



Ceilcote

Air Pollution Control

Equipment	Systems	Technical Services	Bulletin 1201
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CEILCOTE
AIR POLLUTION CONTROL

The Ceilcote Air Pollution Control Advantage

From engineered products to complete turnkey systems, Ceilcote Air Pollution Control has the answer to your air pollution control problems.

You can be sure that your process facilities will meet environmental industry standards without excessive downtime or workflow interruption.

For over half a century, Ceilcote APC has offered the industry's broadest spectrum of equipment, systems and technical services. This experience combined with our comprehensive knowledge of EPA regulations and Air Pollution Control codes allows us to offer a fully integrated package with performance guarantees.

Contact us today to learn how our highly-experienced engineers can provide you with a fully functional air pollution control solution that will meet your environmental needs.

Over 50 years experience with air pollution control systems and codes.

Products constructed in fiberglass reinforced plastic (FRP) or other corrosion resistant materials.

Skid mounting available for ease of installation and start-up.

Extensive test data and pilot equipment capabilities.

Designer and manufacturer of FRP fans.

Exclusive manufacturer of Tellerette® Packing.

A highly-experienced engineering staff.

Your single source for air pollution control solutions.

Industries

Chemical Processing
Wastewater Treatment
Microelectronics
Pulp and Paper
Pharmaceutical
Plastics
Metals
Food Processing

Applications

Particulate Removal (including sub-micron)
Acid Gas Removal
Emergency Vapor Spill Control
Tank Ventilation Systems
Chemical Ventilation Systems
Odor Control
Foundry
Pickling and Metal Finishing
Various other Contaminant Removal

Equipment

Systems

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Bulletin 1201

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1

IWS® Systems for Submicron Particulate Removal

IWS® Systems

The Ceilcote Air Pollution Control Ionizing Wet Scrubber system is a proven technology for opacity reduction and the removal of problem pollutants from industrial process gas streams.

Our patented Ionizing Wet Scrubber (IWS®) system combines wet scrubbing with electrostatic particle charging for simultaneous collection of large particulate down to submicron particulate and absorption of gases. Unlike traditional electrostatic precipitators, the IWS® will collect particles with either high or low resistivity.

Ceilcote's IWS® system charges the particulate before it enters the packed bed scrubber section containing Tellerette® packing. Some of the particulate is captured on the ionizer plates, while the majority of particles are captured on the packing via image force attraction and electrostatic principles. Acid gases are also absorbed and treated.

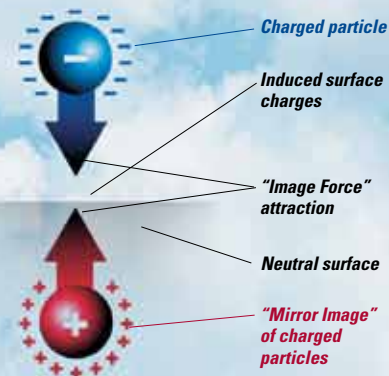


Figure 1: Primary collection method—*image force attraction (patented process).*

Highlights:

- Collects particles of almost any size or composition: organic or inorganic, solid or liquid and with either high or low resistivity.
- High turn-down: collection efficiency improves with turn down from 100% to near zero load.
- Low energy consumption: pressure drop through a single stage IWS® is only 0.50 to 1.5 inches WC. Energy for particle charging is low approximately 0.2 to 0.4 KVA per 1,000 ACFM.
- Particle collection/gas absorption: particles of any size or composition are collected by image force attraction (see Figure 1) with high efficiency—from 0.05 to 2 microns and larger. Simultaneously, noxious gases are removed through absorption and/or absorption in concert with chemical reaction.
- Modular design permits expansion. Staging available for higher efficiency performance.
- Demonstrated particulate removal in applications as diverse as hazardous waste incineration and veneer drying to glass manufacturing.
- Uses Ceilcote APC Tellerette® packing that combines low pressure drop with high particulate removal efficiency.
- Corrosion resistant construction.
- Various types of alloy constructions are available depending on the corrosiveness of the environment.

This two-stage IWS® is designed to remove submicron particulate from a fluorescent light manufacturing process.



Twenty-two Ceilcote APC countercurrent scrubbers remove acid emissions from a microelectronics facility.

Countercurrent Vertical

This scrubber is most commonly used for the removal of noxious gases from airstreams. It is designed for high collection efficiencies and maximum corrosion resistance. The unit is compact—ideal where floor space is at a premium. Availability of standard models reduces design, engineering and drafting time, and shortens delivery.

Crossflow Horizontal

Flexible and efficient for removing gases from exhaust airstreams. This scrubber design is characterized by low liquid irrigation rates, high volume airflow and low pressure drop. It is ideal where ceiling height is limited or where roof mounting is required.



Highlights:

- Effectively removes particles down to 7 microns through inertial impaction.
- Removes gaseous contaminants at high efficiency rates depending on bed depth, liquid flow rate and scrubbing-liquid composition.
- Lower portion of scrubber shell serves as integral sump providing recirculating liquid supply.
- Multi-Bed Crossflow scrubber can remove two or more gaseous contaminants. Independent packed bed sections can accommodate different scrubber solutions (Crossflow only).

Standard units:

- Include all component parts: access doors, spray headers, piping connections and nozzles, internal structure supports, Tellerette® Tower Packing, support plates and hold-down lugs.
- Can be customized for special process requirements.
- Available from 100-100,000 ACFM. Higher flow rates are available.

Application: Odor Control

Ceilcote Air Pollution Control has over 500 odor control installations throughout the world that eliminate odors from a wide variety of applications. These systems are tested and guaranteed to perform to your specifications. The crossflow scrubber (**shown at the right**) represents a typical installation where Ceilcote APC was called upon to control H₂S and other odors from a municipal wastewater treatment facility. The low profile of these units allow for roof mounting, thus saving floor space for other facility needs. Ceilcote APC blowers are constructed using corrosion resistant materials. These fans are designed to provide the required air exchanges for the facility, thus minimizing worker exposure.

Contact Ceilcote APC for guaranteed elimination of your odorous emissions.

One application for the crossflow scrubber is for removing hot acid vapors from steel pickling lines.



3

Venturi Scrubbers

Venturi Scrubbers

Ceilcote APC engineers have designed a complete line of venturi scrubbers for a broad range of applications. These systems are relatively inexpensive and achieve high removal efficiencies.

VSV

Our standard or variable throat venturis are used for removal applications ranging from large particle sizes down to sub-micron range.

Highlights:

- Removes particulates and highly soluble noxious gases.
- Design promotes thorough mixing and contact of entrained particles in gas stream and liquid droplets.
- Can be used as quenching chamber and evaporator.

MTV (Rod Scrubber)

This is an ideal, cost effective way to achieve 99% and higher efficiencies for heavy particulate loadings.

Highlights:

- Maximum collection efficiency with particulate loadings of 1 grain to 5 grains per ACFM and greater at minimum energy and scrubbing liquid rate.
- Mist eliminator wash with self-cleaning, self-draining design minimizes maintenance.
- Easy pressure drop adjustment by adding or subtracting rods. Rod sections are easy to inspect and replace.

Application: Emergency Vapor Spill Control

Many operations only require use of a scrubber system on an emergency basis. One such application is for emergency release of a hazardous or toxic compound. Typical of these applications are facilities handling chlorine from cylinders. In this situation, a scrubber needs only be on standby until a release occurs. Ceilcote APC has designed a full range of equipment to deal with these applications. The



This Eductor Venturi is used to control highly toxic emissions for an electronics manufacturing facility.



Eductor

The Eductor Venturi is recommended for the removal of particulate matter and noxious gases where a compact, highly efficient scrubber is required. Ideal for tank venting, gas scrubbing and low volume exhaust applications.

Highlights:

- Collection efficiencies of 80 to 90% where gas is highly soluble or reactive with scrubbing liquid using a single stage eductor.
- High removal efficiencies can be achieved by using multiple eductors in series.
- Can achieve inlet static pressures up to 10 inches WC.
- No fan required.

installation shown at the left handles intermittent venting of returned gas cylinders for an industrial gas supplier. Ceilcote APC provided the complete skid-mounted system with controls for chemical monitoring. Contact Ceilcote APC for your special ventilation requirements.

Packaged Interel Systems

Ceilcote Air Pollution Control/Interel pre-engineered gas absorption scrubber systems are built to fit your specific needs. We design small footprint, self-contained solutions to accommodate limited floor space and safety concerns. Each system is pre-wired, pre-plumbed, pre-assembled and pre-tested for fast delivery.



MS MiniScrubber with a simple, sparger tube design; 500-6,000 ACFM. Used for lab hoods, core machines and process tanks.

MS MiniScrubber

Designed for processing small to medium gas flows. Used for lab hoods, vents, core machines, chemical processing and a wide variety of applications.

Highlights:

- Available in 7 sizes from 500 to 6,000 ACFM.
- Removal efficiency in the range of 95-99%.
- Simple in design. Fabricated in corrosion-resistant polypropylene. Easy to install.
- Includes a built-in fan.
- Sparger type design eliminates the need for liquid circulation pump and spray nozzles.

GKP/GWP/GWF Scrubbers

Offered in a wide variety of pre-engineered options to meet your needs.

Highlights:

- GKP comes with an integral pre-installed fan with air flow rates from 900 to 10,000 ACFM.
- GWP comes without the fan in air flow rates from 900 to 10,000 ACFM.
- GWF comes without the fan in air flow rates from 900 to 60,000 ACFM. Fabricated in FRP.
- Emission removal efficiency as high as 99.99%.
- Fabricated in thermoplastic or FRP.
- Fully featured complete prepackaged scrubber systems.
- Easy to install, start up and operate.

IC Scrubber

Designed to process small gas flows, high concentrations of gas emissions and/or very high absorption efficiencies. Used for storage tank vents and other intermittent operations.

Highlights:

- Available in 4 sizes from 100 to 400 ACFM.
- Packing height and type of packing can be selected to meet any scrubbing efficiency.
- Simple in design. Fabricated in corrosion-resistant polypropylene.
- Has no moving parts and is easily serviced.

The GKP is a high efficiency, self-contained packed bed scrubber with an integral fan for a wide range of applications.



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Packaged
Interel
Systems

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Air Washers, Strippers (Aeration Towers), Sieve Tray

Air Washers

Our simple, low-cost air washers are designed to remove low concentrations of large solid particulate and liquid particulate (entrained, carry-over and mist) from exhaust airstreams.

Highlights:

- Particulate collection through high-efficiency Tellerette® packings.
- Collection efficiencies as high as 99% for particulates of 7 microns and larger with inlet concentrations as low as 50 PPM by weight.
- Irrigation rates as low as 1 GPM per 1,000 ACFM.
- Pressure drops of 1.0 inches WC and lower, results in extremely low operating costs.

Strippers (Aeration Towers)


For high-efficiency removal of volatile organic compounds (VOC's) found in ground water supplies, industrial wastewater and process effluent.

Highlights:

- Standardized towers pre-engineered to assure quick delivery and low cost.
- Uses high efficiency-low pressure drop Tellerette® packing.
- Custom-designed strippers available for special process conditions and unusual contaminants.

Application: NOx Removal

In response to our customers' needs, Ceilcote APC has developed a wet scrubber system that eliminates oxides of nitrogen plus the acids that usually accompany them. Ceilcote Air Pollution Control DeNOx Systems range from one to five stages depending on the severity of the application and the mix of NOx in the emission stream. An integrated control system is also included to minimize chemical consump-



Air washers effectively remove particulate and entrained liquids from a variety of industrial processes.

Sieve Tray

Used for recovery and concentration of acid gases or other soluble gaseous contaminants. Will handle relatively high inlet solids loadings while using less water than packed bed scrubbers.

Highlights:

- Sieve Tray Scrubbers employ step-wise contact on a number of trays arranged to disperse the gas stream through a layer of liquid on each tray. Liquid flows downward from stage to stage while gas rises through perforated trays.
- Standard models can be customized to accommodate individual requirements depending on rate of mass transfer and overall removal efficiencies desired.
- Scrubber requires no recycle pump since lower liquid rates provide for a once-through operation. Energy savings further enhance cost effectiveness.
- Resists plugging.

tion while maximizing NOx removal efficiency. The two-stage system shown at the left was installed to control emissions from a plating line. The first stage removes acid gases and the second stage reduces NO₂, effectively eliminating the visible plume from the facility. Contact Ceilcote for all of your NOx removal needs.



Cooling and Condensing Towers

Ceilcote APC's cooling and condensing towers are exceptionally efficient in reducing temperatures of corrosive process liquids and cooling water.

Highlights:

- Direct contact cooling of corrosive solutions.
- Typical fill of Type-K Tellerette® Tower Packing achieves, under normal ambient air conditions, a 5°F or better approach temperature.
- Ceilcote APC mist/drift eliminator with chevron blades limits drift loss to less than 0.005% of the flow.

Quenches

Ceilcote APC offers a variety of specially designed quench chambers for the adiabatic cooling of hot gas streams.

Highlights:

- Used in combination with other scrubbers for maximum design benefit.
- Choice of materials to meet temperature requirements:
Refractory-lined steel for high temperatures.
Heat resistant fiberglass for low temperatures.
Alloy steels or refractory-lined fiberglass for medium temperatures.

Wet Cyclone Scrubber

More efficient than spray towers in removing mists and dusts from airstreams. The wet cyclone achieves higher throughputs by forcing gas into a spiral flow pattern.

Highlights:

- Low energy requirements.
- No internals to plug with solids.
- Collection efficiencies down to 5 microns.
- High-pressure spray nozzles produce extremely small liquid droplets. This enhances collection efficiency.
- Cyclone scrubbers are designed to remove dust along with mist particles by centrifugal force and interception.

Ventilation Products

Ceilcote APC's ventilation products include hoods, stacks and ductwork that complement our scrubber systems.

Highlights:


- Hoods are in accordance with "Industrial Ventilation Handbook" and OSHA guidelines.
- Stacks are engineered for size, design, function, wind loading, and earthquake hazards.
- In addition to customized ductwork, a complete line of accessories includes blast gates, elbows, reducers, weather caps and roof skirts.

TriMode Scrubber

Our three-in-one TriMode is a cost-effective solution to small-volume air pollution problems. It provides reliable and highly efficient control of noxious fumes and entrained particulates.

Highlights:

- Handles corrosive mists, gases and particulates with non-plugging operation at performance efficiencies to 99+%.
- Compact design for floor, mezzanine or roof mounting.



Many Ceilcote APC products were integrated into this hazardous waste incineration system resulting in cost savings and guaranteed performance.

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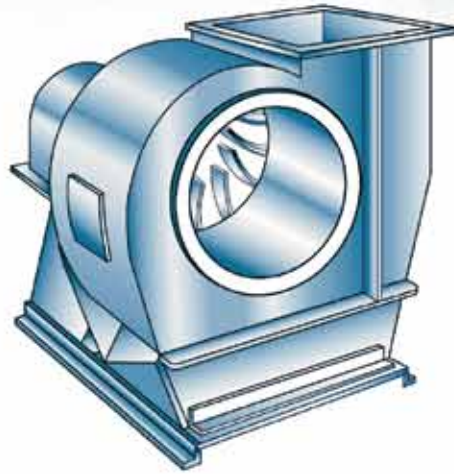
Additional Products

7

Fiberglass Reinforced Plastic (FRP) Fans

Centrifugal, Axial and In-line Centrifugal Fans

Our rugged, lightweight fans are designed to exhaust corrosive air in chemical environments. Housings and impellers are constructed of premium grade vinyl ester resin using "C" chemical glass surface veil inside and outside or optional nexus veil for protection. Ceilcote APC has over 40 years of experience designing and manufacturing fans. Custom or stock fans are available.

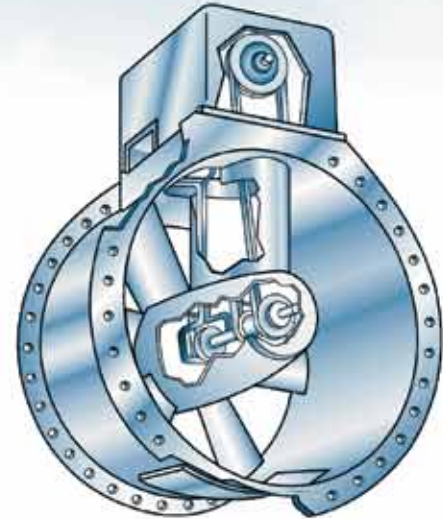


Centrifugal

50-150,000 ACFM at static pressures up to 40" WC. Many sizes ranging from 8" to 88" diameter.

Models:

CLUB Backward Curved Blades
CMHR Forward Curved Radial Tip Blades
CMHP Radial Blades
CH Forward Curved Blades
CHP Radial Blades
CLMR Forward Curved Radial Tip Blades
CLMP Radial Blades

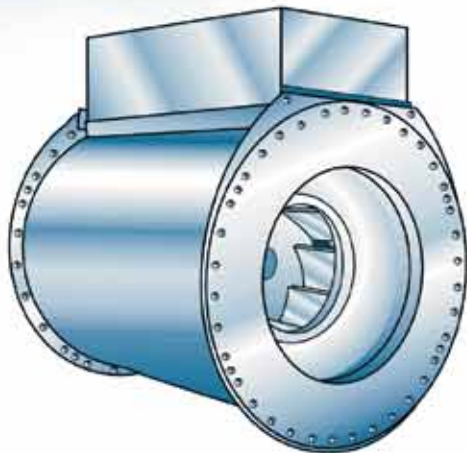
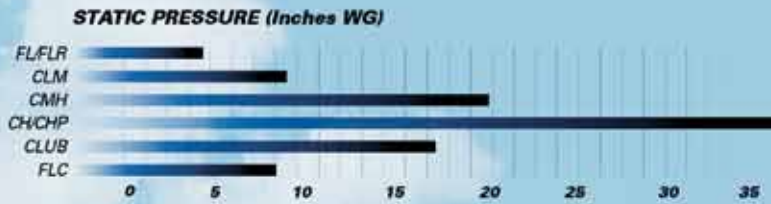


Axial

50-110,000 ACFM at static pressures up to 2.5" WC. Eleven sizes ranging from 1" to 72" diameter.

Models:

FL Propeller Blades, Duct Mounted
FLR Propeller Blades, Roof Mounted



- All surfaces have "C" grade fiberglass veil or optional Nexus veil to protect against weathering, fumes, spillage, and ultraviolet attack.
- Quality guaranteed to AMCA standards for performance and C-582 and D-4167 ASTM specifications for fiberglass fabricating procedures.
- Extremely low vibration; as low as 0.025 in./sec. for direct drive and as low as 0.0785 in./sec. for belt drive.
- Lightweight FRP Fans; structural requirements are significantly less than steel or alloy fans.
- Spark-resistant construction.

Fan Accessories:

- Many arrangements: 10,9,8,4 or I-E.
- Customer-selected resin and/or veil system.
- Titanium, Hastelloy and other alloy shafts and impellers.
- Custom-sized outlet and inlet transition.
- Access door.
- OSHA canopy, belt and shaft guard.
- Shaft seals; stuffing box, teflon, mechanical or special.
- Graphite Impregnation.
- Inlet boxes.
- Acoustical treatments: housing insulation*, silencers and enclosures.
- Dampers/inlet vane controls.
- Backvanes on impellers.
- Birdscreen.
- Variable frequency drive.
- Removable bearing assembly (axial fans).
- No-loss stack.
- Custom accessories to meet your needs.

In-line Centrifugal

200-75,000 ACFM at static pressures up to 8" WC. Seven sizes ranging from 18" to 66" diameter.

Models:

FLC Backward Curved Blades

Centrifugal Fan Impeller Styles

- Backward-curved impeller for non-overloading horsepower.
- Paddle-wheel impeller to handle high-pressure airstreams with solids present.
- Forward-curved radial-tip self-cleaning impeller for high-efficiency exhaust of airstreams with moderate solids.

Highlights:

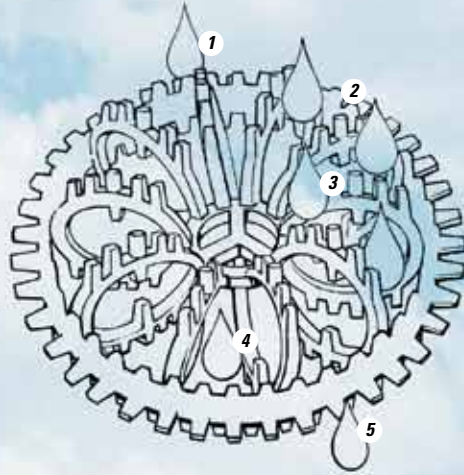


This CLUB 7300, backward curved blades (73" dia. wheel) is currently being used at a microelectronics facility.

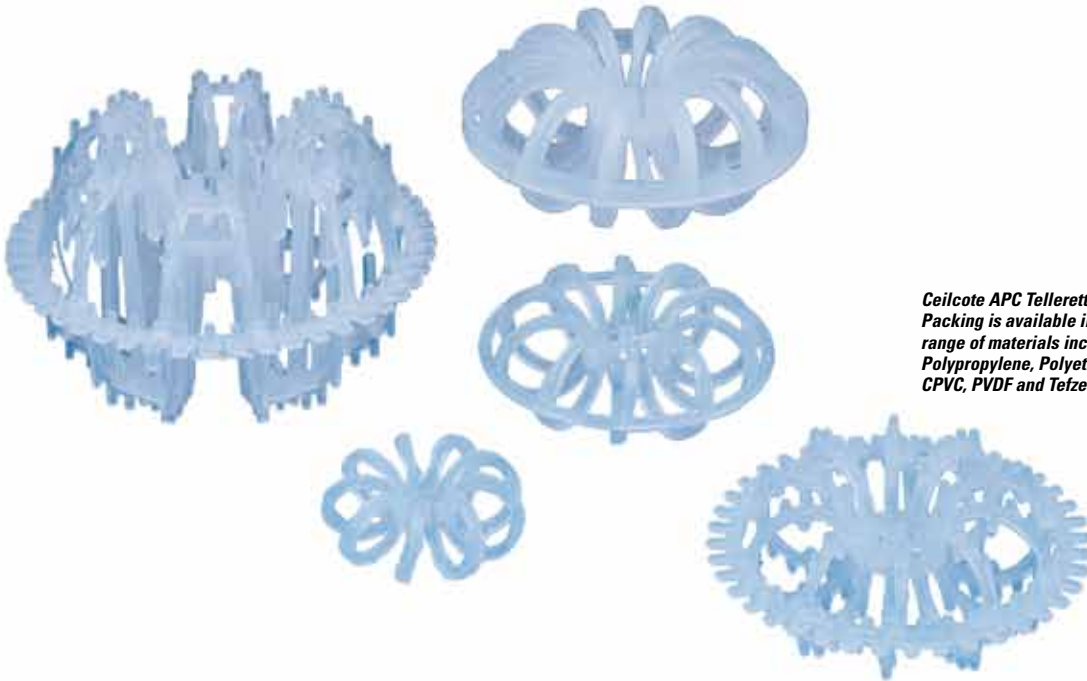
**Unique Ceilcote APC design*

8

Tower Packings and Internals



- 1 *Liquid is collected by inertial impaction*
- 2 *Droplets form at countless interstitial holdup points*
- 3 *As each droplet falls, it strikes the next packing element and bursts, exposing fresh surface to gas*
- 4 *This agglomeration/dispersal cycle repeats continuously with no additional energy requirements*
- 5 *Contaminants are absorbed with unique efficiency*



Tellerettes®

Tellerette® Tower Packing has a unique patented toroidal helix design that makes them dramatically more efficient than conventional packings in a wide range of mass transfer and particulate collection applications.

Highlights:

- Effective with high-solid particulate loading.
- Constantly renews and exposes liquid to the gas flow.
- High efficiency—low packing depth in new columns and high absorption efficiency in existing columns.
- Greater gas flow capacity—permits use of small diameter, low cost columns.
- High column stability. No classic flooding.
- No channeling when proper liquid distribution is used.
- Reduces operating costs.
- A shallow bed of Tellerettes® provides effective mist elimination.

Ceilcote APC Tellerette® Tower Packing is available in a wide range of materials including Polypropylene, Polyethylene, PVC, CPVC, PVDF and Tefzel.

Normal Packing Size	Maximum Dimensions O.D.	Loop Height	Free Volume (%)	Surface Ft ² /Ft ³	Average Packing Factor	Material of Construction
No. 1-Type R	1.81"	0.75"	87	55	36	■
No. 2-Type R	2.75"	1.00"	93	38	18	■
No. 3-Type R	3.75"	1.50"	92	30	16	▲
No. 2-Type K	3.25"	1.25"	95	28	11	■
No. 3-Type K ◦	4.125"	2.19"	96	22	9	▲

◦ Patent pending
 ■ Available in PE, PP, PVC, CPVC, Kynar, Noryl, Tefzel
 ▲ Available in PP only

Mist Eliminators

Ceilcote Air Pollution Control mist eliminators remove liquid entrainment from gas streams, thus providing high efficiency and low pressure drops in scrubbers, cooling towers, air washers, gas absorbers and ventilation systems.

The chevron type offers high performance with mist removal efficiencies often approaching 100%. They also provide excellent resistance against plugging in applications with high solids loading.

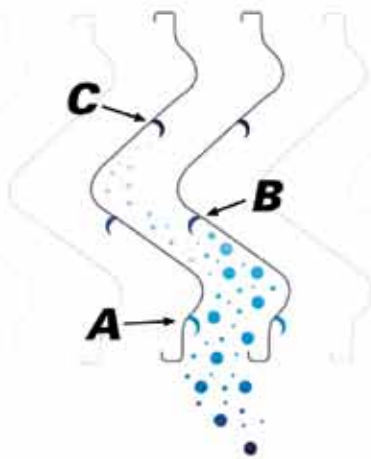
Mist eliminators work on the principle of direct impaction combined with centrifugal force.



Ceilcote Air Pollution Control chevron mist eliminators are available in Noryl® thermoplastic, vinyl-ester fiberglass reinforced plastic, carbon and stainless steel.

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Mist Eliminators and Tower Internals



In the above illustration, the first liquid collection trough (Point A) is critically located to remove the majority of entrained moisture droplets and minimize pressure drop.

Particles that miss the first trough impact on the second collection trough (Point B). Here they remain to drain, as there is insufficient velocity and energy to re-entrain the droplets into the air stream.

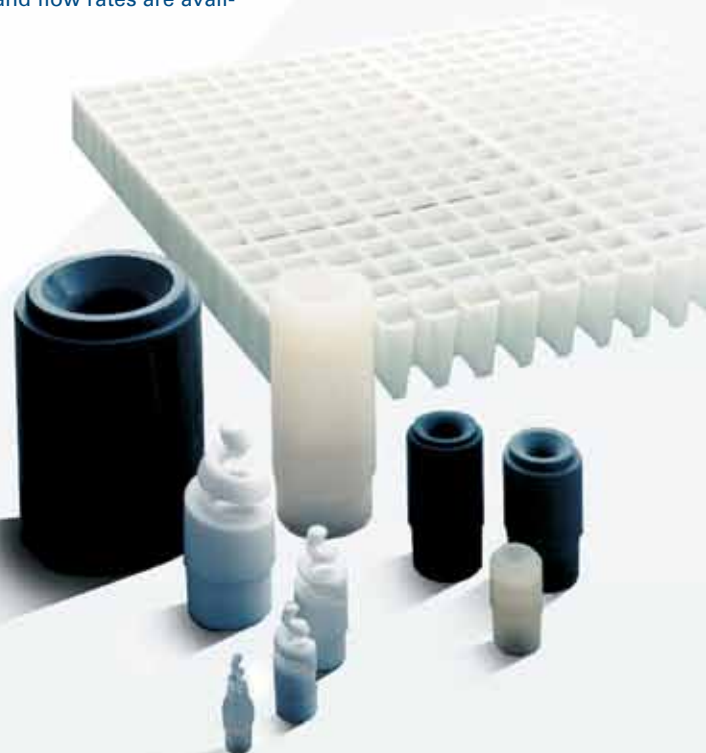
Any droplets small enough to bypass both the first and second troughs are collected at the third trough (Point C). This third trough increases the overall reliability and collection efficiency of the mist eliminator.

Tower Internals

Ceilcote Air Pollution Control offers a complete line of packing support plates and spray nozzles to complement our line of Tellerette® packing.

Highlights:

- Packing support plates provide maximum free passage (open area), minimize solids deposit and allow easy flushing and cleanability.
- A complete line of full cone spray nozzles provide for uniform distribution.
- Various spray angles and flow rates are available.



Ceilcote APC offers a diverse range packing support plates and spray nozzles.

10

Aftermarket and Field Services

Pilot Test Equipment

We have a comprehensive line of pilot test equipment you can lease and set up to receive a slipstream (300-2000 ACFM) from the gas stream under study. Our equipment is self-contained and modular.

Ionizing Wet Scrubber (IWS®)

With ionizer, charged particle crossflow scrubber, high-voltage electrical equipment, exhaust fan, prescrubber and ducting. (Maximum capacity - 2000 ACFM.)

Typical Applications: removal of submicron particulate, including condensed organics.

Packed Towers Scrubbers

Will accept process slipstream of 100-2000 ACFM. Each scrubber is complete with Tellerette® Tower Packing, recirculation pump, piping, tubing and chemical storage tank.

Typical Applications: odor control, mass transfer studies, ground water stripping, cooler/condenser studies.

Miscellaneous Equipment

For conditioning the air stream prior to entering other Ceilcote APC pilot equipment.

Spare Parts

- Tellerette® Packing
- Chevron Blade Mist Eliminators
- Mesh Pads
- Impellers
- Bearings
- Flexible Connectors
- Motors
- Flow Sensors
- Recirculation Pumps
- Metering Pumps
- Gauges
- Valves
- Spray Nozzles
- Circuit Boards
- Flowmeters

Field Support Services

Ceilcote APC's highly-trained technicians are available to assist in the installation, start-up, testing, and training of Ceilcote APC supplied equipment.

We also provide evaluations of existing air pollution control equipment to upgrade system performance and/or capacity to meet future emission requirements.

Should your system require immediate attention, our technicians are available 24 hours a day for emergency services.

**For over 50 years
we have provided
single products or
turnkey systems
for:**

Noxious gas removal

Corrosive liquid
particulates
(mists) removal

Submicron particulate
removal

Odor reduction
(caused by airborne aero-
sols and gases)

Product recovery



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Ceilcote Air Pollution Control has a network of qualified representatives in the U.S. and Canada ready to serve you. Answers to your air pollution control needs are only a phone call away.

To find the name of the representative nearest you, call Ceilcote Air Pollution Control sales offices at 800.554.8673 or 440.243.0700.

Strong product/system support is an integral part of Ceilcote Air Pollution Control's resource capabilities. We are broadly experienced in the design, engineering and installation of a wide range of air pollution control equipment and systems. We will undertake contracts ranging from consulting engineering to complete green field turnkey projects.

Products and Services

Air Pollution Control Systems
IWS® Systems
Odor Abatement Systems
Ventilation Systems
Wet Scrubbers
Tellerette® Tower Packings
Mist Eliminators
FRP Fans
Venturis

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