

Semiconductor

Industry Challenges

The semiconductor fabrication process requires large volumes of ultra-pure water and generates a wide range of wastewaters of varying characteristics. The wide disparities in dissolved and suspended solids, metallic contaminants and proprietary chemical constituents have presented major technical challenges for fab shops to manage wastewater of this high complexity. Most of the water is consumed for processes including CMP, wet etch, wafer cleaning, dicing and backside grinding. As the global demand for semiconductor devices continues to grow at a rapid pace, the fabs have to confront the ever-increasing water scarcity issue and become self-sufficient of the water resource to meet the production needs. Duraflow (DF) developed state-of-the-art membrane microfiltration technology to address these difficult problems. The DF microfiltration products can be applied in a number of semiconductor facilities to remove fluoride, copper and silicon particles from etching and CMP processes, and recycle or reuse high-quality wastewater generated from the wafer fabrication activities.

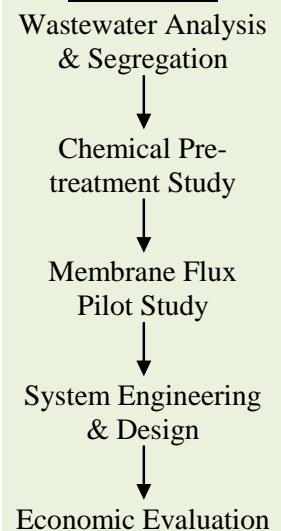


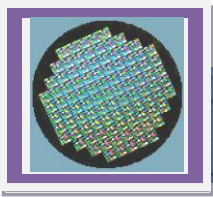
**Duraflow 10-Tube
Microfilters**

Duraflow Solution

- **Fluoride Bearing Etch Wastewater** – High concentration of fluoride is precipitated as CaF_2 with the aid of inorganic coagulants. DF microfiltration is applied to separate the fluoride particles. Fluoride can be reduced from $>3,000$ mg/L in the raw wastewater to <10 mg/L in the filtrate for final discharge.
- **Wafer Dicing/Backgrind & PCB Cutting Wastewater** – Silicon particles produced from the wafer and PCB fabricating process are coagulated and separated from water by the DF microfiltration process. The filtrate with a SDI <3.0 and NTU <1.0 is typically directed to the ultra-pure water (UPW) treatment system for recycle.
- **Copper CMP Wastewater** – Chelate breaking treatment chemicals and coagulants are used for precipitation of copper and agglomeration of colloidal particles. After separation by the DF microfiltration, clean filtrate is discharged or sent to the UPW system for water recycle.
- **RO Brine Wastewater** – The RO reject stream produced from the ultra-pure water treatment system and other high TDS side streams can be treated and reused via chemical softening to precipitate hardness followed by DF microfiltration and RO.

DF Design Approach For Semiconductor Wastewater





DF Microfiltration



Module Cross-Sectional View

After chemical reaction, the wastewater is processed through the Duraflow microfiltration membrane filters designed for separation of the precipitated suspended solids from water. The waste solution is pumped at a high velocity through the membrane modules connected in series. The turbulent flow, parallel to the membrane surface, produces a high-shear scrubbing action which minimizes deposition of solids on the membrane surface. During operation, clear filtrate permeates through the membrane as depicted in the Cross-flow Filtration Diagram, while the suspended solids retained in the re-circulation loop are periodically purged for further de-watering. The filtrate is directed to the POTW for discharge or to the UPW treatment system for recycle or reuse.

Duraflow microfiltration membranes are manufactured in a tubular configuration capable of handling high solid concentration. The membranes, made of PVDF, are cast on the surface of porous polymeric tubes to produce a nominal pore size of 0.1 micron. The extraordinary chemical resistant property of PVDF allows the use of a wide range of chemicals - acids, bases and solvents for cleaning of the persistent fouling substances. An automatic back-pulse mechanism is an integral part of the operation design to provide periodic physical surface cleaning.

Duraflow 10-Tube Microfilter Specifications:

- Module size: 6" diameter, 72" long
- Number of tubes: 10 / module
- Membrane tube diameter: 1"
- Total membrane surface area: 15 ft² / module
- Shell construction: Schedule 40 PVC
- Membrane material: PVDF
- Nominal pore size: 0.1 micron
- End sealing material: Epoxy resin

Duraflow Microfiltration Operation Parameters:

- Flow configuration: Cross-flow
- No. of modules per train (max): Up to 18
- Operating pressure (max): Up to 60 PSI
- Operating temperature (max): 110°F
- Design flux (Typ.): ~ 500 GFD
- Feed flow velocity: 12 – 15 ft/sec
- Rated filtrate flow/10-tube module: 5 GPM

