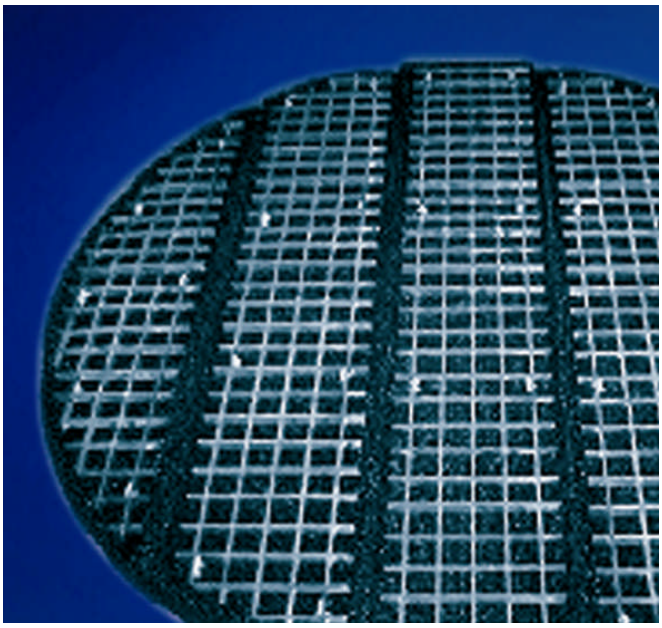
Jaeger XMIST™ Wire Mesh Mist Eliminators

Product Bulletin 300



Superior performance by design™

Raschig GmbH - Jaeger Products, Inc

RASCHIG JAEGER TECHNOLOGIES

A new Alliance in Mass Transfer Business.
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TABLE OF CONTENTS

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Raschig Jaeger Technologies – September 2006

In order to establish a new alliance in mass transfer business RASCHIG GmbH and its parent company PMC GLOBAL INC have acquired JAEGER PRODUCTS INC., a Houston Texas based company, which is a major manufacturer of tower packings, column internals and speciality trays and very active in the Mass Transfer and Environmental Business.

RASCHIG JAEGER will be integrated into the PMC network of highly specialized, internationally operating companies and will therefore be better prepared to meet increased globalization and further improved customer orientation. Wherever in the world – in all continents – RASCHIG JAEGER is on the spot.

Synergies

This strategic acquisition combining RASCHIG and JAEGER into one larger group gives a great advantage to our customers giving them access to products of both entities in Europe, The Americas and in other parts of the world. It will create new dimensions in mass transfer technology. The advantages of our process engineering know-how and our technologies benefit even more the planning, modernization and construction of our clients' processes. And: saving energy and investment cost is part of it.

The new alliance offers a diverse array of products to meet the mass transfer needs of the industries. While specializing in high performance products, the comprehensive products line of RASCHIG JAEGER also includes traditional fractional trays as well as structured and random packing types that best fit the application.

Leading In-house distributor test-facility

The company operates one of the largest in-house distributor test-facilities worldwide. Liquid distributors can be tested up to 12m in diameter at a maximum liquid load of 2400m3 per hour.

All products of RASCHIG JAEGER are the result of consistent development work long years of experience. Comprehensive quality management in all stages of production and the principle of offering complete solutions are the basis of our excellent reputation – worldwide.

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THE COMPANY

Jaeger Products, Inc. is a manufacturer of tower packings, column internals, and specialty trays. Our products are common to many chemical processes and environmental applications where mass transfer equipment is needed. In 1978, Jaeger revolutionized the plastic random packing industry with the introduction of the high performance Jaeger Tri-Packs®. It is still the plastic random packing to which all others are compared. Other performance products include Max-Pak™, a sheet metal structured packing, Cascade Mini-Rings®, and the CoFlo™ Tray, a new high capacity tray. While specializing in performance products, our comprehensive product line includes traditional packing types in plastic, metal, and ceramic. No other company offers such a diverse array of products to meet the mass transfer needs of the chemical and environmental industries. Jaeger has the product to meet your most demanding application.

Technical Experience

Of course, with such a comprehensive product line comes the need to design and build the many associated internals required to make mass transfer systems work effectively. Jaeger's capable engineering staff has the knowledge and experience to recognize the nuances of each system and offer the design that best fits the application. Each internal is custom made and matched exactly with the appropriate packing and operating conditions. Our vast database of experience will work for you. Ask about our written process guarantees.

Customer Service

A huge factor in the success of any company is their commitment to customer service. Our professional sales and customer service staff will provide competitive quotations promptly without having to wait weeks. Our commitment to quality products, ample inventories, same day air shipments, just in time delivery scheduling, and no minimum order quantities is partly why Jaeger has the best customer service ranking in the industry. Jaeger has an able and ready staff to meet your service requests.

Facilities and Plants

Jaeger's corporate offices are located in Houston, TX, just inside the north beltway area. This five acre, multi-use facility houses the sales and engineering departments as well as light manufacturing and limited inventory. Our primary molding facility, Century Plastics, is a corporate-owned subsidiary centrally located in El Dorado, KS for timely shipments anywhere in North America. Additional plant and warehouse facilities are located in Toronto, ONT. Other affiliated offices include locations in Germany and other parts of the world.

The purpose of this brochure is to offer a brief overview of our product line. Should you require additional information on a product, please contact us for a brochure specific to that product or request a complete catalog. The additional information will offer performance curves, data for design use, as well as other information. We look forward to the opportunity to be of service

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Comparison of Various Packed Column Internals

In the last few years our industry has consolidated through varies acquisitions and mergers. Because of these business activities part numbers for varies items have become difficult to follow. In an effort help everyone with this conversion the chart below is provided. The information for Raschig and Jaeger is very accurate; however, because of some unique design characteristics some part numbers could be interpreted using slightly different numbers.

The information provided for the other vendors is our best effort to convert there system to "fit" our numbering system; again this information is subject to some interpretation due to constantly changing designs.

At best this information should be used as a starting point or a guide. Do to the nature of the information we cannot guarantee its accuracy.

Internals	Raschig	Jaeger	Sulzer CT	Old Norpro	Koch-Glitsch-Norpro
Liquid Distributor / Redistributor	DR 2	LD1, CR1	VSL, VSI, VSH	106, 845, 107	301A, 301B, 906
	DR 3	LD5, CR5		798	301A, 301B, 905
	DT 1	LD4	VEG, VKG	126, 1016	126, 320, 926
	DT 1 (1)	LD4 (1)	VKR	136	136, 321, 986
	DT 2 (2)	LD4 (2)	MTS, VEL, VEP	806	310, 302, 806, 985
	DT 2 (1)	LD4 (2)	MTS, VEL, VEP	126, 1016, 127, 1017	
	RP 2	LD1, CR1		116, 816, 117, 817	301A & D, 916, 917
	RP 2 (1)	LD2, CR2		116, 1006, 117, 851, 1007	301B & D, 116, 117
	DP 1	LD3, LD7	VRG	844, 141	304, 330, 342, 941
	DP-S	LD6	VRD	1044	344, 305, 1044, 943
	DT-S	LD4 (1)	VEL, VEP	136, 137	312, 312S
	DT-MF	LD-MF	VKRPW		996
Feed Pipe	DP-P	FP1	VR, LV	119, 129, 719, 729	340, 119, 719
Gas	GV 1	GD3	GIO, GIG	196, 198	342, 746
Distributor	GV 2	GDS Vane Type	GIV	194	351, 768
	GV 3	GD2	SK	896	716
Flash Device	FB 1	FP1 (3)		655	300, 745
	FB 2			855	705
	FB 3		LRR, LRP	755	341, 755
	FB 3/RP 2			898	300
Bed Limiter - Random	HP 1	BL1	RPB	103, 823	401
- Random	HP 2	BL1			402
- Structured	HP-P	BL2	HE, HS	133	403
Support Plate - Random	SP 1	PS1	GIS	804, 819, 1019	101R, 804
- Random	SP 2, SP 3	PS1	EMS	809, 818	101, 103, 814, 824
- Structured	SP-P	PS2	TEB, TSB	134	102, 802
	SP-HG				104
	SP 1/ RP 2				201A, 201B
Liquid	CV 1	CT3, CRS	SLR	633	510, 511
Collector	CP 1	CT1	SK	733	501
	CP 2	CT2	SK	833	501
Liq-Liq extraction	DSP 1			834	600
(internals not in Raschig HB)	DSP 2			835	600
	DP-P			644, 744	

(1) Drip tubes in troughs

(2) Notches with drip tubes

(3) Flash Device

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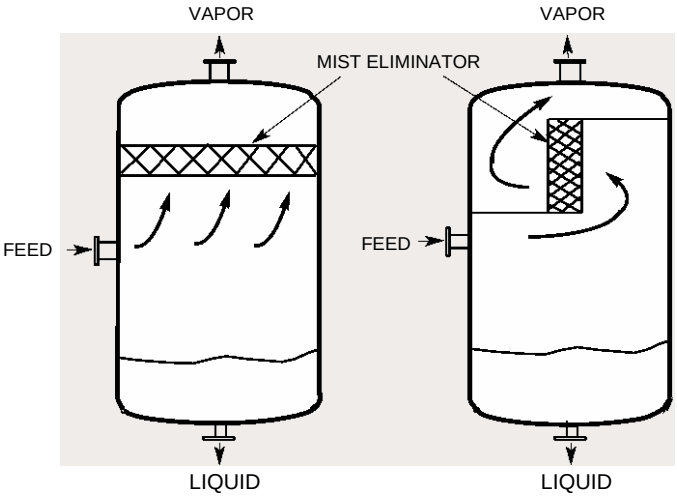
Jaeger XMIST™ Wire Mesh Mist Eliminators

Features

- Wire Mesh Mist Eliminators are engineered to provide the optimum performance for mist elimination or entrainment separation.
- High Efficiency
- Low Pressure Drop

Benefits

- Advanced mechanical design and careful selection of materials provide maximum performance lifetime.
- As a consequence of maximizing performance lifetime, life-cycle cost (total cost) is minimized.
- Superior technical support minimizes risk in process design and plant operations.
- When-needed delivery prevents unnecessary plant downtime.
- Industry leadership in quality assures customer satisfaction



KNOCK-OUT DRUMS

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INTRODUCTION

Jaeger XMIST™ mist eliminators provide the highest performance and economy of any mist eliminator available. Performance and economy result from superior engineering, manufacturing, and technical support. Various models are manufactured to span the range of condi-tions encountered in any process. If the process can accommodate a moderate pressure drop and if there is little possibility of fouling by solids, then a very high surface area mist eliminator can be used. If, on the other hand, pressure drop or fouling is a significant consideration, then an intermediate surface area mist eliminator is appropriate. For extreme liquid loading or for serious solids contamination, a low surface area vane type (chevron, parallel plate) mist eliminator is needed (see Product Bulletin 302).

CONSTRUCTION OF MIST ELIMINATORS

Jaeger XMIST™ mist eliminators consist of two components: the knitted wire matrix, referred to as "mesh"; and the framework, referred to as "grids". Grids may be constructed from materials different from the mesh. For example, low-carbon alloy steel (e.g. type304) may be recommended for the grids (which undergo welding). For the mesh, however, ordinary alloy steel (e.g. type 304) is appropriate. Polypropylene mist eliminators may have polypropylene grids or fiberglass reinforced plastic grids.

Mist eliminators typically have six inches of mesh thickness with one-inch thick grids, making an overall thickness of eight inches (20mm). Decades of experience have shown that a six-inch mesh thickness provides optimum performance for vertical upflow operation in hydrocarbon processes. By customer specification, Jaeger XMIST™ mist eliminators can also be supplied with four-inch or eight-inch mesh thickness. For air-water systems, experience has shown that four-inch thickness polypropylene units provide excellent entrainment control.

Jaeger XMIST™ mist eliminators are fabricated according to stringent specifications to ensure longest possible service life.

MATERIALS OF CONSTRUCTION

Materials of construction are a key consideration for maximizing the service life of the mist eliminator. For a typical wire size of 0.011-inch (280 microns), even a low corrosion rate will quickly deteriorate the mesh.

Jaeger XMIST™ mist eliminators are custom manufactured using materials specified by the client. Typical stainless steel, polypropylene and PVDF items are maintained in inventory. Other alloy steels are available by special order; other polymeric materials are also available. Extremely high surface area units using co-knits of stainless steel with either multifilament glass fiber or multifilament PTFE fiber (and others) are available by special order. Jaeger engi-neers are available to provide technical input for material selection by the client.

MODEL NUMBERS

Jaeger XMIST™ mist eliminators have model numbers based on their mesh density, specific surface area and materials of construction. The ME1 prefix indicates that it is a wire mesh mist eliminator. Parallel plate (vane-type) mist eliminators are designated ME2. A unit popular in air strippers, ME1-04-085-PP/FRP has a mesh bulk density of 4 pounds/ft^3, and a specific surface area of 85 ft^2/ft^3. It is constructed using polypropylene mesh with fiberglass reinforced plastic grids. It's comparable in performance to the ME1-09-085-304/304L stainless steel pad.

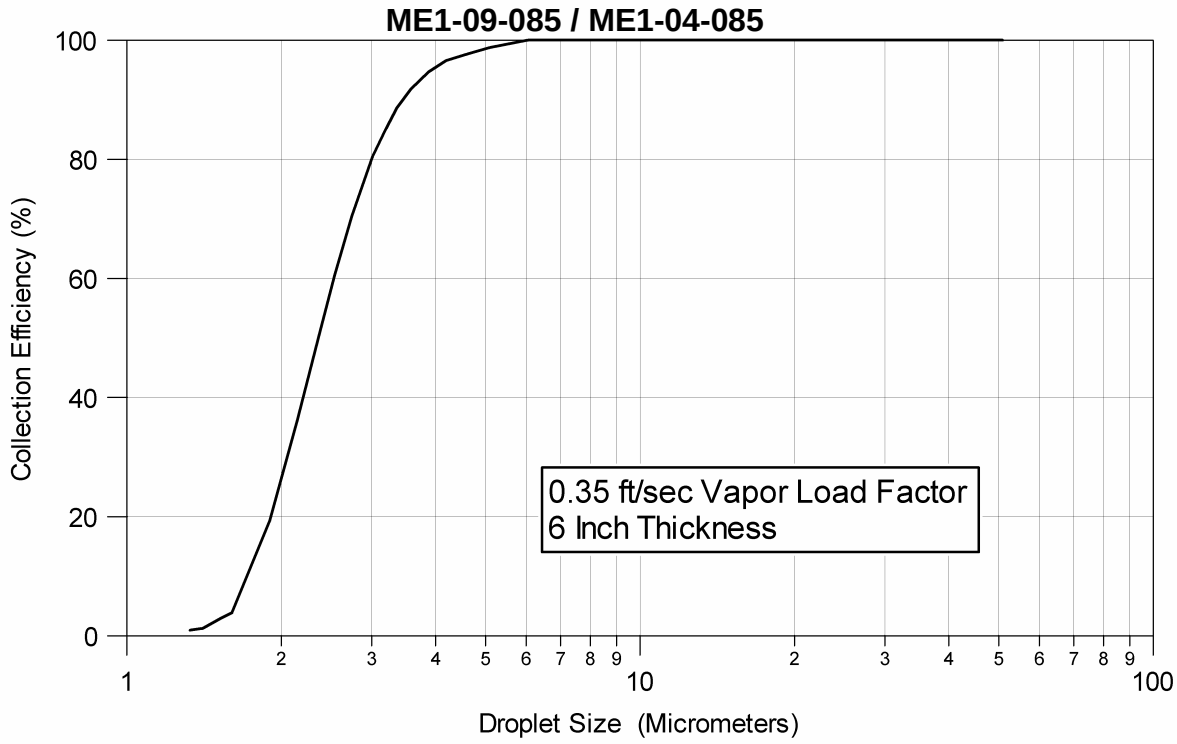
Table 1 – XMIST™ Mist Eliminator Properties

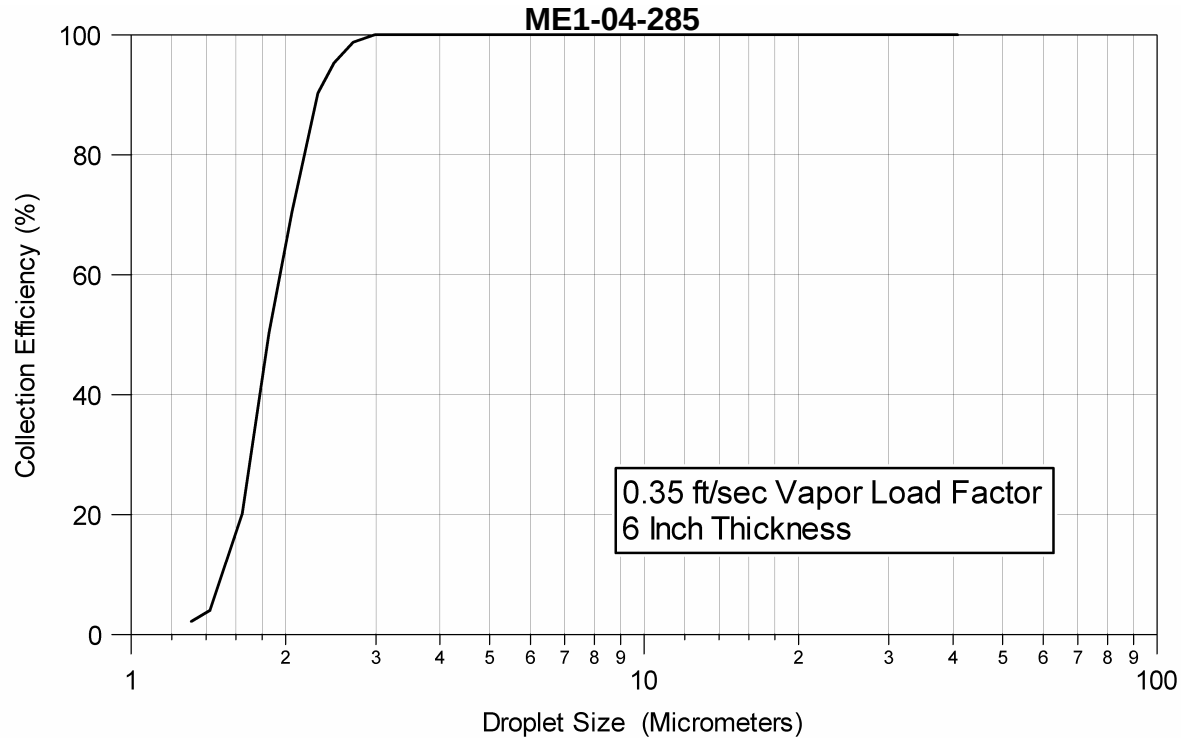
MODEL	BULK DENSITY OF MESH	SURFACE AREA	WIRE SIZE	CRITICAL DROPLET DIAMETER
	LB/FT^3	FT^2/FT^3	INCH	MICRON
	(KG/m^3)	(m^2/m^3)	(MICRON)	(MICROMETER)
STAINLESS STEEL MESH				
ME1-05-45	5 (80)	45	0.011 (280)	10
ME1-09-085	9 (144)	85	0.011 (280)	6
ME1-12-115	12 (192)	115	0.011 (280)	5
ME1-09-158	9 (144)	158	0.006 (152)	4
POLYMERIC MESH				
ME1-04-085	4 (64)	85	0.030 X 0.090 (762 X 2286)	6
ME1-04-285	4 (64)	285	0.012 (305)	2.6

PERFORMANCE

Mist eliminator performance is evaluated on the basis of efficiency, pressure drop, and corrosion resistance. Efficiency is a well-characterized property of a mist eliminator. It is primarily a function of droplet size, wire size, specific surface area of the mesh, pad thickness, and physical properties of the system. Because the efficiency versus droplet size curve is so sharp (see Figures 1 and 2), a good variable to characterize performance is the "critical" droplet size. Jaeger XMIST™ mist eliminator performance characteristics include a critical droplet size, defined as the diameter at which 99% capture occurs. Droplets larger than the critical diameter will be captured at a rate greater than 99%, droplets smaller than the critical diameter will have a capture efficiency less than 99%. As a "rule-of-thumb," droplets smaller than one -third the critical diameter will pass through the mist eliminator unimpeded. In terms of an overall removal efficiency, the volume of uncaptured liquid may be negligible (or at least tolerable for the process). Table 1 shows the critical droplet diameter for the most popular styles of XMIST™ mist eliminators .

EFFICIENCY vs DROPLET SIZE





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The most common type of mist eliminator is constructed using 0.011-inch diameter stainless steel wire to create a mesh bulk density of 9 pounds/cubic foot (Jaeger XMIST^{TM} ME1-09-085). Depending on design, Jaeger wire mesh mist eliminators have critical droplet diameters between 2 and 20 microns. Parallel plate (vane) units have critical droplet diameters between 20 and 50 microns. Multifilament co-knit units can achieve critical droplet diameters in the submicron range; however, these units are prone to fouling

FOULING

The same mechanism that causes mist eliminators to be effective at capturing liquid droplets also causes them to be effective at capturing solids. Any particle above a critical size, liquid or solid, will intercept a filament of the mist eliminator. Because of surface tension, the droplet or particle will be "captured". Liquids will coalesce and drain downward by gravity. Solid particles, however, generally are trapped on the wet filament. Therefore, fouling becomes the main reason why mist eliminators must be replaced periodically.

Fouling becomes a problem whenever an upstream operation inadequately removes solid particulates. Fouling can also become a problem if an upstream operation requires a high degree of recycle. Whenever fouling is anticipated, the mist eliminator should have differential pressure monitoring.

A spray wash system is sometimes used to counteract fouling. The spray should be directed at the upstream edge of the mist eliminator so as to avoid an artificial overload in liquid holdup. If heavy solids loading is anticipated, a parallel plate (vane type) unit is appropriate (see Product Bulletin 302).

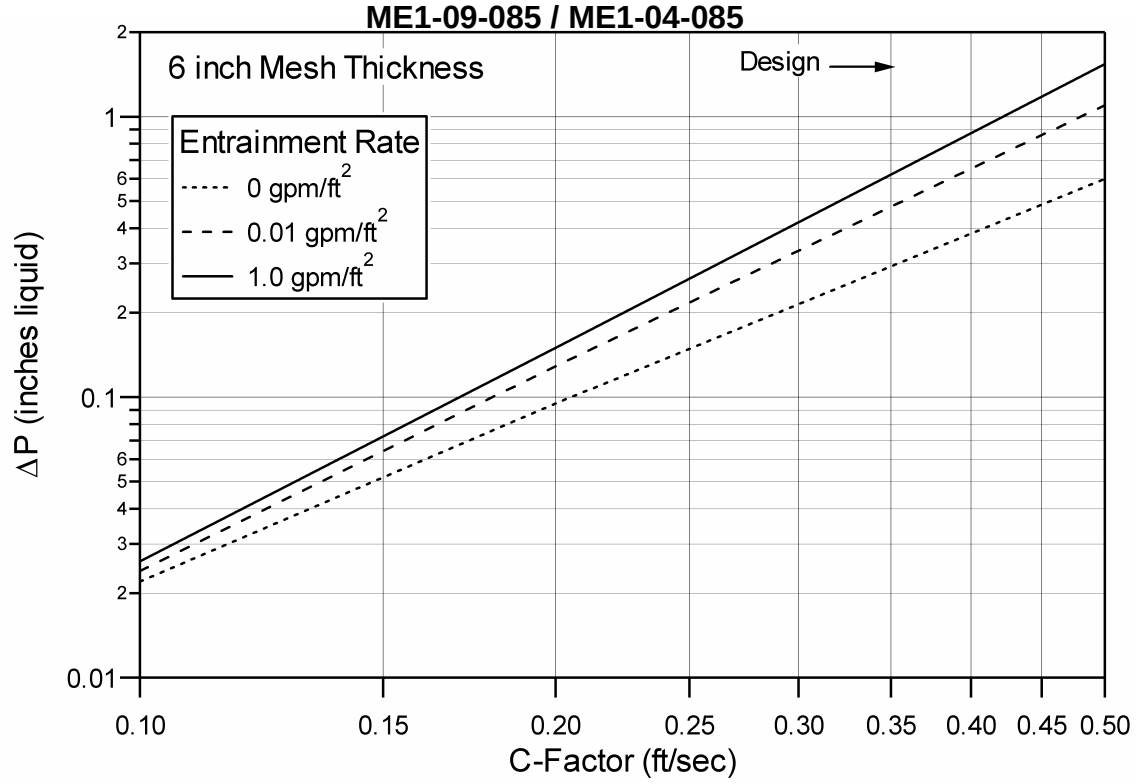
PRESSURE DROP

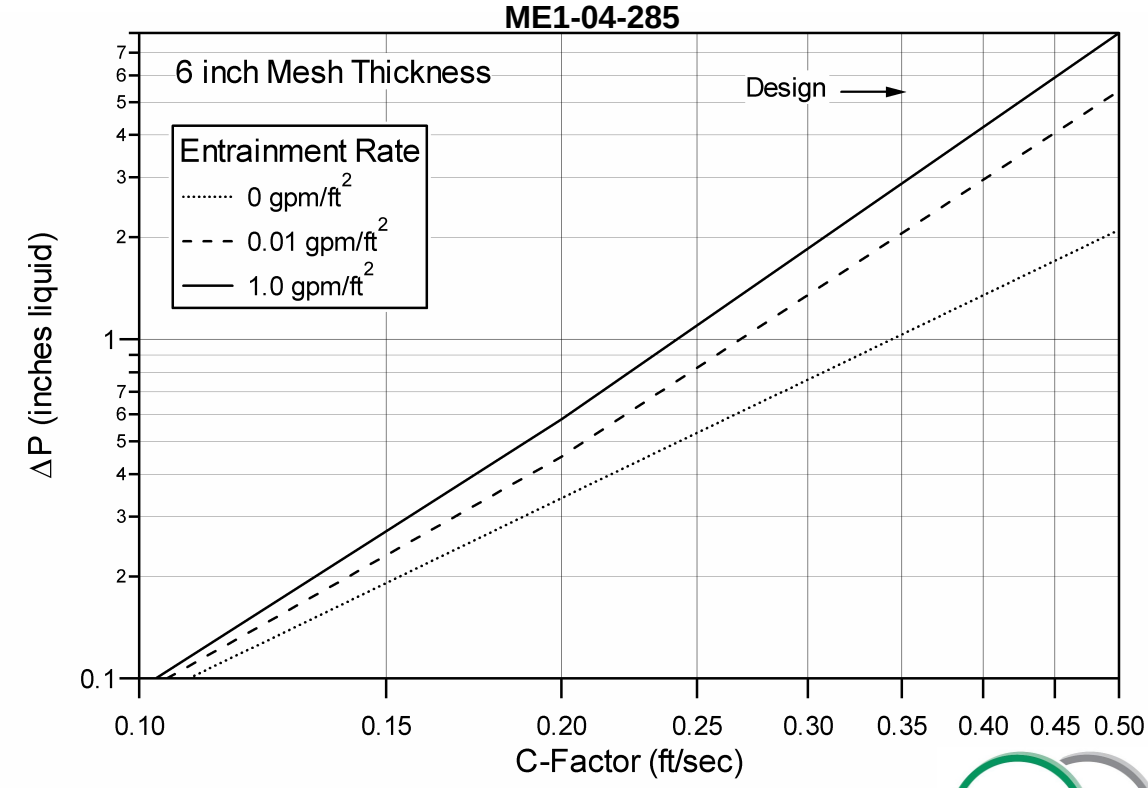
In general, high pressure-drop for a mist eliminator correlates with high efficiency; however, there is not necessarily cause and effect. There is, however, cause and effect for high surface area correlating with high efficiency. Pressure-drop for Jaeger XMIST^{TM} mist eliminators varies from less than 1 inch H_2O for low bulk density units up to 10 inches H_2O for extreme efficiency multifilament co-knitted units. Generally, the pressure-drop of a mist eliminator is not a design constraint (see Figures 3 and 4)

MIST GENERATION

"Mist" is a term that refers to droplets less than 10 microns in diameter. "Spray" refers to droplets larger than 10 microns. Mechanical processes (two-phase contacting, leakage from high-pressure seals, condensation, etc.) typically produce droplets larger than 20 microns. Extremely high shear rates (such as in centrifugal compressors or in machining), however, produce some droplets smaller than one micron. Furthermore, chemical processes such as gas-phase reactions also produce sub-micron droplets

PRESSURE DROP vs VAPOR LOADING





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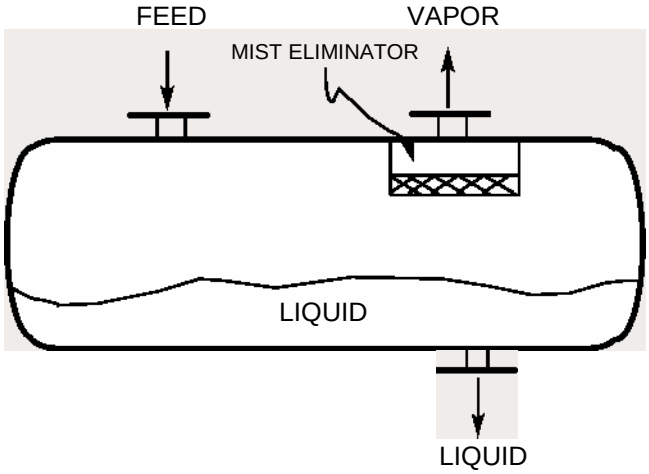
Droplet size is not uniform. There is a distribution in droplet size about an average or mean. Collisions between droplets cause the mean droplet size to increase. For example, oil mist from high-speed machining has a particle size distribution between 0.1 and 1 micron or larg-er. The XMIST^{TM} co-knit mist eliminators will remove essentially all the droplets greater than approximately 0.6 microns, but the smaller droplets will escape. Another example would be an air stripper column; most of the droplets produced in such a unit are larger than 20 microns. Hence, an XMIST^{TM} ME1-04-085 mist eliminator will remove more than 99.99% of the entrained liquid (provided the correct operating range for vapor rate and liquid load are maintained

PROCESS SYSTEM PHYSICAL PROPERTIES

Fluid mechanical properties of two-phase process systems operating in gravity conditions are primarily determined by density difference and by interfacial or surface tension. Process systems having viscosities less than 10 centipoise are often analyzed as "inviscid" systems. That is to say, viscosity effects are ignored. For mist elimination problems, viscosity effects can generally be ignored. Vapor density, liquid density, and interfacial tension are the critical physical properties.

Interfacial tension represents the energy necessary to create a unit area of liquid surface. The units of interfacial tension are dynes per centimeter (equivalent to ergs per square centimeter). Water/air systems have an interfacial tension (interfacial free energy) of approximately 27 dyne/cm (erg/cm2). This is a relatively high interfacial tension for vapor liquid systems; consequently, droplet size is relatively large (spray regime). If there are surface active contami-nants (such as detergents), the interfacial tension may be decreased considerably; consequently, droplet sizes are smaller. For hydrocarbon distillation processes, interfacial tension is typically 0.1-5 dyne/cm. Fine mists, however, are not generally a problem except for vacuum distillation. Although interfacial tension dramatically affects droplet coalescence and liquid drainage, its magnitude is not usually considered directly in the selection of mist eliminators



SEPARATORS

Vapor and liquid density determine inertial, gravity and buoyancy effects in two-phase sys-tems. Consequently, system loading is expressed as a volumetric flux (flow per unit area or superficial velocity) multiplied times the square root of the vapor density and divided by the square root of the density difference between the phases. This variable is referred to variously, including "C-factor" and Souders-Brown velocity. C-factor expresses the vapor flux for a two- phase system that is independent of the system. Vapor flux in an air-water system is mechan-ically similar to that in a hexane liquid-vapor system as long as the C-factors are equal. C-fac-tor is, therefore, used as the design parameter for mist eliminators.

$$\text{C-Factor} = Q/A * [(\rho_V)/(\rho_L - \rho_V)]^{1/2}$$

where

Q = Volumetric Flow Rate, ft^3/sec

A = Cross-Sectional Area for Flow, ft^2

ρ_L and ρ_V = Density of Liquid and Vapor, lbs/ft^3

INSTALLATION

Mist eliminators are manufactured in sections so that they may be installed or removed through manways. Each section is constructed oversize to ensure a compression fit and, therefore, no vapor bypass. Care must be exercised in the installation to prevent warping the grids or deforming the mesh. The sections must be secured firmly to the support ring and cross beams. Jaeger Application Specialists should be consulted for installation recommendations. Properly selected and installed, Jaeger XMIST™ mist eliminators will provide excellent entrainment separation and long service life.

MIST ELIMINATOR SIZING

Mist eliminators are generally sized based on a C-factor of 0.35 ft/sec (0.11m/sec) for vertical upflow or 0.5 ft/sec (0.15 m/sec) for horizontal flow. In horizontal flow, liquid drains faster from the pad because drag effects are at right angles (cross-current) rather than opposite to the vapor flow (counter-current). The resulting better drainage allows a higher vapor load.

For fractionation systems, such as distillation or strip-ping, the C-factor based on column cross-section is generally less than 0.30 ft/sec (0.11m/sec). A mist eliminator operating at these conditions is not at risk of flooding, even at liquid entrainment rates approach-ing 8 gpm/ft2 (0.05 m3/sec-m2). For entrainment rates above 1gpm/ft2, the design C-factor should be diminished by 3%/gpm/ft2. If entrainment is anticipated beyond 8 gpm/ft2 (0.05 m3/sec-m2), a parallel plate (vane type) mist eliminator should be used (see Product Bulletin 302).

Mist eliminator efficiency decreases with decreasing vapor flux. For this reason, fractionating columns operating a low C-factor (0.13 ft/sec (0.04 m/sec) or lower) often have a mist eliminator smaller than the column diameter or else employ blanking baffles to increase vapor flux.

Superficial velocities observed in air-water tests are not appropriate for other systems. Vacuum systems can tolerate high superficial velocities because buoy-ancy effects and drag effects (upward forces) are small relative to gravity effects (downward force). In high pressure systems, on the other hand, superficial velocities must be lower because buoyancy effects and drag effects are large relative to gravity effects.

Minimum mist eliminator area is calculated by:

$$A_{min} = Q/0.35 * [(\rho_V)/(\rho_L - \rho_V)]^{1/2}$$

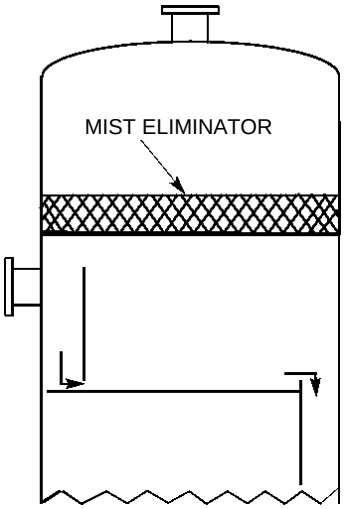
where

Q = Volumetric Flow Rate, ft^3/sec

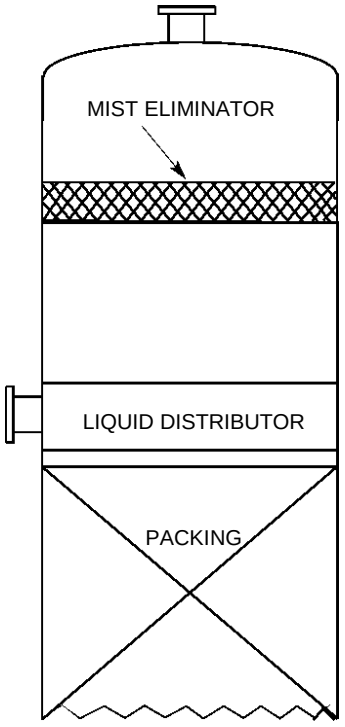
A = Cross-Sectional Area for Flow, ft^2

ρ_L and ρ_V = Density of Liquid and Vapor, lbs/ft^3

for vertical up-flow



FRACTIONATORS



STRIPPERS / SCRUBBERS

APPLICATION CHECKLIST

❑Process engineering input concerning the droplet size distribution could help in selecting a mist eliminator.

❑At process conditions producing a C-factor of 0.35 ft/sec for vertical upflow, a wire mesh mist eliminator will be operating at 70% to 80% of flood, depending on liquid entrainment rate. A design C-factor 0f 0.35 ft/sec is therefore recommended for most situations.

❑For horizontal flow, a design C-factor of 0.5 ft/sec may be used.

❑Turn-down of a wire mesh mist eliminator permits adequate vertical upflow operation between 0.12 ft/sec and 0.4 ft/sec, at entrainment rates between zero and 1 gpm/ft2.

❑Between 1 and 8 gpm/sqft wire mesh mist eliminators should be derated at 3%/gpm/ft2 (i.e. use a smaller C-factor).

❑For entrainment rates beyond 8 gpm/ft2, parallel plate (vane , chevron) mist eliminators should be used.

❑Re-entrainment (flooding) generally occurs at a pressure drop of 2 -3 inches of water for typical wire mesh mist eliminators 6 inches in thickness. This represents the approximate steady-state condition for upward forces and downward forces on the liquid attached to the wire filaments.

❑If solids are present (dissolved or suspended) consider the application of a spray wash sys-tem in co-current flow with the vapor.

❑Solids could also indicate the use of a parallel plate type mist eliminator.

❑If plugging or fouling is anticipated, differential pressure measurement may be appropriate.

❑Diligence in the anticipation of corrosion effects can have a major effect on the cost of entrain-ment control. Chlorides, pH, and temperature are key corrosion considerations.

❑Flow channeling (uneven vapor distribution) can cause diminished efficiency or local flooding in the mist eliminator. Consult Jaeger Applications Engineers for guidance concerning these problems.

❑Jaeger Applications Engineers can provide assistance if blanking strips or baffles may be needed.

Locations / Production Sites

Ludwigshafen and Espenhain,
Germany

Houston, Texas
El Dorado, Kansas
And Monterrey, Mexico.

Furthermore we co-operate with reliable partners all over the world

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