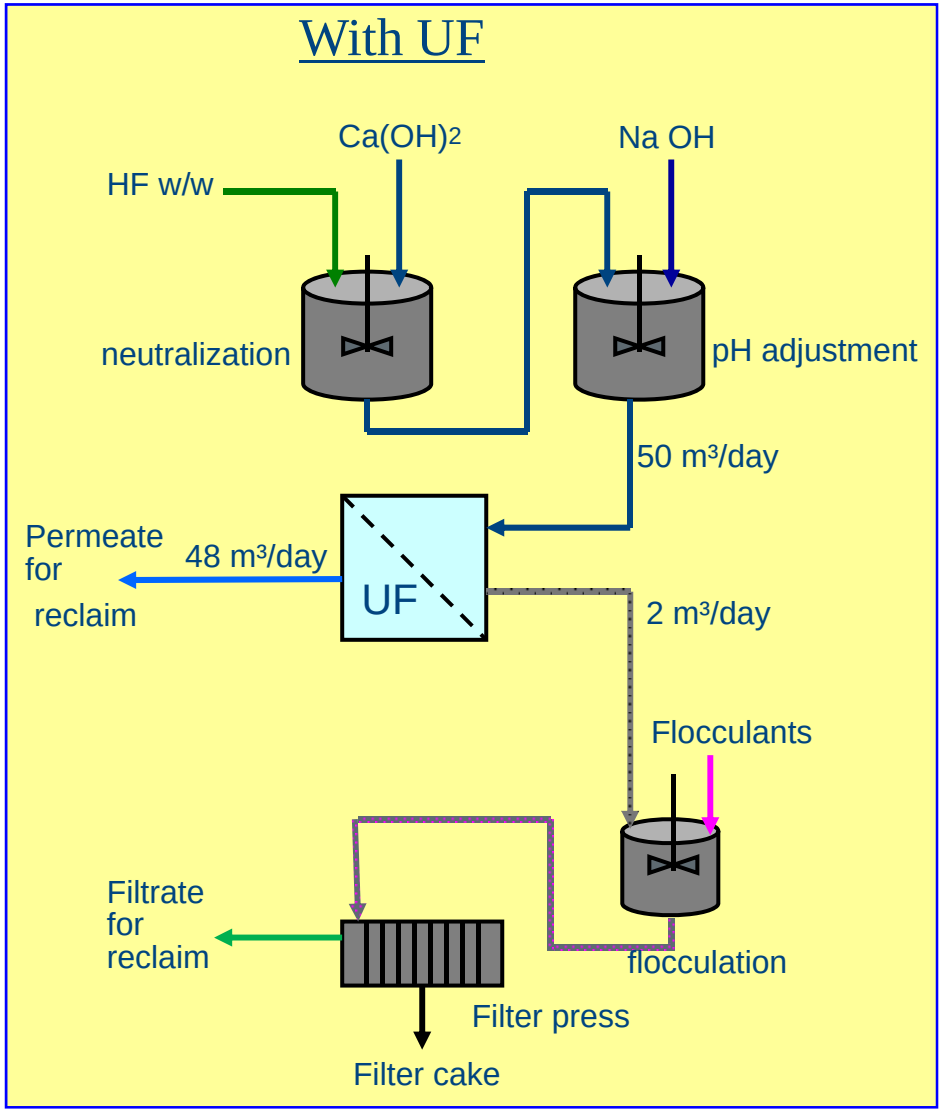
- Capacity: 1 m³/hr concentrate from 1st stage
- Final TSS: 350 g/l (equal to original slurry)
- Scope of Supply: Turn-key system, incl. buffer tank and control
- Special: On-line measurement/ control of TSS

Comparison conventional vs UF

- Lower space requirements
- Improved water quality for reclaim
- Reduced consumption of coagulants/ flocculants

Application e.g.

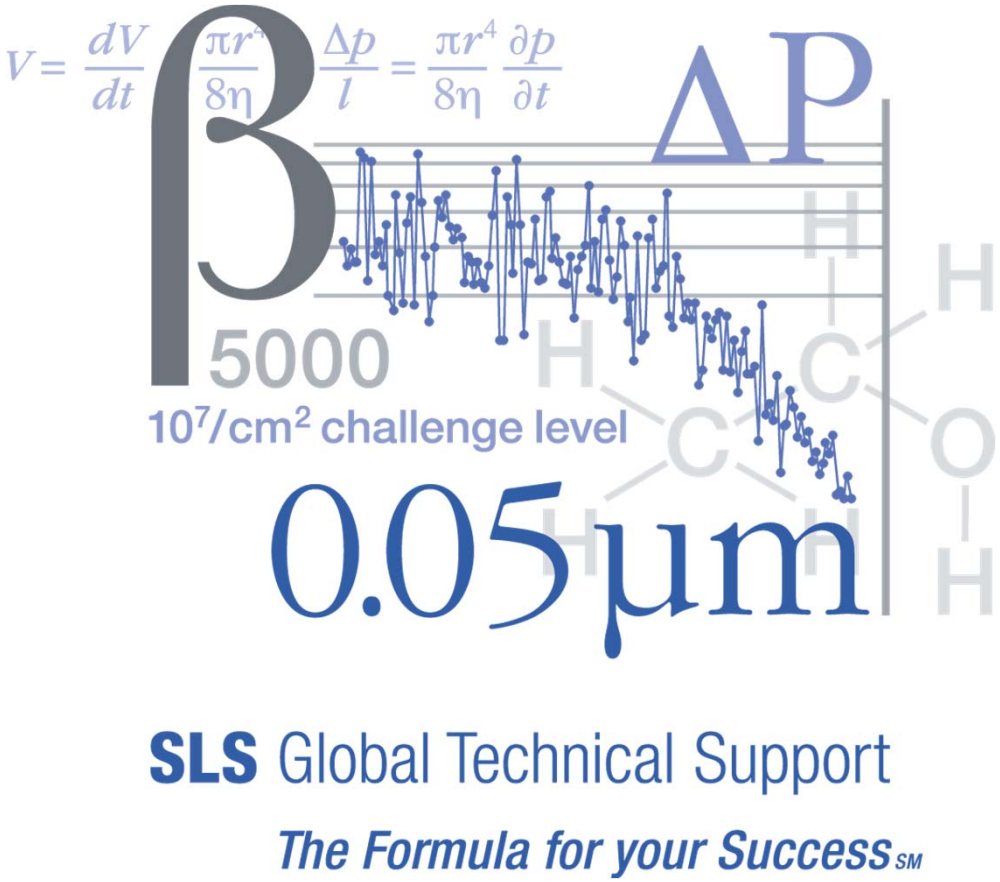
- For capacity increase of existing treatment systems
- For new systems with space limitations



We are looking forward to our co-operation…

Pall Corporation

*Better Lives. Better Planet.*SM



Pall SLS

A global customer support organization

Jochen Ruth
SLS Director CE