Recycling of Water Based Fluids with TUF Technology
Diamond Wire Coolants

TUF Filtration Technology

CRS Tough Ultra Filtration (TUF) Technology is a proprietary, highly engineered cross flow filtration system. During the cross flow filtration process the feed stream (used fluid) is filtered into a permeate stream (re-usable fluid) and a concentrate stream (contaminants). The TUF system can be configured as microfiltration, ultrafiltration or nano-filtration, dependent upon the application and the degree of filtration required.

CRS has successfully used this technology over the last 7 years to recycle many different fluid types in many industries.

Diamond Wire Coolants

In the photovoltaic (solar) and semi-conductor industry silicon wafers are the primary starting material to make solar arrays and electronic chips. These thin wafers are created by slicing large silicon crystals with a wire saw tool. The wire used by these tools is a steel wire with a nickel coating that is imbedded with small diamonds. As this wire is passed through the silicon crystal, a great deal of heat is generated. To cool the cutting process, these saws use large volumes of coolant which are referred to as diamond wire coolants (DWC). As the cutting process continues, the coolant becomes loaded with silicon saw dust (kerf) that eventually causes the diamond wire to lose efficiency. When that event happens the wafers become damaged and must be rejected. This becomes a very expensive proposition for the wafer manufacturer especially if the manufacturer must waste and replace the coolant after each cut.

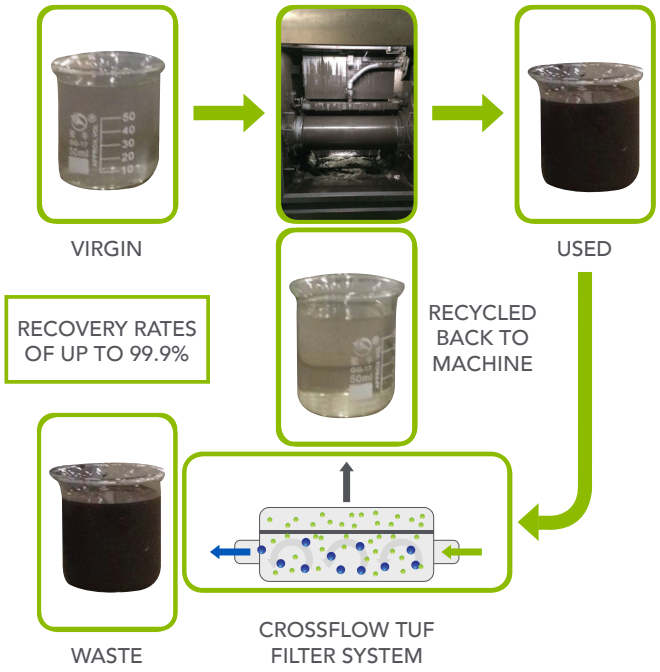
CRS has applied the TUF technology to recycling these DWC's in a very effective way. The TUF can remove the silicon solids without harming the coolant ingredients and additives. Overall coolant recovery can be as high as 99%. The right membrane selection is key to maximizing the recovery and maintaining coolant quality. Use of the TUF in a continuous kidney loop versus batch filtration mode has allowed wafer manufacturers to actually maintain steady state solids levels at or below 1%. This has led to faster cutting and improved wafer quality at reduced operating cost.

Quality:
- Silicon solids levels can be maintained at a steady state 1% on a continuous system or solids level can be maintained at <.1% at the beginning of the cut for a batch filtration system.
- Additive make up is typically less than 10%

Capacity:
- The TUF system will be designed based on the customer's specifications for capacity.
- Systems can be designed for single saws or for >200 saws on a continuous system connected with a piping manifold.

Advantages over competing technologies:
- Other filter systems using cartridges or filter presses are maintenance and labor intensive
- Filter aids are typically required
- Waste costs are higher and in most cases the coolant quality is not acceptable for reuse

Flexibility:
Add-ons to the TUF will allow:
- Automatic additive addition
- Online quality monitoring
- Unattended operation
- Automated silicon kerf drying and packaging for shipment
- Higher solid and free oil content in feed stream
- Hardness control
- H2S removal
- TDS removal



Coolant Component	Mass Percentage				Component Function
	Virgin	Before Cut (90% Water)	After Cut (90% Water)	CRS Recycle Recovery Rate After TUF Recycling	
Silicon		0	6-8% Solids	<.1% Solids	
Polyether Polyol	0.8-1.0	0.08-0.1		100%	Lubricant
Organic Silicon	1.0-1.2	0.1-0.12		80%	De-Foamer
Triethanolamine	0.2-0.3	0.02-0.03		90%	pH Regulator
Acetic Acid	0.05-0.1	0.005-0.01		100%	pH Regulator
Hydroxyethyl Cellulose	0.2-0.3	0.02-0.03		70-80%	Viscosity
Water	97.0-97.5	99.7-99.75		99%	Cooling

CRS REPROCESSING SERVICES