







Mist Elimination

ECKOCH-OTTO YORK

SEPARATIONS TECHNOLOGY

OTTO YORK

A Koch-Glitsch, LP business group

Type- BD PRFII, 12" \$ 18" 19

KOCH-OTTO YORK®

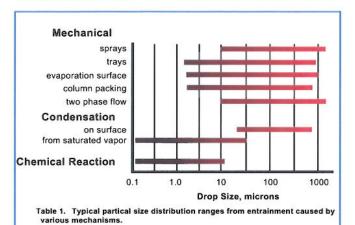
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Why Entrainment Occurs

In any process where gas and liquid come into contact, the gas will entrain some liquid. This entrainment is generated by three basic mechanisms: mechanical action, condensation and chemical reaction.



The droplet sizes can often be estimated with good accuracy. For initial evaluation, experience shows that droplets generated by mechanical means are mainly over $5\text{-}10\mu$ in diameter. Entrainment from a boiling or bubbling liquid surface will form droplets down to just a few microns in diameter, so careful consideration to performance requirements must be given to equipment such as evaporators, tray columns and steam boilers.

Entrainment swept off the surface of packing or the surface of heat exchanger tubes consists mostly of relatively large, easily removed droplets. But extremely fine entrainment is often generated when a liquid condenses from a saturated vapor, as in a compressor where lubricating oil is locally heated and vaporized, and then quickly condenses causing very fine "blue smoke" entrainment.

When two gases such as SO₃ and water react to form a liquid product, sulfuric acid, this requires high efficiency separation equipment.



FLEXICHEVRON® mist eliminator style VIII in FRP.

Benefits of Using a Mist Eliminator

To reduce loss of valuable chemicals

mist eliminators can markedly cut glycol, amine or solvent consumption in absorber and distillation towers.

To increase throughput capacity

anywhere gases and liquids come into contact in process equipment, significant velocity increases will be made possible by installing a mist eliminator.

To improve product purity

mist eliminators can prevent contamination of side draws and overheads in refinery atmospheric and vacuum towers, and other distillation columns.

To eliminate contamination

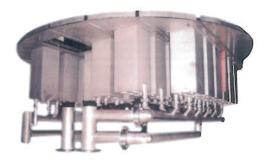
mist eliminators can prevent poisoning expensive downstream catalysts. They provide boiler feed water quality condensate from evaporator overheads.

To provide equipment protection

of molecular sieve dryers, prevent corrosion of ductwork and heat exchangers, turbine and compressor blades, eliminating serious maintenance problems.

To prevent air pollution

mist eliminators help reduce droplet emissions to environmentally acceptable levels.



SpiraFlowTM Cyclone mist eliminator assembly for a vertical vessel with mounting deck and liquid drain piping.



Types of Mist Eliminators

Almost all mist elimination equipment falls into four classes: vane assemblies of chevron-shaped blades, cyclones, knitted mesh types, and fiberbeds.

When the vessel size is not set by the mist eliminator, such as packed or tray towers, heat exchangers or evaporators, the practical starting point is often the mesh pad type. DEMISTER* knitted mesh mist eliminators provide high separation efficiency at the lowest installed cost.

If the mist contains solid particulates, viscous, sticky liquids, or if large slugs of liquid occur, the fouling resistant FLEXICHEVRON* mist eliminator, or, in extreme cases, tangential inlet multi-cyclones, may offer a better solution. These concerns have made this equipment the standard starting point in industries like oil & gas production.

Where the vessel size is set by the mist eliminator, then the benefits of high capacity FLEXICHEVRON® mist eliminators or SpiraFlowTM Cyclone mist eliminators could be the most cost effective overall solution.

	Knitted Mesh	Van	Cyclone	Fiber Bed
Cost	1	2 <mark>-</mark> 3	3-5	10
Gas Capacity	5	6-15	15-20	1
Efficiency	3-10μ	10-40μ	7-10µ	<0.1µ
Pressure Drop WC	, <25mm (1")	<10-90mm (0.4" - 3.5)	200-350mm (8" - 14")	50-500mm (2" - 20")
Liquid Capacit	y 5	10	10	1
Solid Handling	3	10	10	1

Table 2. Selection guide for choosing from the various common mist elimination equipment. The relative scale used in several categories is based on 1 as the lowest, and the others are scaled.

For applications involving sub-micron particles, FLEXIFIBER[®] mist eliminators provide excellent solutions.

While these comments help clarify selection, your final selection should be made only after reviewing your application with an equipment designer of proven expertise. KOCH-OTTO YORK*, provides an enormous resource to help you make the best choice for your particular application.



DEMISTER® mist eliminator style 709, in stainless steel.

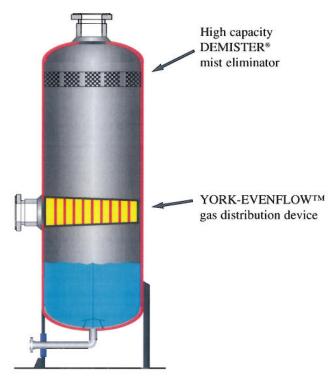


FLEXIFIBER® mist eliminator type IC-SRF.



DEMISTER® Mist Eliminators

The DEMISTER* mist eliminator is an assembly of YORKMESHTM knitted mesh supported on, and held down by high open area grids. It is made to any size and shape. Stainless steels and exotic alloys are fully annealed to provide maximum corrosion resistance.



When a vapor stream carrying entrained liquid droplets passes through a DEMISTER* pad, the vapor moves freely through the YORKMESHTM knitted mesh, but the inertia of the droplets causes them to contact the wire surfaces, coalesce, and ultimately drain as large droplets.

DEMISTER* mist eliminators are available in all 300 and 400 series SS, Alloys 200, 400, 600, 800, etc., Alloy 20, titanium, tantalum, aluminum, copper, polypropylene, Teflon*, Halar* and Kynar* and more than 80 other metals and 30 non-metals. For example, Alloy 66 is a specially designed material to extend service life in sulfuric acid plants.

- * Teflon® is a registered trademark of EI DuPont de Nemours.
- * Halar[®] is a registered trademark of Ausimont.
- * Kynar* is a registered trademark of Elf Atochem.

Design Parameters

For general design, Equation 1 has been used as a velocity guideline for many years:

$$V=K [(\rho_L - \rho_V)/\rho_V]^{1/2}$$

Equation 1

		<u>Metric</u>	English
V =	design velocity	m/sec	ft/sec
ρ _L =	liquid density	Kg/m ³	lb/ft³
ρv =	vapor density	Kg/m ³	lb/ft3
K =	capacity factor	m/sec	ft/sec

The recommended value of "K" varies depending on several system factors, including liquid viscosity, surface tension, entrainment loading, content of dissolved and suspended solids, and the operating pressure. Recommended "K" values are also highly dependent on the mesh structure.

For over 40 years, the industry has used K=0.107 m/sec (0.35 ft/sec) as a standard guideline for calculations based on traditional KOCH-OTTO YORK* styles (see Table 3) which have become the worldwide standard in the chemical process industries. Excellent performance is obtained from 30-110% of the calculated value. Operating pressure drop is usually negligible, <25 mm water (1" WC). For high vacuum applications, high performance is routinely achieved with ΔP on the order of 2-3 mm water (0.1" WC).





The State-of-the-Art DEMISTER® Mist Eliminator

Over the past several years, KOCH-OTTO YORK* has developed and refined a new family of styles, replacing the traditional styles KOCH-OTTO YORK* originally introduced shortly after founding the company in 1947. These new styles take advantage of improved knowledge about how the internal wire geometry affects capacity and performance in the same way that structured packing surpassed dumped packing performance. Compared to the older styles, the new KOCH-OTTO YORK* styles provide:

- · 20% higher design velocity, or more.
- 10 to 15% lower pressure.
- · Higher efficiency at design velocity.
- · Equal or better corrosion and fouling resistance.

Table 3

Traditional Style	New Style	Capacity Gain	Efficiency Gain	Description	
371	215	>35%	Same	Glass fiber & metal for maximum efficiency	
326	194	>25%	Same	Ultra-efficiency design for fine particles	
421	709	>20%	Same	Heavy duty, high efficiency design	
431	172	>20%	Same	General purpose style	
931	708	>22%	Same	High open area for viscous or dirty liquid	

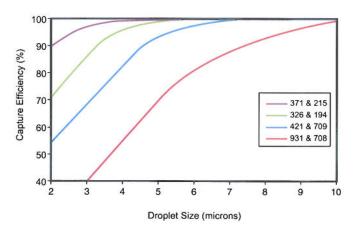


Figure 2. Capture efficiency vs. particle size for four traditional DEMISTER® mist eliminators and their high capacity equivalents in an air/water system at atmospheric conditions.

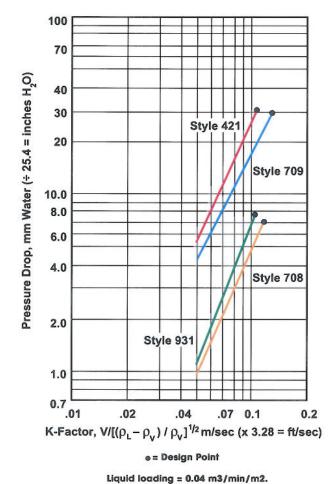


Figure 3. Pressure drop vs. Capacity factor.

For particular equipment and processes, KOCH-OTTO YORK* engineers also utilize special families of mesh styles based on years of actual, in-plant performance experience to meet customer efficiency requirements.

Benefits of DEMISTER® Mist Eliminators

- · Easy to install in all process equipment.
- Most cost effective solution when equipment sizes are set by other requirements.
- High efficiency with low pressure drop.
- · Emergency delivery available.



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FLEXIFIBER® Mist Eliminators

FLEXIFIBER® mist eliminators consist of a packed fiber bed between either two concentric screens or two flat parallel screens. Depending upon design parameters, these mist eliminators collect up to 99.95% or greater of all submicron liquid particles.

Benefits of FLEXIFIBER® Mist Eliminators

- · Reduce or eliminate visible stack gas plumes.
- · Provide unlimited turndown from design capacity.
- Achieve guaranteed pressure drop less than 40 mm (1.5") W.G.
- · Are interchangeable with existing fiber bed equipment.
- · Capture submicron mist particles 0.1 microns or smaller.

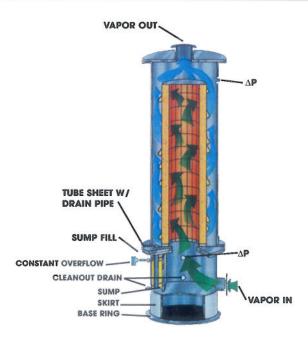


Figure 4. FLEXIFIBER $^{\circ}$ mist eliminator for lube oil tank vents on gas or steam turbines.

FLEXIFIBER* mist eliminators are custom-designed and fabricated with cages made from a wide variety of metal alloys, thermal-set plastics or FRP. The packed fiber beds are made of special glass, ceramic, polypropylene, PTFE or polyester fiber. This style of mist eliminator has proven ideal for use in sulfuric, nitric and thermal phosphoric acid plants; chlorine and other chemical plants; pulp mills; textile mills; asphalt saturators; food processing operations; chrome plating processes; turbine lube

oil tank vents; and plastic forming operations. Special carbon fiber media is available for those applications which contain fluorides, high pH or steam.

Typical FLEXIFIBER® Installations

Figure 5 shows a typical FLEXIFIBER* mist eliminator installation. Basic components of this system are the FLEXIFIBER* element and vessel. The element consists of two concentric cylindrical screens containing packed fibers in the annular space. The screens are connected to a flange at the top of the element and an end plate on the bottom of the element. The flange, in turn, is bolted to the vessel tube sheet. Mist-laden gases pass horizontally through the fiber bed. Separated liquids drain downward on the inside surface of the element, through the drain leg, and are collected at the bottom of the vessel. Clean gases exit at the top of the vessel.

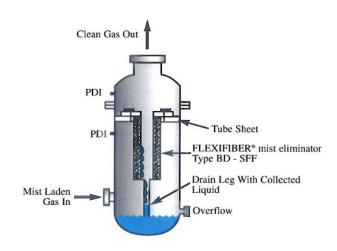


Figure 5. Typical FLEXIFIBER® mist eliminator assembly (forward flow installation).

Coll	D-1	Collection Efficiency		Element Pressure	Bed
	Primary Collection Mechanism	Particle Size (Microns)	Efficiency* (%)	Drop mm W.G. (inches W.G.)	Velocity m/sec (ft./min.)
BD	Brownian Diffusion	>3 <3	Essentially 100 Up to 99.95+	50 - 500 (2-20)	0.03 - 0.2 (5 - 40)
	Impaction	>3	Essentially 100	100 - 250 (4 - 10)	1.3 - 1.8 (250 - 350)
	Cylinder	1 - 3	95 - 99+		
IP I	Impaction Panel	1 - 3	85 - 97	125 - 180 (5 - 7)	2.03 - 2.54 (400 - 500)
		0.5 - 1	50 - 85		

* In H2SO4 Service

Table 4. Comparison of FLEXIFIBER® Element Types.



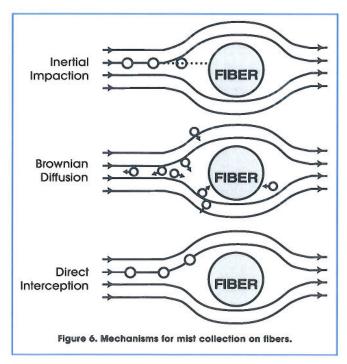
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FLEXIFIBER® Type BD (Brownian Diffusion) Mist Eliminator

Utilizing the Brownian Diffusion mechanism, the Type BD element is able to achieve collection efficiencies of up to 99.95% or higher on all submicron liquid particles down to 0.1 microns. Type BD elements are normally cylindrical in shape, and are available in a wide variety of materials. Operating pressure drops are normally designed in the range of 50 to 500 mm (2-20 in.) W.G. An interesting feature of the FLEXIFIBER* Type BD mist eliminator is that, with submicron particles, the collection efficiencies are actually increased slightly as the gas flow rate through the bed is reduced. At reduced gas flow rates, the mist particles have a longer residence time in the fiber bed. This provides the liquid particles with an increased chance to contact individual fibers and be collected.



FLEXIFIBER® Type IC (Impaction Cylinder) Mist Eliminator

Utilizing primarily the impaction mechanism, Type IC fiber beds are designed to capture and collect particles in the 1 to 3 microns range economically. Collection efficiencies on 1 micron particles will vary from 90% on liquid mists with a specific gravity of 1.0 to 97% on liquid mists with a specific gravity of 1.8. Operating pressure drops are usually in the range of 100-250 mm (4-10 in.) W.G. Type IC-M and IC-K fiberbeds, a combination of knitted wire mesh and glass fibers, are also available. These elements are primarily used in sulfuric acid plants.

FLEXIFIBER® Type IP (Impaction Panel) Mist Eliminator

Type IP fiber beds are also most commonly used in sulfuric acid plants. Utilizing primarily the impaction mechanism, collection efficiencies on 98% sulfuric acid mist are essentially 100% on all particles greater than 3 microns, 85 to 97% on all particles 1 to 3 microns and 50 to 85% on 0.5 to 1.0 microns. Operating pressure drops are normally 125 to 180 mm (5 to 7 in.) W.G. Elements are normally rectangular in shape and are available in various metals.

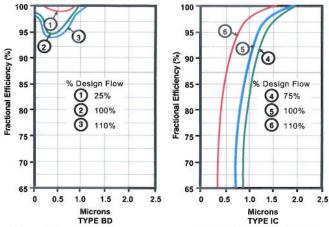
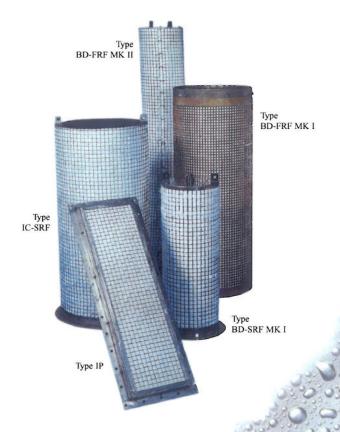


Figure 7. Typical performance curves for FLEXIFIBER® mist eliminators.





KOCH-OTTO YORK® Technology & Service Leader in the Mist Elimination Industry.

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