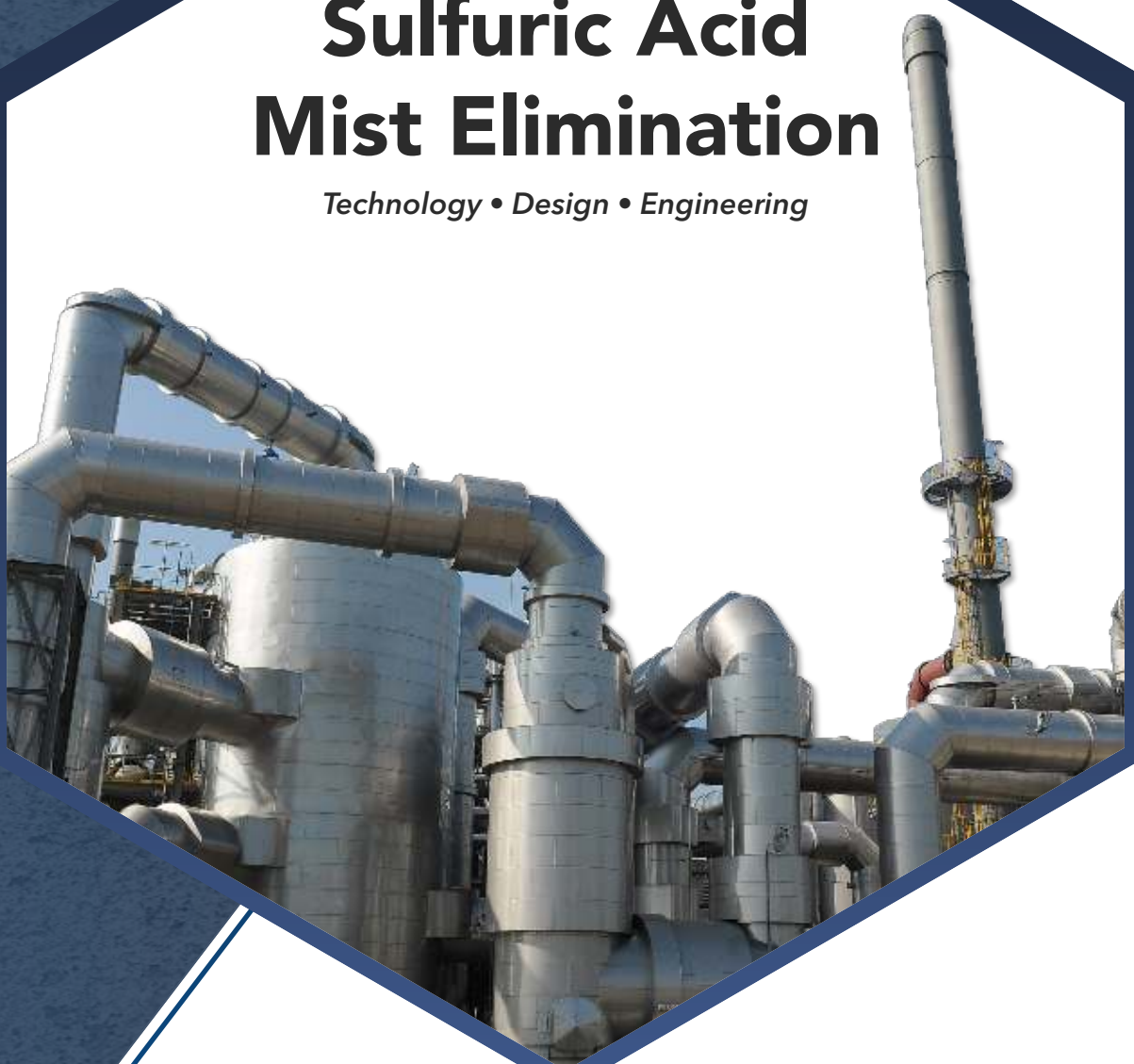
Sulfuric Acid Mist Elimination

Technology • Design • Engineering



CECO Filters

A CECO Environmental Brand

CECO Filters

A CECO Environmental Brand

CECO Filters designs and manufactures fiber bed mist eliminators (candle filters) and mesh pad mist eliminators that are used in droplet removal applications. We have more than 50 years of droplet separation / mist elimination experience in the sulfuric acid Industry. We are committed to delivering solutions to meet our customers' requirements, while optimizing their performance and efficiency. Our expertise ranges from design, manufacturing, installation and field services.

Our mist eliminators can be custom-designed and manufactured to meet even the most complex requirements of new installations, or to retro-fit existing installations. Our repacking services, consultancy, and testing provide you with added value to optimize your total cost of ownership throughout the life of your equipment.

Our aim is to deliver to our clients a complete solution. Our in-house manufacturing facilities are operated to the highest quality control and manufacturing standards. Upon completion of assembly, each filter is tested for pressure differential through the media to ensure that performance parameters will be met.

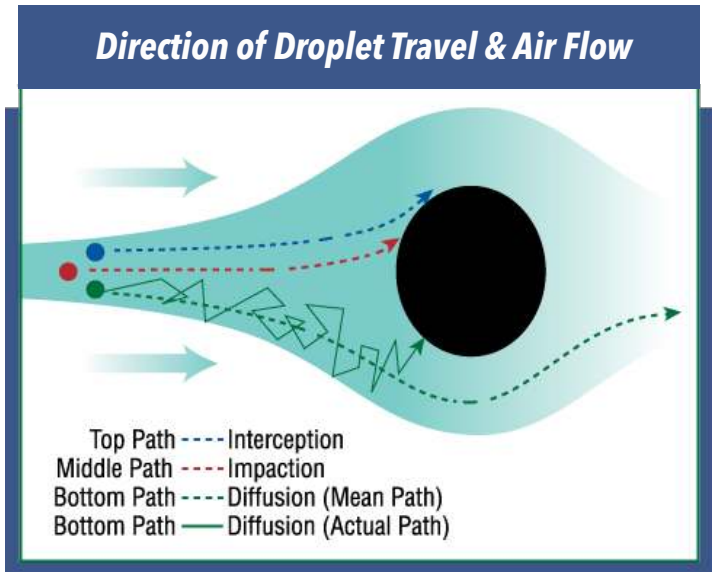


How Acid Mist (Droplets) Are Created?

Droplet formation via chemical reaction:
When two or more gaseous components react, they can instantly form very small liquid droplets (less than 1 micron) which are difficult to separate from the carrying gas stream.

Droplet formation via thermal change:
Sub-micron droplets (less than 1 micron) are formed by sudden condensation of saturated gas to liquid.

Droplet formation via mechanical action:
Droplets are formed by mechanical shearing of liquids and gas. These types of droplets are normally above 2 micron diameter.



Droplet Collection Mechanisms

Droplets within a gas stream are collected within the mist eliminator by a combination of mechanisms: impaction, interception and Brownian Diffusion. The droplets are directed through the mist eliminator with the gas. The droplets are removed by contacting fibers or wire media through the following collection mechanisms:

Impaction

Droplets larger than 2 micron in diameter move along with the gas stream until the droplet comes to an obstacle such as a fiber in the filter media. The gas stream flows around the fiber and the large diameter droplet, controlled by its momentum, continues its original trajectory and "impacts" onto the fiber.

Interception

Smaller droplets of 0.5-3 microns are collected by interception. The droplet has less momentum, and the center of gravity path goes in the same direction as the gas, around the fiber. However, the droplet has a finite diameter, and the edge of the droplet is "intercepted" by one or more fibers and is collected.

Brownian Diffusion

Sub-micron mist droplets have very little mass and little momentum, so the mean path of these droplets follows the gas stream around the fiber. However, the sub-micron particle movement mimics the random movement of a gas molecule (Brownian Motion) causing deviations away from the mean stream. With a given fiber diameter, residence time, gas velocity, bed depth, and packing density, these deviations cause the sub-micron droplet to collide with the fiber and be collected.

Sulfuric Acid Mist Elimination Technologies

Our in-house experience of sulfuric acid plant technologies allows us to clearly tailor the optimized mist elimination solutions to all our new and existing customers. Our range of equipment can be used for a wide spectrum of sulfuric acid mist elimination applications.



Sulfuric Acid Production Type	Unit Operation	Brownian Diffusion Candle Filters	Impaction Candle Filters	Mesh Pad
Elemental Sulfur Burning / Sulfuric Acid Regeneration	Drying Tower	No, (Except in some Regeneration plants)	Yes	Yes
	Intermediate / Inter-Pass Absorption Tower (IAT)	Yes	Yes	No
	Single or Final Absorption Tower (FAT)	Yes	Yes	No
	Oleum Absorption Tower	Yes	No	No
Wet Sulfuric Acid	Scrubbing Tower	Yes	No	No
Oleum Fumes Acid	Storage	Yes	No	No
Mist	Various Applications	Yes	No	No
Tail Gas Scrubber	Scrubbing Tower	Yes	No	No

Importance of Mist Removal in Critical Absorption Tower			
Safeguards	**Single Absorption Tower**	**Intermediate Absorption Tower**	**Final Absorption Tower**
Prevents corrosion to heat exchanger and economizer tubes; and avoids catastrophic and expensive damages to the downstream equipment	✓	✓	N/A
Prevents instrumentation corrosion	✓	✓	✓
Protects catalyst (Vn_2O_5) from Sulfuric acid poisoning	N/A	✓	N/A
Meets environmental stack emission regulations	✓	✓	✓



Candle Filters

CECO Filters offers a complete line of fiber bed (candle filters). CECO's technologies are used extensively in sulfuric acid production plants to enhance operating performance and corrosion resistance, and to control environmental emissions. CECO Filters takes pride in offering a variety of selection options to accommodate sulfuric acid applications. Our experts will provide or assist you with comprehensive solutions to meet your technical requirements.

Candle Filter Media and Structure Selection

CECO Filters understands the impact of harsh sulfuric acid conditions on the materials of construction for a mist eliminator. We carefully consider corrosive compounds (i.e., fluoride, ammonia), acid concentration (% wt/wt) and operating temperature before selecting the most suitable material of construction. Our objective is to maximize the useful life of our mist eliminators within each operation to ensure that our customers achieve the largest return on their investment.

Our "Graded Bed™" media bed is constructed of multiple layers of different types of media, each with desirable functionality. When challenged with sub-micron aerosol droplets, such as sulfuric acid mist, CECO Filters' Graded Bed™ filters are a proven solution for droplet removal efficiency and low pressure drop.







Fiber Media Selection Table

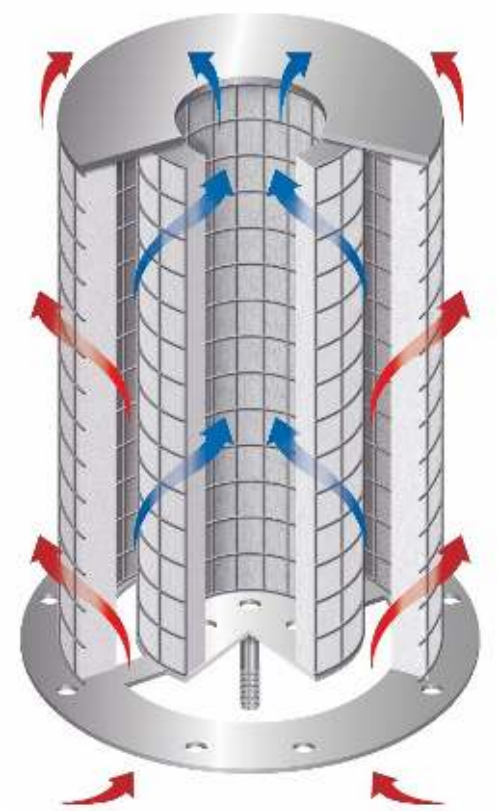
Performance (Brownian Diffusion)					
Media Type	**Fiber Material**	**Typical Efficiency**	**Pressure Drop [1]**	**Velocity**	**Hanging**
P1	Glass or as required	100% >0.6µm >99% >0.2µm	1.7-2.5 kPa 6.8-10 inwc	< 0.15 m/s < 30 ft/min	Standing or Hanging
P2	Glass or as required	100% >0.9µm >99% >0.5µm	1.3-2.0 kPa 5.2-8.0 inwc	< 0.18 m/s < 35 ft/min	Standing or Hanging
P3	Glass or as required	100% >1.1µm >99% >0.9µm	0.7-1.4 kPa 2.8-5.6 inwc	< 0.20 m/s < 39 ft/min	Standing or Hanging
P4	Glass or as required	100% >2.5µm >99% >1.6µm	0.4-0.9 kPa 1.6-3.6 inwc	< 0.23 m/s <45 ft/min	Standing or Hanging
High Capacity (Impaction)					
Media Type	**Filter Material**	**Typical Efficiency**	**Pressure Drop [1]**	**Velocity**	**Orientation**
HC1	Glass Mat and Metallic[2] Woven Mesh	100% >2.3µm >99% >1.3µm	2.2-3.5 kPa 9.0-14 inwc	1.5-2.7 m/s 300-550ft/min	Standing
HC2	Glass/Metallic[2] Woven Co-knit Mesh and Metallic[2] Woven Mesh	100% >2.9µm >99% >1.9µm	0.7-1.2 kPa 3.0-5.0 inwc	1.5-2.7 m/s 300-550ft/min	Standing
Structure Material Selection Table					
316L Stainless Steel			Polypropylene		
Aluminum 20			GRP/FRP with corrosion resistant resin (Derakane)		

[1] Clean and saturated at max velocity and 1,000 mg/NCM liquid loading
[2] Typically 316 Stainless Steel or Alloy 20

-R Media Type suffix specifies that rope fiber is part of the fiber material configuration

TWIN-PAK®

CECO Filters invented and patented TWIN-PAK® candle filters which utilize the unused inside space of the filters; giving additional surface area. This is useful for process expansions allowing up to 60% more gas flow or lower pressure drop within an existing tower.
A TWIN-PAK(R) retrofit gives you this without expensive tubesheet redesign and replacement.



Repacking Solutions

CECO Filters offers candle filter restoration services, by repacking new fiber media within the original filter structures. Often, filter structures are unphased or undamaged by the process and can be re-used. This is an economical and effective solution to avoid the unnecessary procurement of new filter replacements. This cost saving solution is available to all of our clients who are seeking an economical and effective way to renew existing candle filters by simply replacing the filter media. We offer repacking services at customer sites and at our own facility. Contact us for more information.

Stack Emissions

WHAT CECO FILTERS DO FOR YOUR STACK EMISSIONS?

BEFORE INSTALLATION



AFTER INSTALLATION



Candle Filter Benefits

- High droplet removal efficiency
- Low pressure drop
- No moving parts
- Long filter service life
- Unlimited turndown ratio
- Low operating and maintenance costs
- High surface area fiber bed packing
- Handle high liquid loading
- Variety of filter media to meet technical requirements
- Custom designed candles for new or existing systems
- TWIN-PAK® Retro-fitting solutions
- Meets Environmental Emission Standards Worldwide
- Field re-packing services either on-site or at CECO's Facilities.

Mesh Pads

CECO Filters mesh pads are designed and manufactured to meet sulfuric acid drying tower (DT) mist elimination requirements. Our mesh pads are tailored to meet new design requirements or as replacements for existing designs. Drying towers remove moisture and solid particulate through a packed bed. Large sulfuric acid droplets are created mechani-cally by the sheer force of the gas flowing counter-currently to the sulfuric acid. We understand the importance of mist removal to prevent downstream corrosion of expensive equipment such as blowers, compressors, heat exchangers.

Mesh Pad Benefits

- **High Droplet Removal Efficiency**
- **Low Pressure Drop**
- **Simple to Install**
- **Short Leads Times**
- **Cost Effective**
- **Tailored Solution**



Mesh pad mist eliminators are made of layered knitted mesh, which is individually crimped to the desired height to maintain density and specific surface area. The mesh arrangement has a high open area for gas flow to reduce pressure drop and fine wire surface area to increase droplet collection efficiency. Mist droplets collide on wire surfaces (impaction and interception collection mechanisms), and/or coalesce together to form larger droplets, which then drain to the bottom of the pad through the force of gravity. Our engineering staff has the knowledge to the identify the optimal solution while maintaining droplet removal efficiency, pressure drop, and gas capacity.

Design and Material Selection

Various arrangements can be combined to meet the desired specification for mist elimination:

- **Wire diameter**
- **Number of mesh layers**
- **Thickness of mesh pad**
- **Number of wires together**
- **Size of mesh stitch**
- **Material – Plastic or Metal**

Standard Mesh Pad Material of Selection

We can manufacture with a wide spectrum of materials to meet specific process conditions and increase the service life of the pads.

Metal

- 316L Stainless Steel
- Alloy 20

Plastics

- E.T.F.E.
- E.C.T.F.E.





We use co-knitted wire mesh configuration to enhance mist eliminators capabilities. We can knit additional fibers in conjunction with the standard wire to achieve higher surface area and in turn, higher efficiency. These additional fibers promote coalescing of droplets and achieve fine droplet removal.

Co-knitted Fiber Material of Selection

- Glass Fiber
- P.T.F.E.

Standard mesh pad knitted



Co-knitted mesh pad



Mesh Pad Selection

Our alternative mesh pad arrangements optimize the operational performance. The original method of a single stage mesh pad has been used conventionally through the years. Double stage arrangements have been introduced as new improvement designs over the last 20 years. In the dual stage configurations, the first stage demister acts as a coalescing mesh pad.

The selection is based on the desired process requirements and the type of mist generated within the tower. We have the capabilities to design the most suitable solution to meet the droplet removal efficiency and pressure drop requirements.

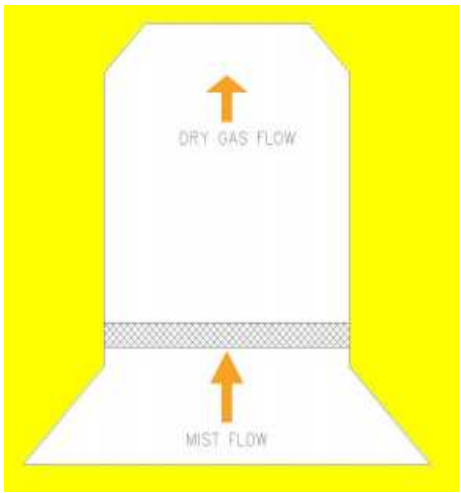
The small droplets merge together within the confined stitching of wire to form larger droplets. These larger droplets are then removed in the final stage conventional demister. This increases the droplet removal efficiency and performance of the tower. Retrofitting arrangements such as the coned shaped demister are offered to increase the contact surface area and gas flow rate. This has been proven to be an effective problem solving method for existing systems.

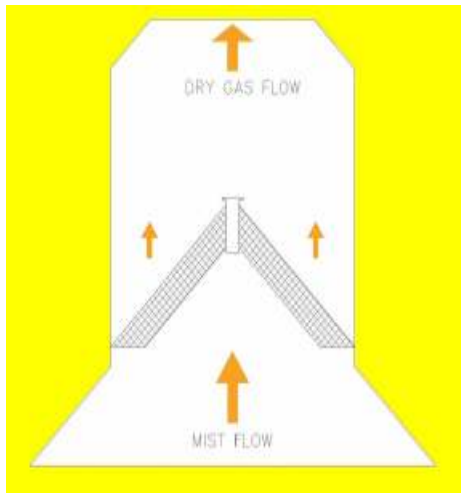
Conventional Mesh Pad and Retrofit Arrangements

Our variations of drying tower mesh pad arrangements are suited for specific cases of sulfuric acid production, and these are customized to meet process specifications.

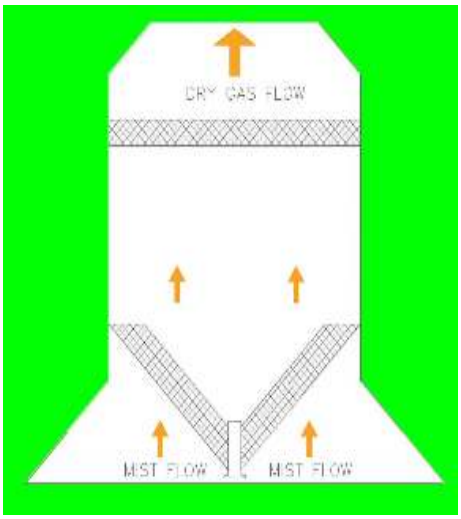
Conventional Mesh Pad and Retrofit Arrangement Selection			
Mesh Pad Arrangement	**Efficiency**	**Pressure Drop**	**Velocity Range**
Single Stage Low Pressure Drop	100% > 10 micron	0.1-0.6 kPa 0.4-2.4 inwc	2-4 m/s 395-790 ft/min
Single Stage Standard Efficiency	100% > 5 micron	0.2-0.9 kPa 0.8-3.6 inwc	2-4 m/s 395-790 ft/min
Single Stage High Efficiency	100% > 3 micron 95% > 2 micron	0.6-1.0 kPa 2.4-4.0 inwc	2-3 m/s 395-590 ft/min
Double Stage High Efficiency	100% > 3 micron 99% > 2.5 micron 98% > 2 micron	0.8-1.2 kPa 3.2-4.8 inwc	2-3 m/s 395-590 ft/min

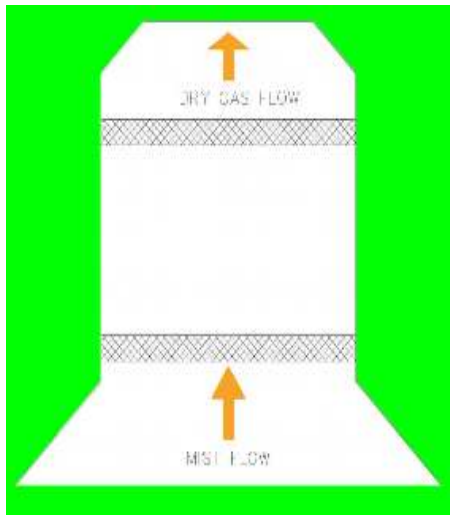
Conventional Mesh Pad Arrangement

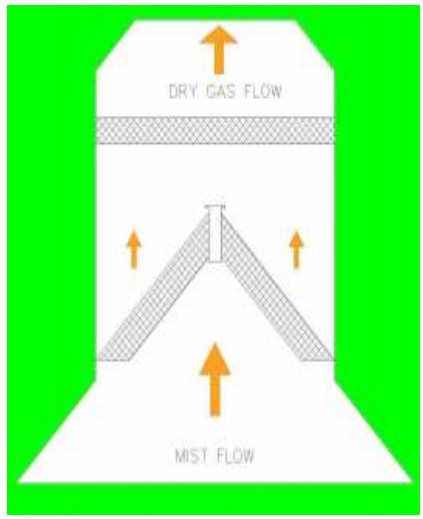


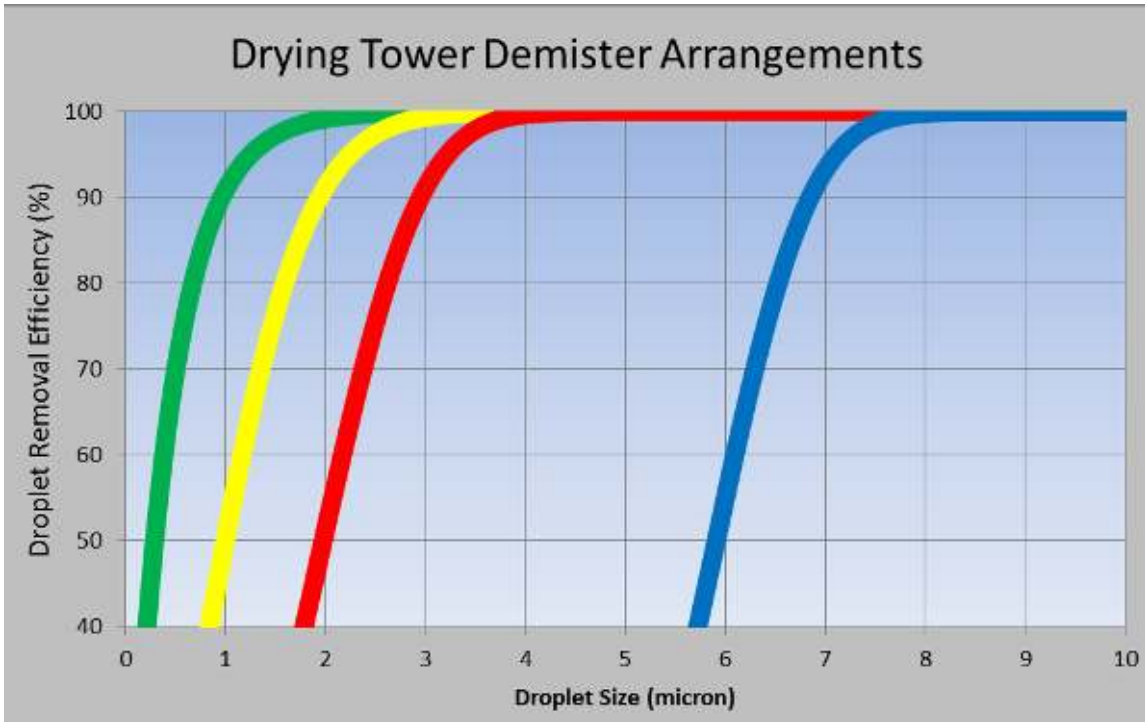


Retrofit Mesh Pad Arrangement









CECO Filters

A CECO Environmental Brand

Excellence in Pollution Control Technology, Service and Support Worldwide

CECO Filters' focus on unsurpassed customer service and innovative filter designs for the Sulfuric Acid Industry has earned us a reputation as an industry leader, providing cutting edge technology solutions for the past 5 decades. CECO Filters are designed to create cleaner processing and safer environment.

Contact Information:

USA
Factory, Engineering & Sales

CECO Environmental
700 Emlen Way,
Telford, PA 18969
USA

Toll Free: 800-220-8021
Phone: 610-825-8585
Fax: 610-825-3108

UAE
Engineering and Sales

Peerless Europe Limited
(DMCC Branch)
A CECO Environmental Brand
AU Gold Tower,
Floor 28, Office A
Cluster I, Jumeirah Lake Towers
PO Box 62435
Dubai, UAE

Phone: +971 (0) 4434 0004
Fax: +971 (0) 4434 0666

China
Factory, Engineering & Sales

CECO Environmental
Shanghai Co., Ltd.
Suite 611, No.1081,
Wuzhong Road,
Minhang District,
Shanghai, 201103,
China

Phone: +86-21-62560387