

**POREX® Tubular Membrane Filter (TMF)™ Applied in Backgrinding and Die Sawing Wastewater Reclaim System for an Integrated Circuit Packaging Plant in Suzhou,China.**

**Abstract Introduction**

Backgrinding and die sawing are two steps in the Integrated Circuit (IC) packaging process. For easier transportation and protection of the wafer, the thickness of the industrially produced wafer is larger than required. Therefore, before the IC is packaged, it is ground to a thin disc in the “backgrinding process”. Die sawing is another process which is used to cut large silica wafers into smaller discs (see diagram below). After either of these processes, the wafer chips must be rinsed with Ultrapure Water (UPW) to remove fine silica particles and any other contaminants. Backgrinding wastewater and die sawing wastewater are typically discharged from the IC packaging plant. This discharged water normally contains only UPW and fine silica particles, but on occasion some grinding fluid is also present. Removal of the fine particles from the wastewater is critical to allow recycle and reuse of this large volume of water.

This document will review a working reclaim system for backgrinding and die sawing wastewater using POREX® Tubular Membrane Filter (TMF)™ system. Facilities using this process find it to be an excellent option for this application.

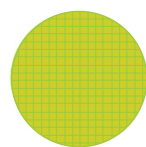


Figure 2-1  
Wafer

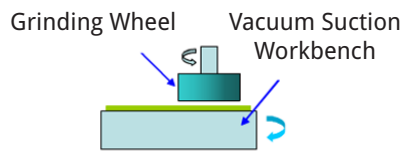


Figure 2-2  
Backgrinding Process

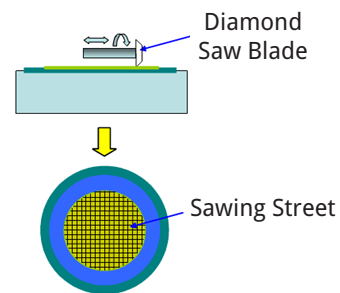
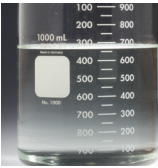
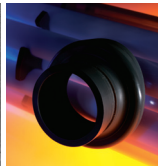
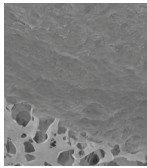


Figure 2-4  
Wafer Sawing Process



POREX FILTRATION

CASE STUDY

## Wastewater Information

In this facility, there are two streams of wastewater being treated by Porex TMF:

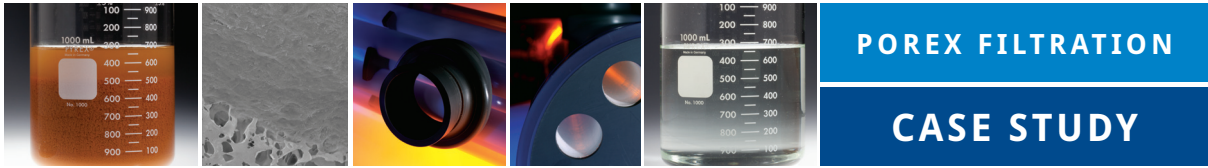
- Wastewater from the site's workshop (backgrinding and die sawing) totaling 100 m<sup>3</sup>/day.
- Backwash wastewater from the site's existing hollow fiber ultrafiltration (UF) membrane system. The hollow fiber UF system was commissioned in 2010, also for backgrinding and die saw wastewater treatment. The UF permeate water is sent back to the facility's UPW treatment system. During service, the hollow fiber UF system is backwashed every 30 minutes. About 60–70 m<sup>3</sup>/day of wastewater are discharged to the Porex TMF system.

The total Porex TMF system is designed to handle 200m<sup>3</sup>/day, or approximately 12 m<sup>3</sup>/hr. The mixed raw wastewater is brown in appearance with numerous very fine particles in the liquid. These particles are very hard to precipitate naturally; a container of the water sample was set out for gravity settling for over one month and no solid/liquid interface could be found.

## TMF Characteristics and Advantages

When used to treat backgrinding and die sawing wastewater the advantages of Porex TMF process are:

1. Combined with a filter press, this system will divide the wastewater into two parts: filtered water and dewatered sludge cake. There is no concentrated or reject water drain resulting in a nearly 100% recovery rate.
2. No chemical dosing into the wastewater is necessary. Therefore, if desired, sludge can be reclaimed for future reuse.
3. No pretreatment stage; the entire system uses simple physical solid/liquid separation.
4. The proprietary POREX<sup>®</sup> Tubular Membrane Filter (TMF)<sup>™</sup> has very high abrasion resistance.
5. The membrane layer is not destroyed by acute silicon particles. Normally this is the biggest challenge when hollow fiber UF membrane technology is utilized for this kind of water. Hollow fiber plugging or breakage can occur due to the small particles size, high concentration and very abrasive nature of the particles.
6. Maintenance of the system is simple. The system can be designed for automatic operation, and can be placed into service mode from standby mode without any upsets or problems.



## TMF Characteristics and Advantages Continued

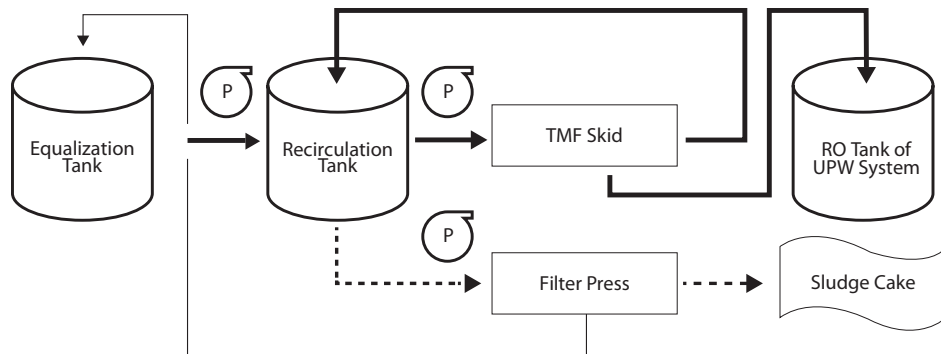
7. The Porex TMF membrane has good resistance to fouling compared with hollow fiber membranes and flux is more easily recovered after chemical cleaning.
8. The system design allows for a skid frame requiring less space than other methods.
9. Expansion capability; water capacity can be enlarged by simply adding more skids or modules.

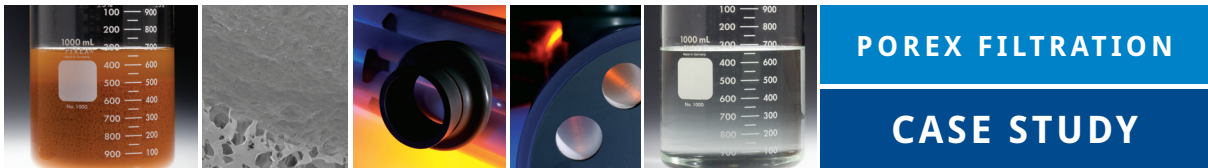
## Porex TMF System Information

The details below describe the installed Porex TMF system.

Water capacity:	200 m <sup>3</sup> /day, divided into 2 trains.
Module Specification:	Porex TMF system (module model # MME3005613VP)
Tubes per Module:	13
Module Housing:	PVC housing
Membrane tube diameter:	1 inch
Membrane:	0.05 micron
Active membrane surface area:	1.82m <sup>2</sup> per module.
Module quantity:	12 modules per train, 2 trains per unit, totaling 24 modules in this system.

## Process Schematic





## Process Description

The backgrinding and die sawing wastewater, and the UF backwash wastewater are collected and equalized in a raw wastewater tank (Equalization Tank). This wastewater is then transferred into the Recirculation Tank (also called the concentration tank). The water is then fed into the TMF system for solid/liquid separation. The Porex TMF filtered water goes to a separate product water tank and then back to the UPW system for reuse. Silicon suspended solids are concentrated during recirculation and some of this concentrate is sent to a filter press for dewatering at specified intervals. The sludge cake is transferred out of the factory, while squeezed water is sent back to the Equalization Tank.

No chemicals are fed into the system during normal operation.

## Operation Status

The system was implemented in November 2011 and system performance has met or exceeded the design specification. The initial filtrate water flow rate is higher than 16 m<sup>3</sup>/hr. Filtrate water turbidity is less than 1 NTU and filtrated water conductivity is less than 20 µs/cm.



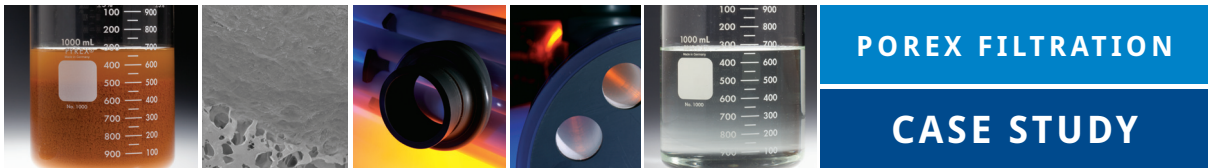
(The TMF system has no effect on product water conductivity. The low conductivity is due to the low TDS load in the influent water)

(Product water turbidity as shown in the above photo)

## Summary

The Porex TMF system is widely used for backgrinding and die sawing wastewater. The excellent filtrate quality, high recovery rate, lack of needed chemical dosing, and ease of operation make the system superior to other processes and technologies in this application.

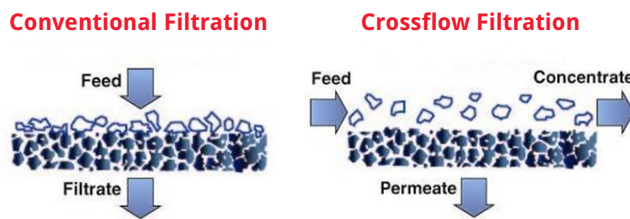
For more information, contact Porex Filtration at [www.porexfiltration.com](http://www.porexfiltration.com).



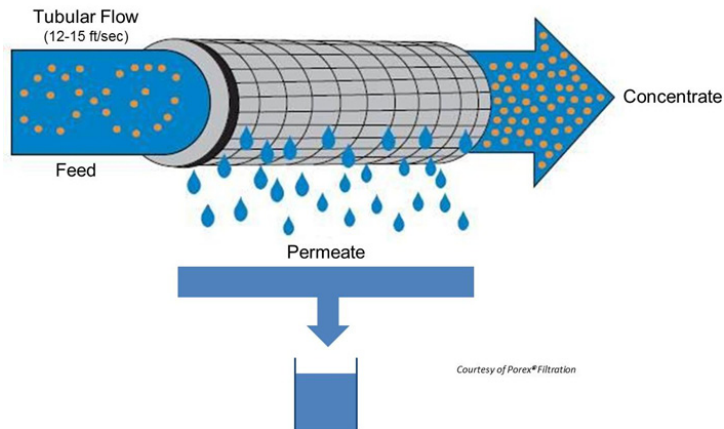
## About Microfiltration

Microfiltration is a cross flow, pressure-driven membrane separation technology designed to remove submicron (and larger) suspended solids from water supplies. It differs from conventional (“dead-end”) filtration in that in a conventional process the entire water supply passes through the filter medium, whereas in the crossflow process, a portion passes through the membrane, becoming “permeate,” while the remainder exits the system as “concentrate,” carrying away almost all of the suspended solids.

The following illustration compares these two processes.

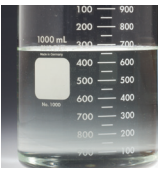
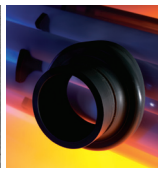
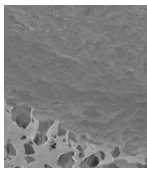


The microfiltration membranes used in this application are POREX® TMF, depicted below.



The feed flow is down the center of the tube (lumen feed) with the permeate passing through the tubular wall and collected from the area around the outside of the tubes inside the module housing.





About Microfiltration Continued

The tubes in this application are 1" I.D., with a polyethylene substrate supporting a PVDF (polyvinylidene fluoride) membrane layer with 0.05µm pores. The membrane module is illustrated below.

Each membrane module consists of thirteen 72" long tubes enclosed inside a PVC housing. Specifications on the modules and tubes are as follows:



Modules	
Housing Diameter	6"t
Permeate Port (Qty 2)	2.875 x 1.89" L pipe stub
Concentrate Ports	6" pipe Anvile Gruvlok groove
Mounting Required	Horizontal; 2 point
Module Length	72"
Tubes	
Number of Tubes	13
Nominal ID	1"
Nominal OD	1.34"
Total Active Surface Area	19.8 ft <sup>2</sup> (1.82m <sup>2</sup> )
Internal Liquid Volume	
Filtrate Volume	3.06 gallons (11.58 ltr)
Concentrate Volume	3.18 gallons (12.04 ltr)
Total Volume	6.25 gallons (23.66 ltr)
Materials of Construction	
Potting	Solvent Cement
Internal Supports	Polypropylene
Gasket Material	None
Preservative (Shipping)	Propylene Glycol
Membrane	PVDF

A total of 24 modules are in this TMF system.

Porex TMF Modules are available in multiple configurations ranging from 1 to 61 tube modules with 1 inch or ½ inch diameter membrane tubes.