



Weighing Options for CMP Wastewater Treatment

Adapted from paper originally presented in
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Brian V. Jenkins, Craig W. Myers, PhD, Kevin S. Olson
Nalco Company, 2008

CMP is an enabling technology...

- Allows fabs to produce chips with smaller and smaller geometries
- Fabs can use the technology to become or stay more competitive
- CMP technology can be used, like many other process chemistries, to achieve specific, unique design goals

...but there are challenges associated with the by-products of its use

- What does one do with the wastewater generated from the process?
 - Solids
 - Metals
 - Organics
 - Reclaimed water

These are some of the more common slurry waste stream components

- Dissolved, suspended and settled fine particles
 - Alumina, silica, cerium oxide
 - Particles are getting finer as CMP technology evolves
- Oxidizing agents
 - eg, peroxides
- Organic complexing agents
 - Chelants
- Inorganic ions
 - Ferric nitrate, iodates
- Dissolved metals
 - Metals removed from the wafer's surface
- Buffers
 - KOH, NH₄OH, MEA
- Surfactants
- Water (as much as 60:1 ratio to CMP slurry)

Most fabs discharge to POTW's

- Regulations continue to tighten
 - Metals content
 - COD
 - TOC
 - BOD
 - pH
- CMP technology continues to evolve, placing additional compliance strain on fab EHS personnel as manufacturing process change / upgrade

The following approaches can be used for some of the more commonly encountered CMP wastewater challenges

- Supplemental processes may be required for suspended solids or copper removal
 - Sludge dewatering
 - Sludge disposal

pH	Oxidant	Suspended Solids	Copper
Chemical Neutralization	Chemical Neutralization	Coagulation / Clarification	Precipitation
	Activated Carbon	Membrane Filtration	Ion Exchange
			Reverse Osmosis



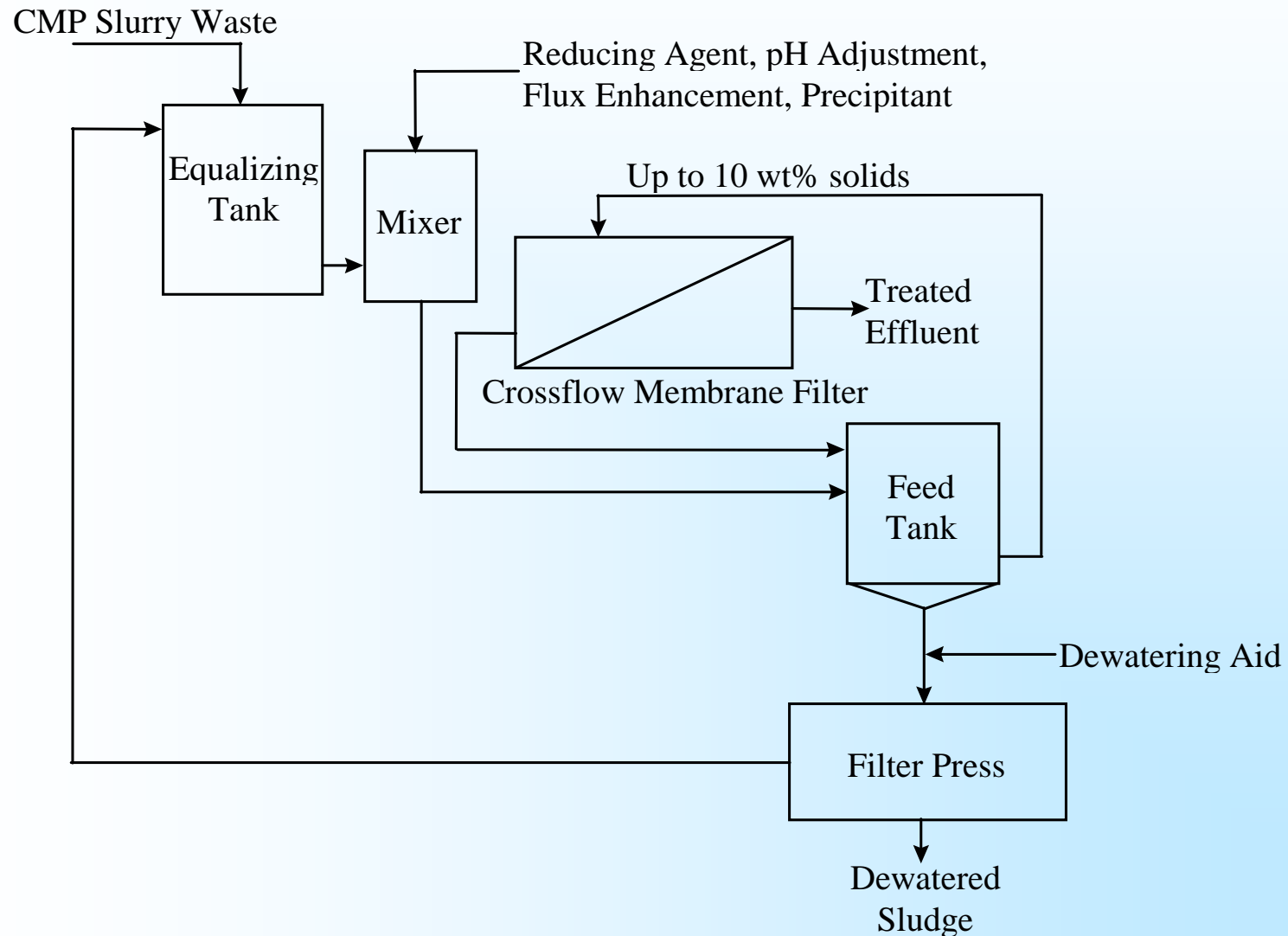
Each method, not surprisingly, offers its own benefits and drawbacks



Membrane filtration

- Coagulant chemistry usually used to enhance flux
- Advantages
 - Consistent effluent quality
 - Reduced sensitivity to upstream process upsets
 - Solids dewatering up to 10%
 - Modular
 - Membrane treatment a common practice in another area of the fab (UPW)
 - Small equipment footprint
 - With correct chemical additives, can also be used for copper removal
- Disadvantages
 - Long-term membrane maintenance procedures needed
 - Membranes need to be replaced periodically

This is an example of a membrane wastewater system



Ion exchange

- Used for copper removal
- Usually best to have achieved suspended solids removal prior to copper removal step
- Advantages
 - Excellent copper removal capability (assuming appropriate resin choice and operating conditions)
 - Small footprint
 - Common and familiar unit op in a fab
 - Tolerant of upstream process changes
- Disadvantages
 - Pre-treatment required to prevent resin fouling and degradation (eg, removal of oxidants and organics necessary)
 - Relatively expensive regeneration system
 - Lower system flexibility for subsequent upstream process changes

There are a couple of important items to consider in association with this topic

- Water re-use
 - Quality variability
 - How to track changes
- What will the future look like?
 - CMP slurries becoming much more sophisticated in response to continued industry innovation
 - More “C” than “M”???
 - PV industry starting its own work using CMP