SEPARATION TECHNOLOGIES

HMT HANBAL MASSTECH LIMITED
MASS TRANSFER TECHNOLOGY

HISTORY

1970

1971. 07 Founded as "Hanbal Metalworking Company"

1976. 07 Renamed as "Hanbal Metalworking Industry"

1980

1984. 07 Established a branch in Seoul

1989. 05 Incorporated technology with Norton Chemical Process Product Corporation in U.S.

1990

1995. 06 Renamed as "Norton Hanbal Korea"

2000

2000. 04 Renamed as "Hanbal Masstech"

2004. 01 Changed as "Hanbal Masstech Limited"

2005. 11 Awarded "10 Million Dollars" Export Tower (KITA)

2010

2011. 01 Estabilshed a branch in Dubai as "Hanbal General Trading(L.L.C)"

2012. 12 Awarded "30 Million Dollars" Export Tower (KITA)

2013. 11 Incorporated technology with Enhanced Industrial Technologies LLC in U.S.

INTRODUCTION

Hanbal Masstech Limited(HMT) is a leading company which designs and manufactures Tower Trays, Internals, Packings, Reactor Internals, Wire Mesh Demisters, Mist Eliminators, etc. Our company has been providing these products for Chemical Companies, Oil Refineries, Petrochemical Plants, etc., and Engineering and Construction Companies since founded in 1971.

We joined Norton Chemical Process Products Corporation in 1979 as Sales Representative and worked with them as manufacturer, Joint Venture Partner(Norton Hanbal Korea Inc.), design/manufacturer and Licensee until April 2002.

We conducted R&D with Korea Institute of Energy Resource (KIER), especially noteworthy has been the R&D held with KIER-Ruhr University in Germany-Hanbal as F.R.I. member for five years under government assistance and our R&D with KIER continues every year.

We learned most of the design fabrication technologies from Norton CPPC, but we have some of our own that will meet our customer's specific requirements.

As we know what and how Norton had tested, and to continue to do that, we built an outdoor test facility, 12 meters, for distribution quality test and what we have designed is questionable, we go for test to make it sure they are perfect.

We also design and produce traditional style internals which are good for easy towers and those cost about 30% less as compared to the high performance ones.

We thank you all for the finest helps and concerns rendered to us so far and wish the same in the future.

Sincerely, President & CEO

SEPARATION TECHNOLOGIES

MIST ELIMINATION

HANBAL MASSTECH LIMITED
MASS TRANSFER TECHNOLOGY

COALESCENCE

INLET DEVICES

SEPARATION VESSELS

Mist Elimination

General considerations in removing entrained liquids from gas streams

Using Mist Eliminators for removing mists, sprays and fogs from process streams will...

- *raise process efficiency*
- *reduce valuable product loss*
- *increase throughput capacity*
- *improve side draw and overhead purity*
- *prevent downstream corrosion*
- *remove pollutants*

Why entrainment occurs

In any process equipment where gas and liquid come into contact, the gas will always entrain some liquid. It is always detrimental. Entrainment is generated by two basic mechanisms: mechanical and condensation as shown in Figure 1.

Droplets in mists generated by mechanical means are almost always over 5-10μ in diameter. For example, hydraulic spray nozzles generate mists of droplet diameter greater than 250μ while pneumatic nozzles form mists with droplet diameters over 15μ. Gas bubbles breaking on a boiling or bubbling liquid surface will form droplets from 1500μ down to just 5μ in diameter, so careful consideration to performance requirements must be given to equipment such as evaporators, tray columns and steam boilers.

Although entrainment swept off the surface of random packing or the surface of heat exchanger tubes consists mainly of relatively large, easily removed droplets >25μ, some types of condensation entrainment are smaller and not so easy to collect. Extremely fine entrainment,

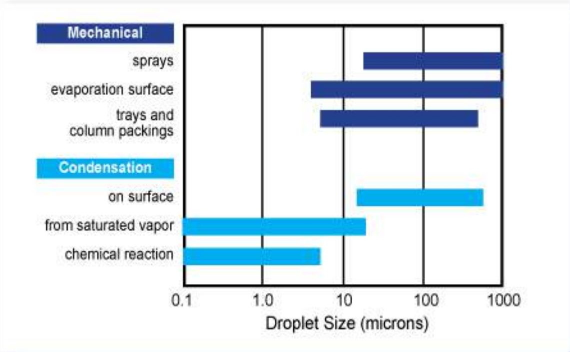


Figure 1
Typical droplet size distribution ranges for entrainment caused by various mechanisms.

<15μ for instance, 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 smoke-like entrainment ~7μ. Condensation, having a smoke like appearance, can also occur when two gases such as SO_2 and water react to form a liquid product, sulfuric acid. These latter types of entrainment require high efficiency separation equipment.

Physical properties of the liquid also have significant effects on droplet size. Consider in most cases, the higher the viscosity, the larger the droplet size – and the lower the surface tension, the smaller the droplets.

Mechanisms of entrainment removal

Mist capture generally can occur by three mechanisms as shown in Figure 2. Note that there are no sharply defined limits where one mechanism takes over from another. Since momentum of a droplet varies directl with liquid density and the cube of diameter, heavier or larger droplets tend to resist following the streamline of a flowing gas and will strike targets placed in their line of travel. This is inertial impaction, the mechanism responsible for removing most droplets ≥5μ. Smaller droplets that do follow streamlines may collide with solid objects if their distance of approach is less than their radius. This is direct interception. It is often the governing mechanism for droplets in the 1-5μ range.

With sub-micron mists, Brownian capture becom the dominant collection mechanism. This depends on Brownian motion – the continuous random motion of droplets in elastic collision with gas molecules. The smaller the particles, the greater the efficiency o Brownian capture.

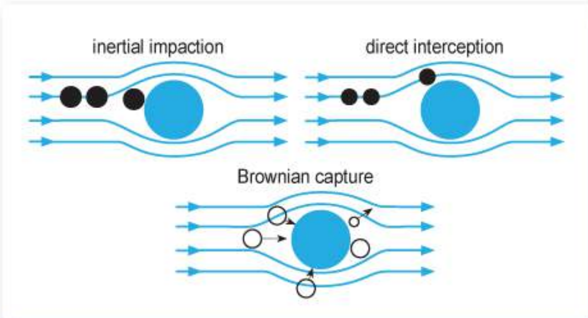


Figure 2
Three basic mechanisms of mist capture.

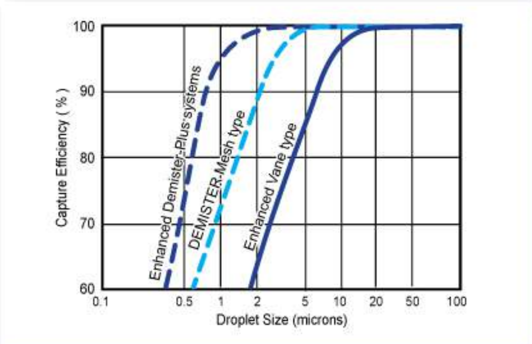


Figure 3
Efficiency of droplet capture vs. droplet diameter is shown for three different types of Mist Eliminators. This performance is based on typical design conditions for the various entrainment separators and will vary based on actual process data.

Types of Mist Eliminators

Almost all Mist Elimination equipment falls into four classes: knitted wire mesh styles, corrugated vane type blade assemblies, cyclonic tube boxes and fibrous bed panels or cylinders.

When to use a Mist Eliminator

- **Reduce loss of valuable product** – Mist Eliminators can stop liquid losses in absorbers, evaporators and distillation columns, markedly cut glycol, amine or catalyst consumption.
- **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.
- **Improve product purity** – Mist Eliminators can prevent contamination of side draws and overheads in refinery atmospheric and vacuum towers, and other distillation columns.
- **Eliminate contamination** – Mist Eliminators can prevent poisoning expensive downstream catalysts - provide boiler feed water quality condensate from evaporator overheads
- **Stop downstream corrosion** – Mist Eliminators can protect ductwork and heat exchangers – prevent solids build-up on fan, turbine and compressor blades, eliminating serious maintenance problems.
- **Prevent air pollution** – Mist Eliminators help reduce emissions from acid plants to environmentally acceptable levels – prevent ammonia and sulfite plumes – stop stack entrainment from settling in nearby parking lots.
- **Reduce water pollution** – Mist Eliminators installed upstream of evaporator barometric condensers can prevent entrainment of polluting substances in the water effluent.

The practical starting point for Mist Eliminator selection is always the wire mesh pad type (Figure 4). Experience with more than 250,000 Mist Elimination installations over the past 45 years, HMT has found that in most cases the knitted wire mesh Demister Mist Eliminators provide required separation efficiency at lowest installed cost.

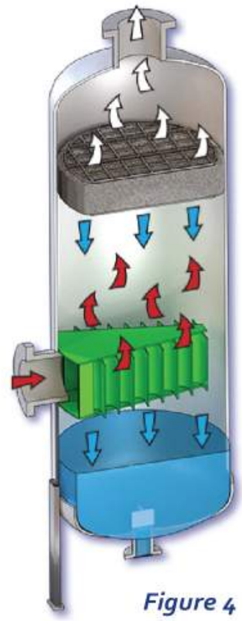


Figure 4

If the mist contains high liquid loadings, high levels of solid particulates, or is highly viscous or sticky, then Enhanced™ Vane Mist Eliminators may offer a better solution.

When submicron droplets are present at low velocities, fibrous beds with ultra-high surface area are the proper selection.

At high pressures, >35 bar (500 psi), where there is a need to capture fine entrainment at high velocities, Enhanced Cyclonic™ Mist Eliminators are best.

When the most difficult or challenging applications exceed single devices, then a system of Mist Eliminators or Enhanced Demister-Plus™ Mist Eliminators, which incorporate the latest in separation technology, will provide an excellent solutions.

More detailed information and calculations are presented in the series of HMT Mist Elimination technical bulletins to help clarify selection. Your final design should be made only after reviewing your application with experienced HMT process engineers. The proven expertise and practical knowhow that HMT has built up over the years will help optimize the design for your particular application. We invite you to take full advantage of this assistance and send in a completed process data sheet.

HMT Mist Elimination Technical Bulletins

Wire Mesh Demisters

Enhanced™ Vane Mist Eliminators

Enhanced Demister-Plus™ Mist Eliminators

Wire Mesh Demisters

Features

- *Easy to install*
- *No moving parts*
- *Low pressure drop*
- *Light weight*
- *Fits all process equipment*
- *Requires no maintenance*
- *Wide variety of materials of construction available**
- *Shipped promptly*

What are Demister Mist Eliminators?

The Demister is an assembly of HMT knitted wire mesh supported on, and held down by, high open area grids. It is made to any size and shape and may be installed in all new and existing process vessels. Wire used in Demister fabrication is of the highest quality. It is smooth, clean and bright for rapid liquid drainage. Stainless steels and exotic alloys are fully annealed to provide maximum corrosion resistance. Perfect fit is assured even in out-of-round vessels, eliminating all vapor by-passing.

How do Demister Mist Eliminators work?

When a vapor stream carrying entrained liquid droplets passes through the HMT Mesh but the inertia of the droplets causes them to contact the wire surfaces and be held there briefly. As more droplets collect, they grow in size, run off and fall free. Properly applied to specific process conditions, DEMISTER mist eliminators achieve 100% separation of liquid entrainment from any vapor stream, assuring pure product overhead. Pressure drop is usually less than 25.4 mm H_2O (1" WC).

* **Construction Materials:** All 300 and 400 series SS, alloys 200, 400, 600, 800, etc., alloy 20, aluminum and copper, polypropylene, Teflon, Halar, and Kynar and any other materials which can be drawn or extruded.

Demister units can be engineered to fit the smallest laboratory still, the largest refinery or petrochemical tower.

Where are Demister units used?

- ***knockout drums and separators*** – save on capital costs by decreasing vessel size-recover costly fatty acids from stream-reduce compressor maintenance by preventing scale build-up
- ***absorbers*** – reduce overhead losses of glycols in dehydrators to no more than 0.1 gal/MMSCF natural gas-cut losses of absorption oil and amines in CO_2 systems
- ***scrubbers*** – reduce chemical discharges from Kraft mill smelt dissolver tank to less than 0.11 kg/dry ton (0.25 lb/dry ton) of pulp-improve scrubber efficiency by removing particulates carried in entrained liquids
- ***distillation columns*** – improve product purities and increase throughput capacities for petrochemicals, organic intermediates, fine chemicals
- ***evaporators*** – prevent carryover loss of valuable products, keep condensate TDS <10 ppm for highest quality boiler feed water-clean up vacuum ejector stream discharge-lower maintenance in vapor re-compression systems
- ***high pressure steam systems*** – provide dry steam-cut TDS to <10 ppb in condensate-eliminate build-up on turbine blades
- ***refinery towers*** – increase throughput capacity-take deeper cuts for greater product yields – prolong catalyst life in downstream cracking and reforming units by reducing carbon and metals in side draws-use lower grade crudes.

Design parameters

Variables that affect design of a Demister include vapor velocity, gas and liquid density, liquid viscosity and surface tension, liquid entrainment loading, particle size distribution, content of dissolved and suspended solids, operating temperature and pressure, materials of construction and required performance. For purposes of preliminary selection abbreviated data are presented here for design capacity factors, pressure drop and particulate removal efficien cy.

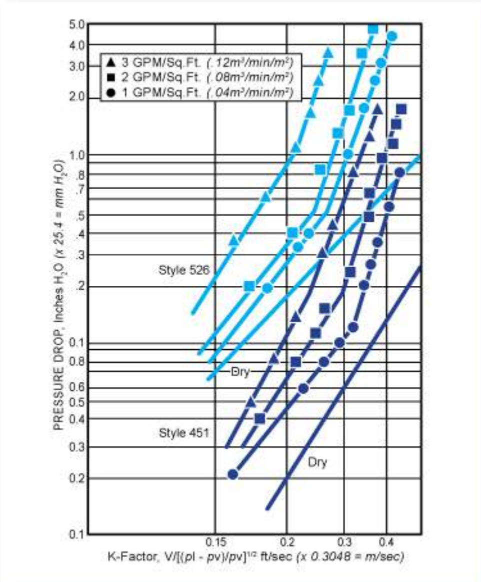


Figure 1
Pressure drop vs capacity factor for Style 526 Demister at three different liquid loadings.

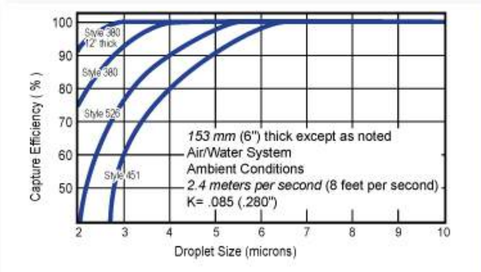


Figure 2
Capture efficiency vs particle size for four types of Demister knitted mesh mist eliminators.

Design velocity and pressure drop

$V = K[(\rho l - \rho v)/\rho v]1/2$
V = velocity in ft/sec
ρv = density of vapor in lb/cu ft
ρl = density of liquid in lb/cu ft
K = capacity factors for free flowing systems

Excellent performance is obtained in most systems for velocities 30-110% of the calculated value. For all other conditions, consult HMT for recommendations. For process equipment applications at normal operating velocity. ΔP is usually negligible–almost always < 25 mm H_2O (1" WC). In vacuum service, high performance is routinely achieved with ΔP on the order of 2.5 mm H_2O (0.1" WC).

Particulate removal efficiency

The Demister is extremely versatile, regularly providing virtually 100% removal efficiency in most mist control applications. Furnished in a great variety of mesh styles, the Demister offers capture efficiency and pressure drop that can be suited exactly to specific process requirements. Curves in graph show typical performance in an air/water system. Actual droplets size separation efficiency in other systems will be affected by gas velocity and liquid and gas densities.

Various Demister Styles

Style 840 Fluoropolymer construction for extremely corrosive service.

Style 644 Polypropylene construction for corrosion resistance at moderate temperatures.

Style 380 Ultra-efficient design for maximum separation of fine particle entrainment.

Style 526 Heavy duty, high efficiency design for heavy entrainment loading.

Style 390 General purpose style. Efficient performance.

Style 451 High open area construction for high gas capacity and low solids retention. For viscous or dirty liquids. Excellent economy.

Style 700 Multifilament glass supported by wire mesh for maximum efficiency on fine particles.

Style 453 A combination of wire mesh styles to obtain high efficiency and capacity in dirty service or high solids applications.

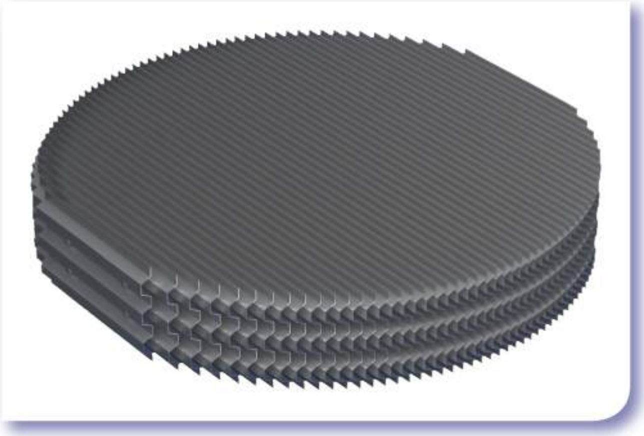
Style 462 High capacity style for de-bottlenecking separators and towers without loss of efficiency.

Most common thickness is 153mm (6"), but thicknesses from 100mm (4") to 305mm (12") are frequently used. Thickness has a significant effect on capacity as well as efficiency.

Enhanced™ Vane Mist Eliminators

Features

- *High gas velocities*
- *High liquid loadings*
- *Ideal for very viscous liquids*
- *Excellent resistance to solids fouling*
- *Sturdy, durable construction*
- *Wide variety of construction materials*
- *Custom-designed*



Typical Enhanced Vane Mist Eliminators for vertical flow units can be fabricated up to 15.24 m (50 ft) diameter.

What are Enhanced Vane Mist Eliminators?

Enhanced Vane Mist Eliminators are inertial impaction devices composed of multiple parallel blades. They are assembled with wide clear channels to minimize fouling, provide unrestricted draining and enhance cleanability. Blade spacing, number of passes, turning angle, presence or absence of either drainage hooks or specially designed pockets, all engineered for specific process requirements. Sturdy construction Eliminates fluttering and vibration.

How do Enhanced Vane Mist Eliminators work?

As liquid-laden gas enters the element, it is forced to change direction through the multiple passages of the Enhanced Vane separator. Entrained droplets impinge on blade surfaces due to their greater inertia. Droplets coalesce into larger drops and rain by gravity. In horizontal flow design, drainage hooks channel collected liquid to the bottom of the unit. This permits higher throughput capacity. Most entrained liquid and solids are removed in the first pass. Subsequent passes remove remaining liquids and solids. Multiple pass designs result in higher efficiencies. Open channels give very low pressure drop and minimize fouling.

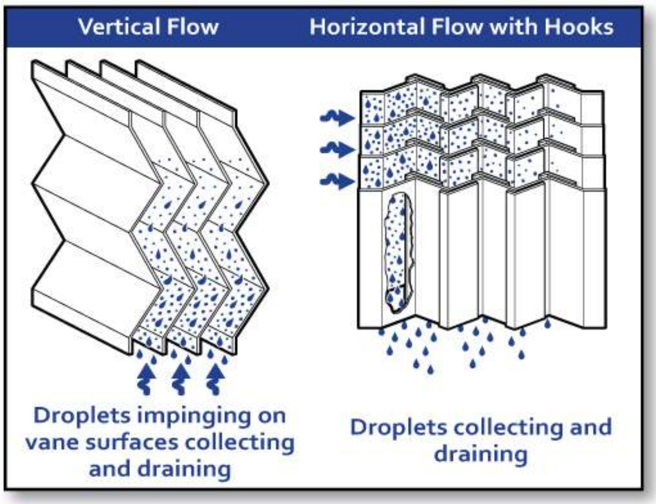


Figure 1
Left: vertical up-flow Enhanced Vane Mist Eliminator
Right: horizontal flow Enhanced Vane Mist Eliminator
Note drainage hooks for higher throughput capacity.

Where are Enhanced Vane Mist Eliminators used?

- *scrubbers* – improve particulate removal in flue gas desulfurization systems – prevent entrainment and fouling in blast furnace, open hearth, BOF and coke oven scrubbers – reduce entrainment in asphalt heaters.
- *evaporators* – limit dissolved solids to 10 ppm or less in overhead steam condensate – reduce carryover of fibrous and dissolved solids in black liquor and other pulp mill evaporators – handle high liquid loads common in long tube rising film evaporators.
- *knockout drums* – reduce drum size with horizontal flow chevron design – improve wellhead separation of crude, gas, and water – remove slugs of liquid hydrocarbons and water in pipeline separators.
- *atmospheric and vacuum pipe stills* – reduce entrainment from wash oil zones where coking is a concern – minimize carbon and metals levels in side draws for deeper cuts and greater throughputs.
- *other distillation columns* – remove viscous, tacky liquids to improve capacity and product purity in dewaxing, de-asphalting and de-oiling draws – use lower grade crudes.

Table 1 – Selected Enhanced Vane Styles		
Flow Direction		Description
Vertical	*Horizontal*	
VP-51	HP-52	Economical design, severe fouling service, lowest pressure drop
VP-61	HP-62	Good capacity, good efficiency
VPDP-96		High capacity, high efficiency

Design parameters

As with other types of Mist Eliminators, selection of the proper Enhanced Vane is affected by gas and liquid properties, temperature, pressure, quantity of entrainment, particle size distribution and, of course, desired performance. For purposes of preliminary selection, determine actual velocity by using K values of 0.14 (0.46) for vertical up-flow and 0.20 (0.65) for horizontal flow usually provide good estimates of space requirements.

Design velocity and pressure drop

V = K[(ρl-ρv)/ρv]1/2
V = velocity in ft/sec
ρv = density of vapor in lb/cu ft
ρl = density of liquid in lb/cu ft
K = capacity factors for free flowing systems

Depending on system process conditions, higher K values as shown in Table 2 can be achieved but it is good practice to over-size equipment by 10-30%. Note in Figure 3 that Δρ is low–generally less than 12.7mm H_2O (0.5" WC) and is higher for horizontal flow because of the drainage hooks or closed pockets.*

Flow rate will vary in most processes. Table 2 indicates turndown ratio achievable at optimum efficiency. Using Enhanced Vane Eliminators it is possible to efficiently remove droplets as small as 12-15 microns in diameter. Figures 2 and 3 show the performance of five standard vanes in an air/water system. Actual droplet size separation efficiency in other systems will be affected by gas velocity and liquid and gas densities.

Table 2 – Turndown Capability Range			
FlowType	Operating K value		Re-entrainment point
	minimum	*maximum*	
VP-51/61	0.04 *(0.12)*	0.15 *(0.50)*	0.16 *(0.55)*
HP-52/62	0.04 *(0.12)*	0.20 *(0.65)*	0.24 *(0.80)*
VPDP-96	0.04 *(0.12)*	0.26 *(0.85)*	0.29 *(0.95)*
Note: English units listed in *(italics)*			

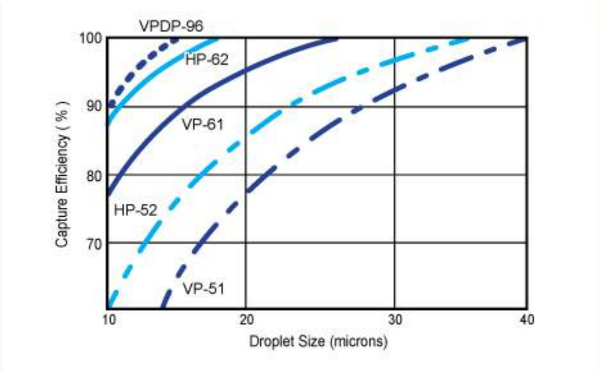


Figure 2
Capture efficiency vs. particle size for five standard Enhanced Vane Mist Eliminators.

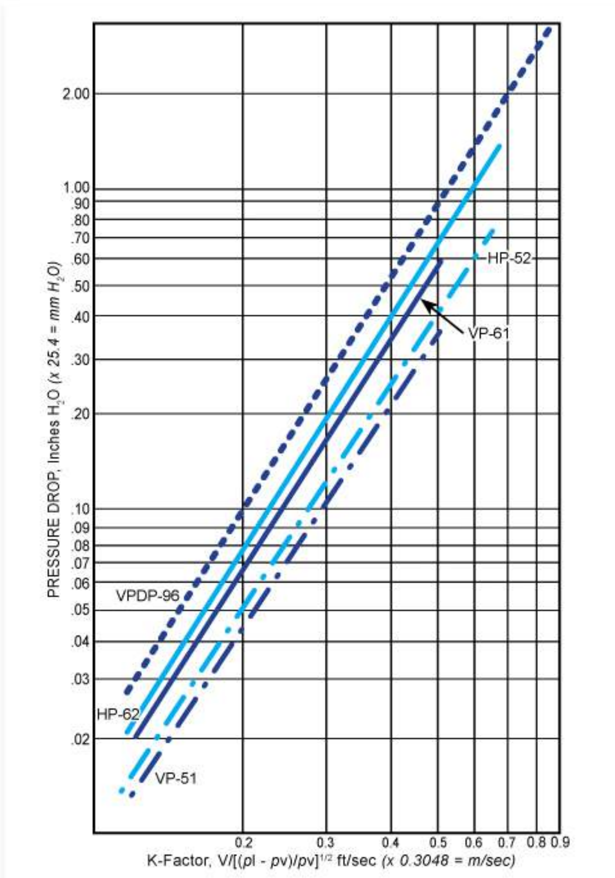


Figure 3
Pressure drop vs. K factor for standard Enhanced Vane Mist Eliminators.

** This denotes high capacity double pocket Enhanced Vanes – style VPDP-96.*

Enhanced Demister-Plus™ Mist Eliminators

Features

- ***Extend existing KO drums/scrubbers capacity as much as 300%***
- ***Reduce new vessel size by 25% to 40%***
- ***Increase any operating range while removing 99%+ of liquid load***
- ***Extend replacement life of internals up to 5 times***
- ***Can eliminate equipment fouling***
- ***Easy installation without welding or recertification of existing vessel***

What are Enhanced Demister-Plus Mist Eliminators?

In most mist control applications the use of a conventional demisters and Enhanced Vanes Mist Eliminators alone will provide the most cost efficient solution. In some situations, however, Enhanced Demister technology can extend Mist Elimin ation technology with Demister-Plus systems or combinations of devices, to improve separation efficiency, obtain higher throughput capacity, improve the handling of solids and/or high liquid load applications.

How do Enhanced Demister-Plus mist eliminators work?

To achieve the required performance, experienced process engineers with advanced design programs identify the source of difficult separation and provide a solution from the widest selection of Demisters, Enhanced Vanes, and Cyclonic mist eliminators.

Where are Enhanced Demister-Plus Mist Eliminators systems used?

- *Upstream, Midstream and Downstream Oil & Gas industry* which has hundreds of applications where separators optimized capacity of trays or packing and protecting downstream compressors, heat exchangers
- *Petrochemical and chemical plants* requiring higher product purity and increased production capacity with lower operating costs
- *Stringent environmental effluent applications* such as in the Sulfuric Acid, Phosphoric Acid, chrome plating, Edible Oils and Chlor-Alkalide plants.
- *Pulp and paper mills* with ever increasing evaporator volume requirements and troublesome fibrous entrainment.
- *Food processing facilities* plagued with oily solid mists, fouling plant processes and plant air quality.

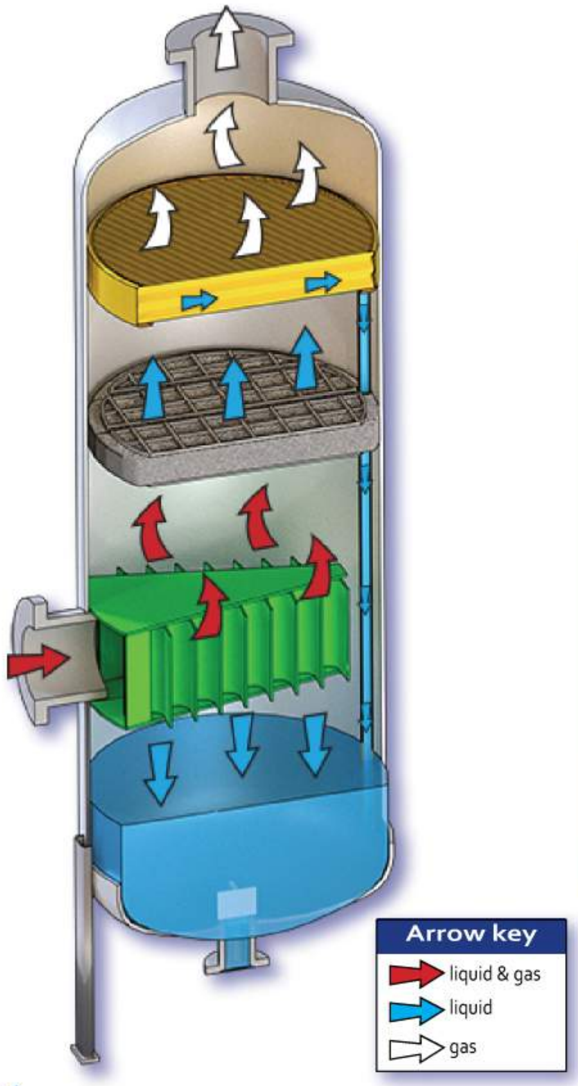


Figure 1
To improve both efficiency and capacity, this vessel was retrofitted with an Enhanced Demister Wire Mesh Pre-conditioner followed by an Enhanced Vane Mist Eliminator.

Enhanced Demister-Plus Systems are also available to upgrade operations limited with unusually high liquid loadings and/or solids. Figure 3 illustrates a vessel designed with a first stage special Enhanced Vane Mist Eliminator to remove bulk entrainment and 99% of solids which could otherwise flood or plug the downstream mist eliminator. This is followed by an ultra-efficient Enhanced Demister Mist Eliminator.

In some installations, the high efficiency separation of a single stage Demister is desired, but velocities exceed the allowable design limits of a vertical flow profile. This can happen when an existing system is pushed for more production or when there is limited space or weight restriction with a new vessel. One solution, shown in Figure 4, is an Enhanced Demister-Plus System that converts vertical flow to a horizontal two-stage flow design. The first stage is always an Enhanced Demister Mist Eliminator which operates as a droplet coalescer at high velocities. The second stage is an ultra-efficient Enhanced Vane Mist Eliminator. This system operates proficiently on the re-entrained droplets by moving droplet bell curve to the right where the larger droplets are easier to capture and remove from gas (see Figure 2).

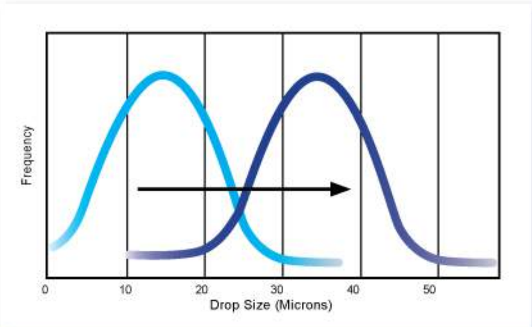
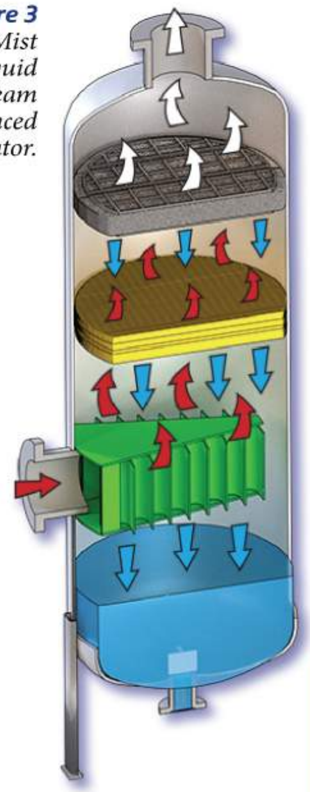


Figure 2
First stage Enhanced Mesh Mist Eliminators function as preconditioners at high velocities shift droplet size distribution.

Another solution in advanced separation technology to achieve the highest capacity level, in either vertical up-flow or horizontal flow installations, is to incorporate a two stage system with an Enhanced Cyclonic Mist Eliminators downstream (Figure 5). This system allows the fine droplets to coalesce in the first stage to a larger size, which pass to the second stage to be captured in cyclonic tubes, collected and drained in downcomer pipes.

Figure 3
First stage Enhanced Vane Mist Eliminator removes bulk liquid and solids protecting downstream performance of Enhanced Demister Mist Eliminator.



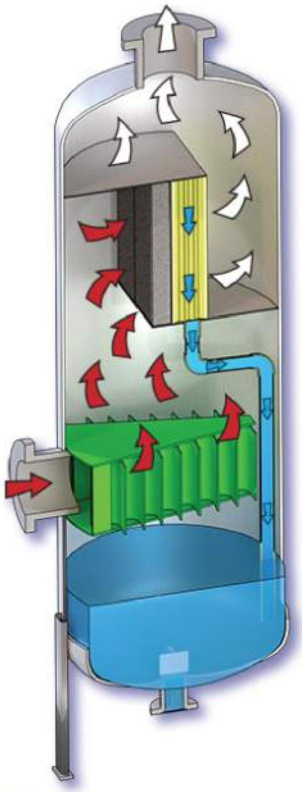


Figure 4
First stage horizontal flow Enhanced Mesh Mist Eliminators/preconditioner at high velocities shift droplet size distribution followed by Enhanced Vane Mist Eliminator.

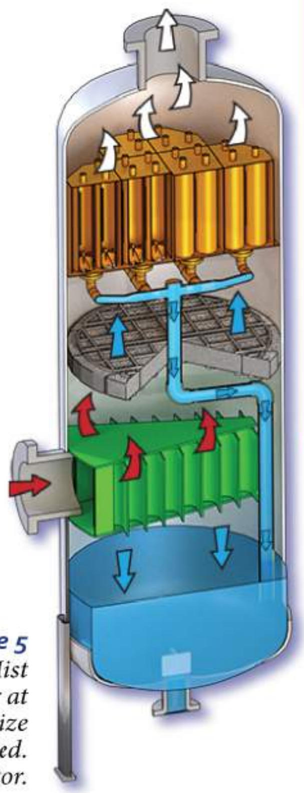


Figure 5
First stage Enhanced Mesh Mist Eliminators/preconditioner at highest velocities shift droplet size distribution followed by Enhanced. Cyclonic Mist Eliminator.

Coalescence

General considerations in the separation of immiscible liquids

Using Coalescers to separate two immiscible liquids will provide...

- *Capital cost savings due to smaller separators*
- *Increases in capacity for existing separators*
- *Savings due to recovery of solvents*
- *Improved product quality*
- *Reduced tank inventory*
- *Compliance with Environmental Regulations*

Why does Coalescing occur?

In an emulsion of two immiscible liquids, Coalescence is the process by which very fine droplets physically join together to form larger droplets which then settles naturally by gravity. The most common method for this phenomenon to occur is to simply allow the mixture to flow at low rates (m/sec) in large vessels and/or sit over time in storage tanks (days sometime weeks) to separate. Gravity and buoyance forces will sooner or later form two distinct layers. In most cases this is not the most economical method. In the case of very stable emulsions consisting of droplets less than 10 microns in size a natural coalescing and separation by gravity might never occur.

The theory of Coalescence

The separation of a dispersion of immiscible liquids has been considered more of an art than a science. Theoretical investigations are based on calculations of droplet size of pure components. Most predictions are based on a mean droplet size, but since the extent of separation is a function of small droplets, a droplet size distribution is a more accurate method. This approach is quite costly, so most designs are not based on theoretical assumptions, but rather from experimental investigation of the pertinent mixture. Practical experience by HMT process engineers is essential in order to reach an effective and economical solution to most industrial coalescer problems.

There will be two major steps involved in this kind of separation. The first is truly coalescence, the physical process of very fine droplets joining on another and forming larger droplets (Figure 1). The second step is the natural separation of the two phases by gravity and bouyancy (Figure 2). Each of the two steps occur simultaneously and can be enhanced by proper design of the vessel and appropriate internals with special emphasis in coalescer media.

Mechanisms of Coalescense – Stokes Settling

We have stated that the simplest mechanism for all liquid/liquid separators is the gravity settler which works solely on the principal of Stokes Law. It predicts the rise and fall of one liquid dispersed in another.

The equation George Stokes developed in 1851 for the terminal settling velocity is still used today:

$$vt = 1.78 \times 10^{-6} (\Delta S.G.) (d)^2 / \mu$$

vt = Terminal Settling Velocity, ft/s
d = Droplet Diameter, microns
ΔS.G. = Specific Gravity Difference between the Continuous and Dispersed Phases
μ = Continuous Phase Viscosity, centipoise

The key parameters are:

- **Density difference between liquids; difficult to separate if low**
- **Viscosity of fluids; difficult to separate if high**
- **Interfacial tension; coalescense difficult if low (can be affected by additives such as corrosion inhibitors)**
- **Gas and/or solids content in the feed**
- **Pressure and/or temperature**
- **Aggressiveness of liquids; material selection varies**

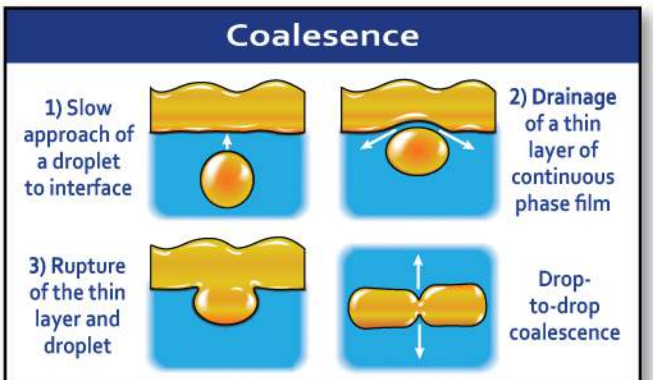


Figure 1 *Coalescence of droplets (1-3) and drop-to-drop.*

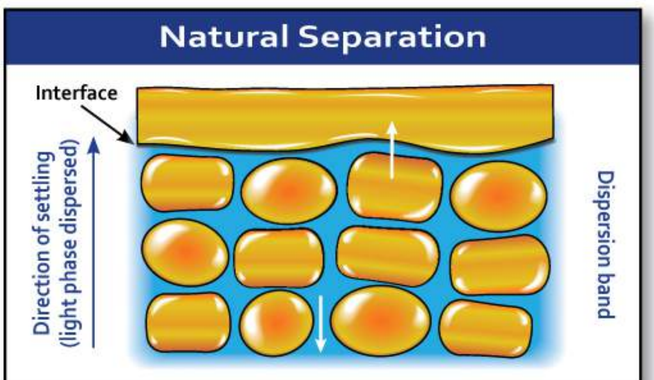


Figure 2 *Dispersion band of Coalescing droplets.*

These designs assume that droplets are truly spherical and flow is laminar not turbulent. When the Reynolds number (the ratio of inertial forces to viscous forces) is high, droplets shapes are deformed and eddy currents are produced which re-disperse them before reaching proper size and weight. How can this mechanism be improved?

An enhancement such as reducing the distance droplet needs to reach interface is one such way. HMT provides coalescing elements with channels. These channels introduce surface area where droplets meet more readily other droplets. Coalescing elements such as the Enhanced Cross-Flow™ and Enhanced Corrugated Plate Interceptor™ will significantly increase the coalescing process over empty vessels which results in much shorter length, smaller in diameter, lower in weight and with a much smaller footprint. New high power software programs model these advantages.

Mechanisms of Coalescense – Direct Interception

When gravity forces with enhancements alone do not produce the desired separation, Direct Interception can be deployed with the use of fibrous media. Fine droplets are drawn to or contact a filament. The finer the filament the finer the droplet captured. Liquid now begins to cover surface as other fine drops contact filament do the same. The thin film of dispersed liquid covers the surface where a much larger droplet begins to grow in size. In Figure 3, surface energy holds a droplet to a filament. The total force of adherence is a function of the contact angle. As the velocity of flow through the media increases. a point will be reached at which the droplets are swept off the filament. This process continues through the element to the drainage zone settling to bottom of vessel or rising to interface. HMT offers a variety of fibrous media including various polymeric materials, glass mats, stainless steel meshes and glass fiber to create that effect. Fine targets of wire, monofilaments, and multifilament are geometrically placed in flow path to capture, coalesce, and drain fine dispersed droplets from continuous phase.

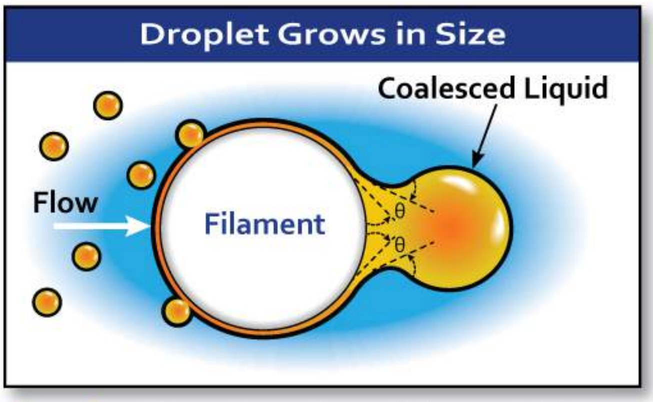


Figure 3 *Assisting coalescence by use of fibrous material.*

Coalescer Type	Source of Dispersions	Mechanism	Min/Max Droplet Diameter	Flow Range m³/hr/m²	Solids Handling
Enhanced Cross-Flow™	Separators with Coarse Emulsions and Static Mixers	Stokes Law Settling	50-1000µ	42-216 (18-90 gpm/ft²)	Good
Enhanced Corrugated Plate Interceptor™	Overhead Drums, Extraction Columns, Distillations Tower Feeds, Impeller Mixers	Stokes Law Settling	40-1000µ	35-180 (15-75 gpm/ft²)	Fair
Enhanced DC™	Haze from Cooling in Bulk Liquid Phase, Surfactants Giving Emulsions with Very Low Interfacial Tension	Direct Interception Preferential Wetting and Interstitial Effect	5-300µ	20-110 (7.5-45 gpm/ft²)	Filter may be required

Design Consideration for Coalescer vessels

For new vessels, typically the settling theory or retention time for the liquid phase is the method used by many. With the use of enhanced coalescers and advanced computer software programs, HMT can offer state-of art design (sizing) or evaluate (rating) separators and scrubbers in detail, right down to the selection of all suitable separation internals. This includes the design layout for the inlet section, coalescing section, demisting sections, and liquid levels, determining optimum vessel sizes, properly select internals and assess the overall performance of each vessel.

Furthermore, HMT can also evaluate an existing design and determine its theoretical performance based on actual operating data and propose improvements to boost capacity, increase operating ranges and provide sharper separation efficiencies.

The HMT optimization capabilities provide an excellent opportunity for equipment cost saving. Vessels designed based on actual performance predictions can often be made smaller than vessels designed solely based on common engineering standards. A reduction in vessel size not only reduces the cost for the vessel, but it can also have a significant effect on lowering the overall project cost.

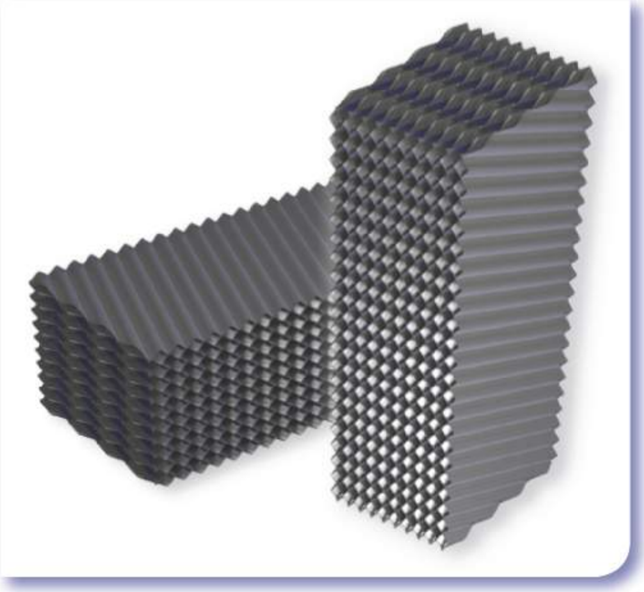
HMT Coalescence Technical Bulletins

Enhanced Corrugated Plate Interceptor™ Coalescer [ECPI]

Enhanced Cross-Flow™ Coalescer [ECF]

Enhanced DC™ Coalescer [EDC]

Enhanced Corrugated Plate Interceptor™ Coalescer (ECPI)



Features

- *High separation efficiency*
- *Low pressure drop*
- *Easy to install*
- *Fits all process equipment*

What are Enhanced Corrugated Plate Interceptor Coalescer packings?

Enhanced CPI Coalescers are structured elements of corrugated plates that provide economical and effective removal of dispersed droplets in a continuous phase process system with clean to light solids present.

How do Enhanced Corrugated Plate Interceptor™ Coalescer Packings work?

In a horizontal laminar flow condition, the continuous phase enters the unique diagonal high surface area plate pack, designed to minimize the distance a free dispersed droplet has to either rise or fall before coming into contact with other dispersed droplets (see Figure 1). As larger droplets coalesce into much larger ones they leave the plate pack rapidly countercurrent against the continuous liquid flow. This design ensures that the dispersed droplets coalesce on the undersides or topside of the corrugated plates, depending on their density relative to continuous phase, facilitating the free removal process.

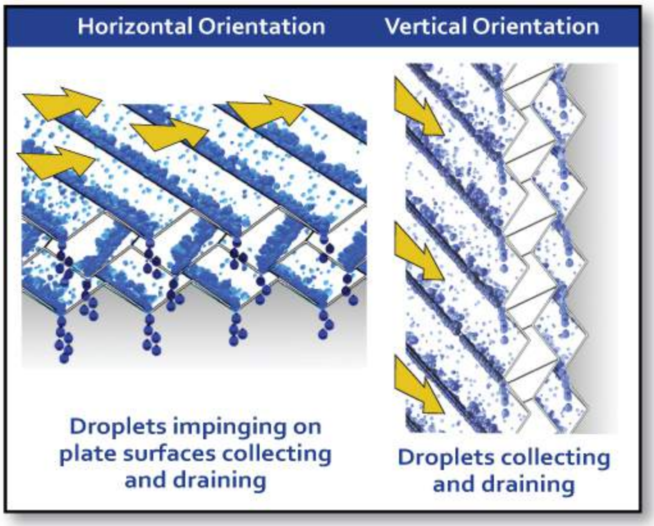


Figure 1
In this equipment, differences in densities of the two liquids cause droplets to rise or fall by their buoyancy. The greater the difference in densities, the easier the separation.

Whether vertical or horizontal orientation, these compact efficient configurations with their various numbers of plates, in a wide range of applications can provide enough effective area for removal efficiency to down to 15 ppm with greater than >60 micron removal. Since the plates are arranged parallel to each other with various spacing, the separator is able to tolerate up to 100ppm total suspended solids without affecting the effluent quality. Typically, vessels with these units are one-third size of standard gravity separator, and produce a finer product or effluent quality. In the vertical configuration, where the ECPI is positioned at a 45º incline, separation flow is enhanced and the risk of plugging the media is minimized. The separated solids in the ECPI pack flow down the valleys of the corrugations to the bottom of the ECPI pack to open area below. The use of a downflow pack configuration ensures the entire continuous phase passes through the plate pack.

Where are Enhanced Corrugated Plate Interceptor™ Coalescers used?

ECPI Coalescer Packings are predominantly used in two, three, and four phase separators (high or low pressure), Liquid/Liquid extraction columns, effluent gravity settling tanks. They are found in:

- CPI industries
- Potable & Process water treatment
- HPI industries
- Pharmaceuticals & specialty chemicals
- Textiles industries
- Food and beverage
- Automotive, iron & steel

Specifications

Style No.	Droplet size cutoff	Pressure drop
Horizontal orientation		
HBS-Pack 375	>40µ	1-10 mbar
HBS-Pack 500	>100µ	0.7-8 mbar
HBS-Pack 100	>200µ	0.5-4 mbar
Vertical orientation		
VBS-Pack 375	>100µ	1-8 mbar
VBS-Pack 500	>150µ	0.7-6 mbar
VBS-Pack 100	>200µ	0.5-2 mbar

NOTE: Typical values for aqueous and organic applications.

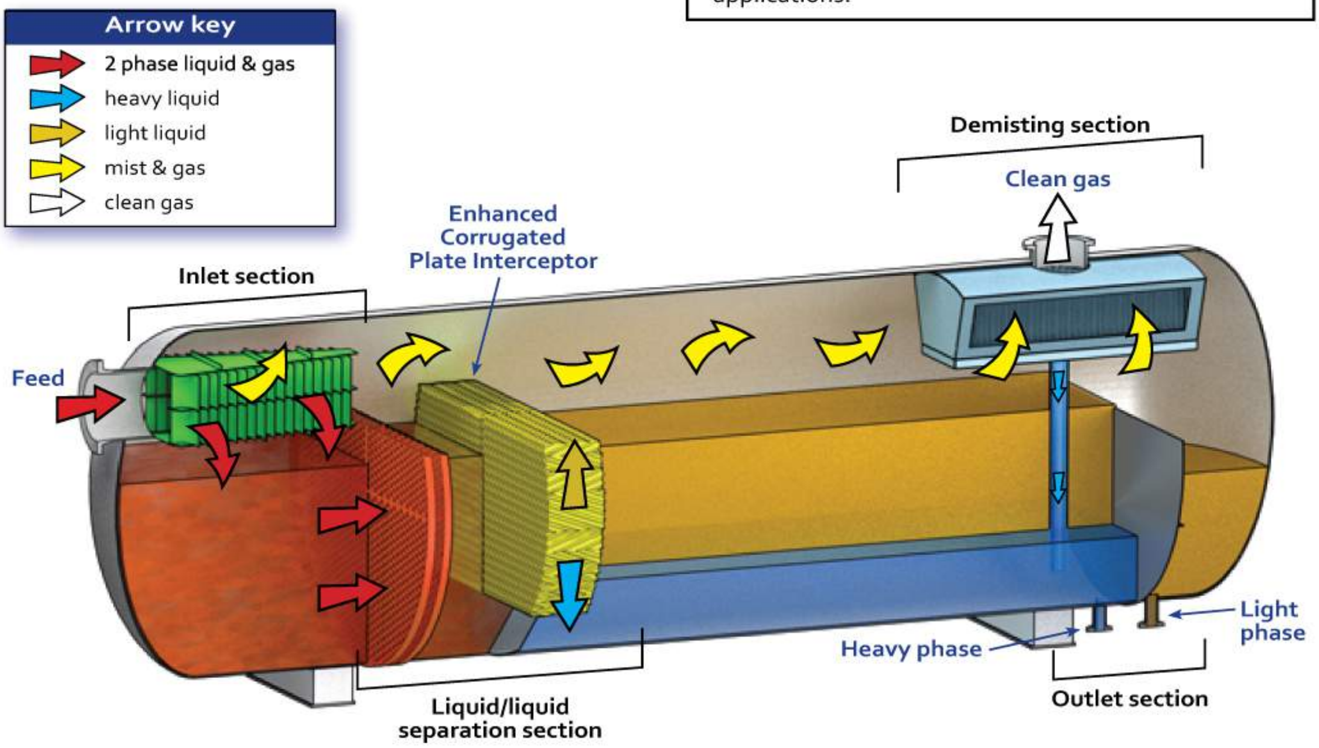


Figure 2
Successful operation of all Coalescer elements depend primarily on vessel geometry such as, properly designed inlet, liquid/liquid separation and outlet sections. Various schemes are used with horizontal vessels depending on whether there is a significant amount of gas present as with Three-Phase Separators.

Experienced HMT process engineers can provide complete process modeling and design whether existing or new vessel to ensure expected efficiencies and flow rate along with trouble-free installation and startup.

Coalescence

Enhanced Cross-Flow™ Coalescer (ECF)

Features

- *Good separation efficiency*
- *Robust construction*
- *Lowest pressure drop*
- *Tolerates medium to fine solids*
- *Fits all process equipment*
- *Easy to install*

What is an Enhanced Cross-Flow Coalescer?

Enhanced Cross-Flow Coalescer is an innovative plate separator specially designed for applications where an improvement in performance of conventional gravity settlers are needed and where other coalescer elements may be not be suitable due to either fouling problems from high concentration of solids or waxy compounds in the feed or when minimal pressure drop is required.

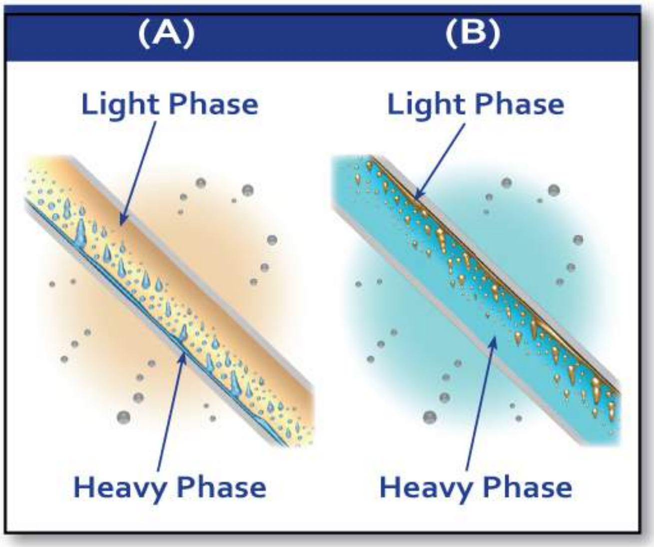


Figure 1

(A) *In the continuous light phase, dispersed heavy phase droplets settle by gravity onto the bottom surface of the plates where they coalesce, forming a thin film which drains to interface region in vessel*

(B) *In the continuous heavy phase, dispersed light phase droplets rise by buoyance forces onto the top surface of the plates where they coalesce, forming a thin film which rises above interface region in vessel*

How do Enhanced Cross-Flow Coalescers work?

In a horizontal laminar flow application, a continuous phase enters the upstream face of the Enhanced Cross-Flow coalescer. Here the feed enters a highly compartmentalized area plate pack designed to minimize the distance a free dispersed droplet has to either rise or fall based on Stokes Law, before coming into contact with a surface and other dispersed droplets thus enhancing the coalescence process. As the larger droplets coalesce into much larger ones on a surface, they accumulate larger mass and leave the plate pack rapidly and counter currently against the continuous liquid flow. This design ensures that the dispersed droplets coalesce on the underside or topside of the parallel plates, depending on their density relative to continuous phase, facilitating the free removal process (see Figure 1). To increase higher removal rates, tighter plate gaps are designed to reduce droplet travel achieving higher removal separation.

Likewise, the solids would work their way downwards through the Enhanced Cross-Flow Coalescer plate pack section out the downstream face, settling to the bottom of the vessel. Changes in the plate angle from 45° to 60° promote an improvement in the tolerance of solids.

Where are Enhanced Cross-Flow™ Coalescers used?

ECF Coalescers are predominantly used in two, three, and four phase separators (high or low pressure) and effluent gravity settle tanks. They also have been installed to promote gas/liquid separation for degassing application. They are found in:

- Oil and Gas exploration and production
- HPI Industries
- CPI industries
- Potable & Process water treatment
- Food and beverage
- Automotive, iron & steel
- Utilities

Specifications		
Style No.	Droplet size cutoff	Pressure drop
18 various configurations	≥ 50μ	<5 mbar

NOTE: Experienced HMT process engineers will custom design from the widest range of ECF Coalescer Plate packs to meet your efficiency, capacity, and turn down requirements.

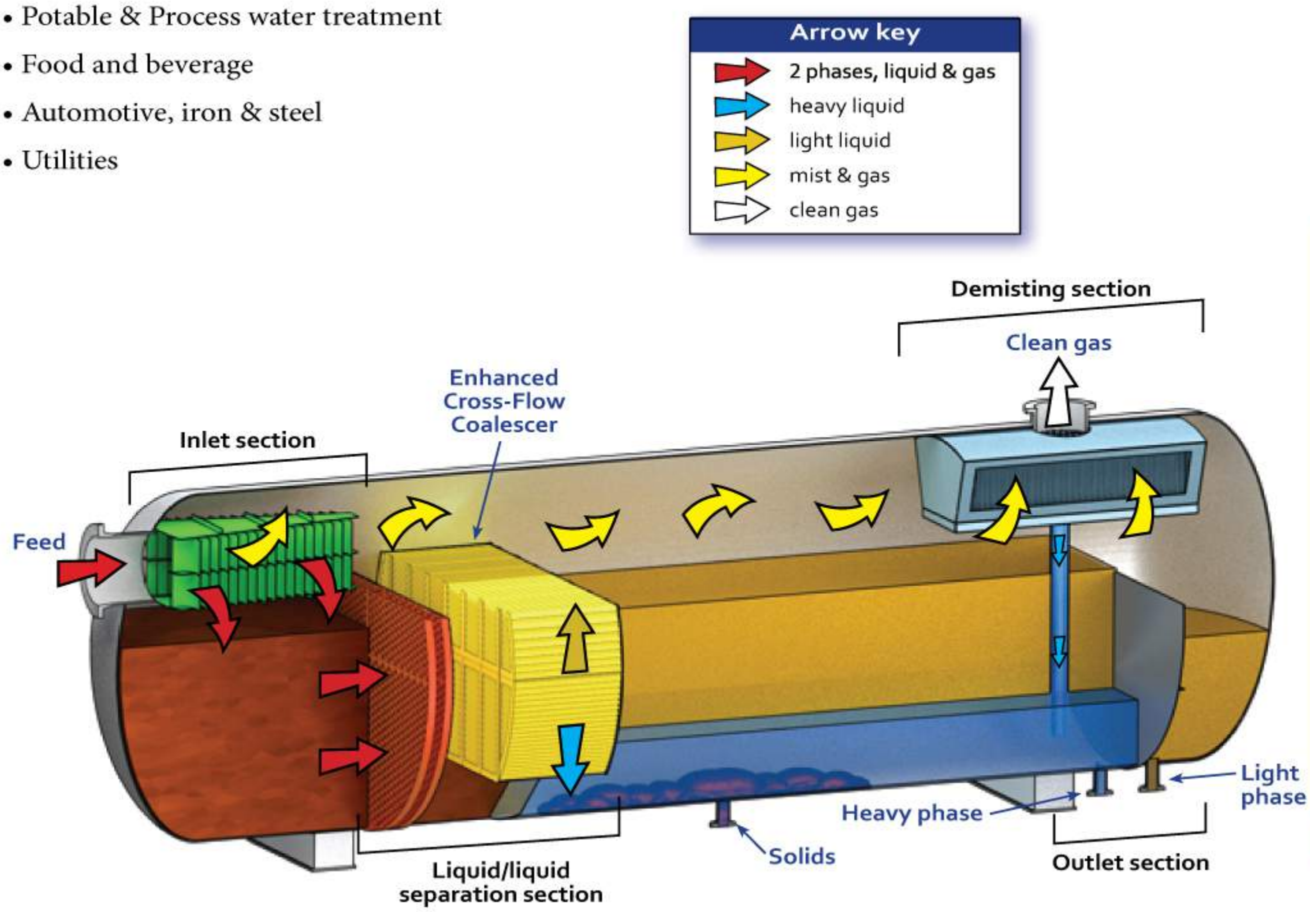


Figure 2
Successful operation of all coalescer elements depend primarily on vessel geometry such as, properly designed inlet, liquid/liquid separation and outlet sections. Various schemes are used with horizontal vessels depending on whether there is a significant amount of gas present as with Three-Phase Separators.

Experienced HMT process engineers can provide complete process modeling and design whether existing or new vessel to ensure expected efficiencies and flow rate along with trouble-free installation and startup.

Enhanced DC™ Coalescer (EDC)

Features

- *Highest separation efficiency*
- *Low pressure drop*
- *Widest range of materials of construction*
- *Fits all process equipment*
- *Easy to install*

What is an Enhanced DC Coalescer?

The Enhanced DC Coalescer is an innovative dual component (DC) serface active device consisting of various size metal wires and/or plastic filaments specially knitted to a precise geometric pattern. They are installed in vertical or horizontal separation vessels. They have immense surface area to attract, coalesce and release fine primary and secondary dispersed droplets in a continuous phase through *Direct Interception* as liquid travels in laminar flow. These elements are much more effective in capturing smaller droplets than those that depend only on *Stokes Settling* and are used in clean or filtered streams to improve separators over other coalescer elements that may not meet stringent separation requirements or to boost capacity in liquid/liquid extraction columns.

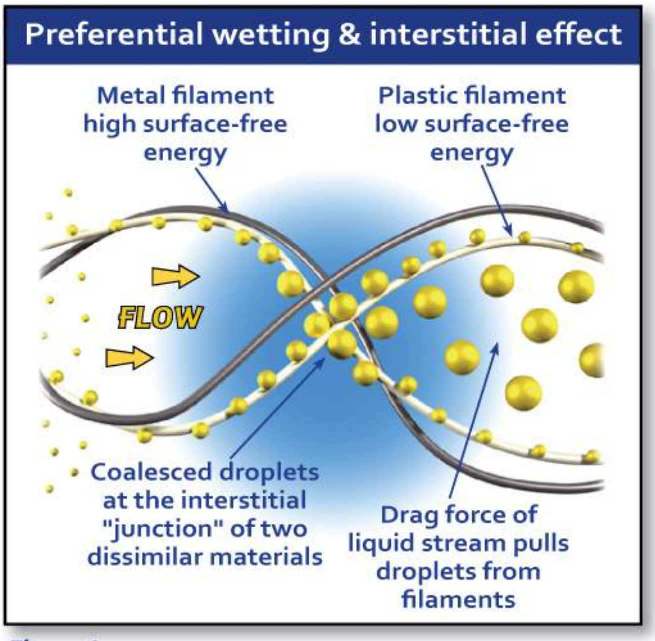


Figure 1

A combination of both high and low surface-free energies provide effective separation irrespective of which phase is dispersed.

How do Enhanced DC Coalescers work?

In either a horizontal or a vertical laminar liquid flow, a continuous liquid phase with dispersion enters the upstream face of the Enhanced DC Coalescer. Here the feed enters a high surface area element ranging from 300mm (12") to 1 meter thick depth of multi-stage metal wire knitted in parallel with one or more plastic filaments. Direct Interception occurs where the size of the target will be close to the average size droplet in the dispersion. Finer coalescing media, or multifilaments, allow for the separation of finer or more stable emulsions resulting in highest separation efficiency.

As fine dispersed droplets are drawn to either the metal wires (hydrophilic dispersion) or plastic filaments (oleophilic dispersion) they begin "preferential wetting" along with an "interstitial effect", thus coalescing larger droplets at the junction of two dissimilar materials (see Figure 1). The rate of coalescence is significantly increased in this process where the droplets continue to grow and grow making their way through the media to the drainage section of elements. There they exit the downstream face of the coalescer where dispersed droplets are hundreds of times larger than their original size. Gravity and/or buoyancy forces now take effect to either settle to bottom of vessel or rise to the interface section.

Where are Enhanced DC™ Coalescers used?

EDC Coalescers are predominantly used in two, three, and four phase separators (high or low pressure) and in liquid/liquid extraction towers. They also have been installed to promote liquid/dissolved gas separation for degassing applications. They are found in:

- Pharmaceuticals
- Specialty chemicals
- HPI Industries
- CPI industries
- Flavors and fragrancies
- Food and beverage

Specifications

Style No.	Droplet size cutoff	Pressure drop	Hydrophilic/ Oleophilic
HBF-Pack Style 1188	4.5	100-300 mbar	Hydrophilic
HBF-Pack Style 1078	11.0	50-200 mbar	Oleophilic
HBM-Pack Style 2622	30.0	50-100 mbar	Hydrophilic
HBM-Pack Style 837	79.0	10-20 mbar	Hydrophilic
HBD-Pack Style 1236	90.0	5-10 mbar	Hydro & Oleophilic
HBM-Pack Style 1236	99.0	5-10 mbar	Hydrophilic
HBM-Pack Style 542	109.0	1-5 mbar	Hydrophilic

Note: Typical values for 300mm (12") thick element in aqueous and organic continuous applications.

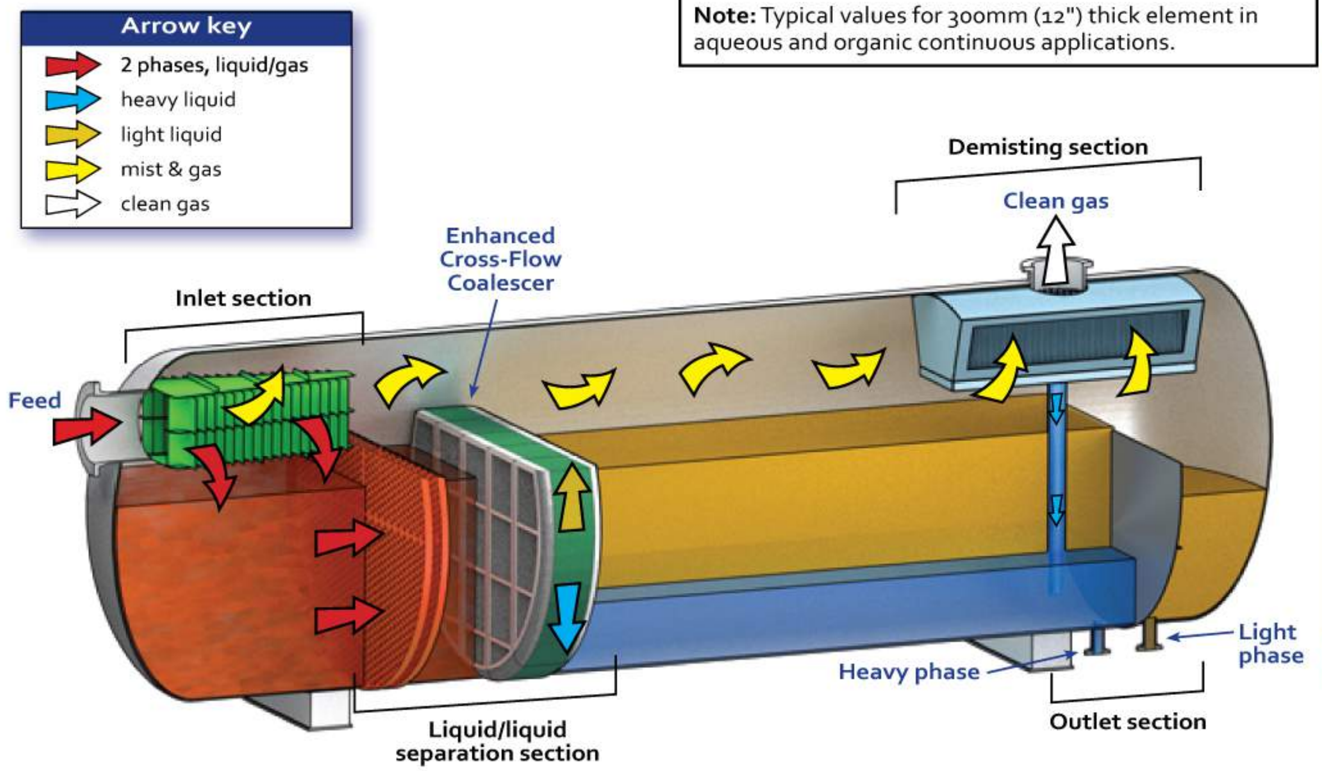


Figure 2
Successful operation of all coalescer elements depend primarily on vessel geometry such as, properly designed inlet, liquid/liquid separation and outlet sections. Various schemes are used with horizontal vessels depending on whether there is a significant amount of gas present as with Three-Phase Separators.

Experienced HMT process engineers can provide complete process modeling and design, whether existing or new vessel, to ensure expected efficiencies and flow rate capacities along with trouble-free installation and startup.

Inlet Devices

Enhanced Type S™ Inlet Devices (ETS)

Features

- *Achieves a considerable reduction of the vertical vessel height*
- *Reduces mist loading to downstream demisters increasing gas capacity*
- *Eliminates droplet shearing over conventional devices improving the separation efficiency*
- *Initiates even distribution of liquid and gas distribution*
- *Prevents or breaks down foam*
- *Easy to install in new or existing process equipment*

What are Enhanced Type S Inlet Devices?

Background

Inlet Devices play an important role in overall performance of a separation vessel or mass transfer column. Traditional inexpensive devices (Figure 1) that are commonly used at low momentum liquids but negatively affect separation at high momentum are: (A) impact plate, (B) dished head, (C) half-open pipe, and (D) open pipe at vessel head. However, for higher-momentum streams, these inlets can cause problems such as shearing of incoming liquid droplets (more difficult to separate), foaming and liquid short-circuiting or channeling.

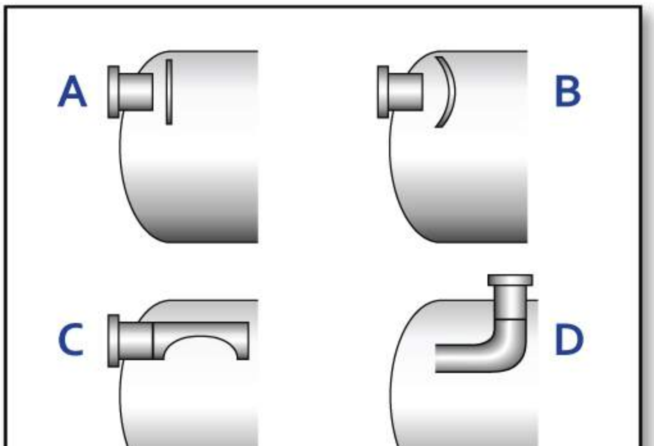


Figure 1
Traditional Inlet Devices used in horizontal or vertical vessels

Superior Design

Enhanced Type S Inlet Devices offer superior design and operating performance versus traditional inlet devises in two ways. They are: uniformly decreasing the momentum of the incoming feed stream and evenly distributing the vapor in the gas section of the vessel.

Extending well into a vertical separator vessel cross section, these devices reduce momentum of the incoming feed giving ample residence time which allow for the removal of bulk liquids (liquid load) and solids present in the feed by gravity. Whether in a vertical or horizontal vessel, they provide even distribution of the inlet gas-liquid mixture over the entire cross section of a separator vessel in a very short and controlled way.

In mass transfer columns, it is important to prevent channeling of fluid, especially through the packed beds. Such channeling leads to reduced gas liquid contact and hence reduced efficiency of the column. Enhanced Type S Inlet Devices enable the even distribution of gas over the Inlet tray, thus preventing channeling of fluid to occur. This insures good gas liquid contact optimizing expected efficiency of the column packing or trays.

How do Enhanced Type S Inlet Devices work?

As gas and liquid enters a vessel or column, the Enhanced Type S Inlet Device splits the mixed phase feed stream into a series of curved vanes to suit the overall geometry of the inlet nozzle and distribution length. Lateral flowing streams gradually reduce the gap, developing a tapered shape. To determine proper nozzle size and design of the Enhanced Type S Inlet Device along with the specific number of vanes and their pitch to achieve the targeted performance one must first determine the inlet momentum (measured in Pascals).

Inlet momentum = ρv2

Where: ρ = mixture density [kg/m3]

v = velocity of the incoming mixture [m/s]

Guideline

- No inlet device < 1000 Pa
- Traditional devices < 1500 Pa
- ETS < 7000 Pa

However, the inlet momentum should not be used as the sole criteria for design. It serves as an indication of the severity of the inlet conditions. This information along with upstream piping layout and flow regime will provide a more meaningful design basis.

The spacing to the vessel wall and between the blades is designed using computational fluid dynamics (CFD) and modeling software to optimize uniform flow (Figure 2).

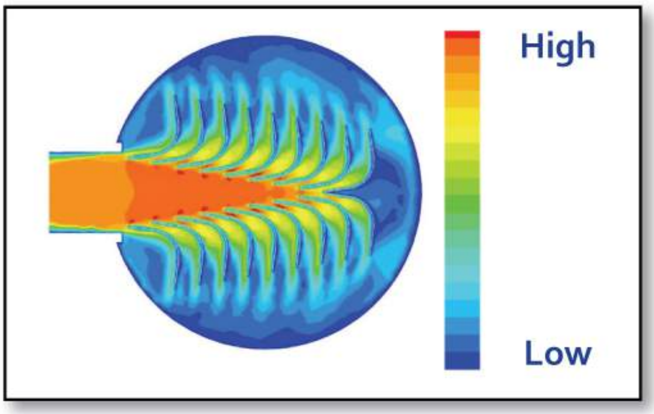


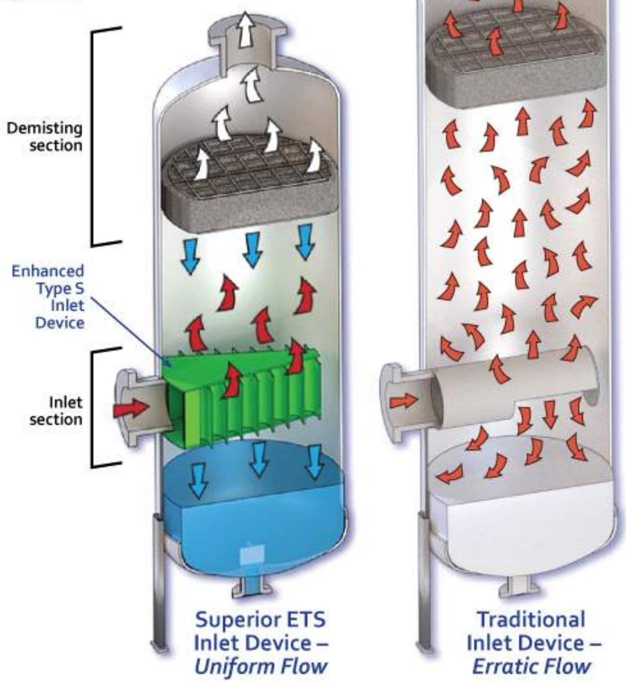
Figure 2
CFD depicting velocity profile from high to low.

Typically, in a horizontal vessel, the length of ETS can be 3 to 6 times the inlet nozzle diameter and for a vertical vessel or column the length can be as long as 90% of vessel diameter.

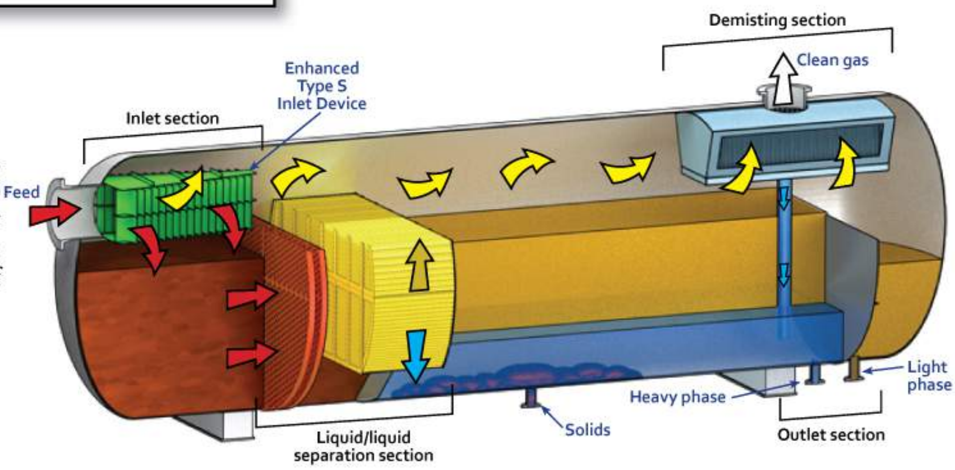
Where are Enhanced Type S Inlet Devices used?

Enhanced Type S Inlet Devices achieve a considerable reduction of the vertical vessel or column height when compared to conventional inlet devices (Figure 3). They are suitable for installation through a manway in new or existing horizontal or vertical two, three & four phase separators without welding to vessel if required (Figure 4). They can also be installed in vertical mass transfer columns.

Figure 3



ETS device can reduce vessel height, as well as liquid load to demister section.



Experienced HMT process engineers can provide complete process modeling and design whether existing or new vessel to ensure expected efficiencies and flow rate along with trouble-free installation and startup.

Separation Vessels

Enhanced Type V™ Separation Vessels

Features

- *Handles low to intermediate gas to liquid ratios*
- *More resistant to motion with smaller dimensions*
- *Solids are easily removed from bottom*
- *More reliable when gas flow surges occur*
- *Reduce foot print, platform and ancillary equipment*
- *Protect downstream corrosion and erosion*
- *Extend capacity of existing vessels while improving efficiency*

Compact Reliable Separation

Enhanced Type V Separator Vessels are vertical vessels generally ideal for two-phase applications, where liquid level control is not critical and gas flow surges may occur. Also in Enhanced Type V separators there is less of a tendency for re-vaporization of liquid into gas phase due to greater vertical distance between liquid level and gas outlet. Experienced process engineers use proprietary software to simulate and optimize all six sections of a vertical vessel with multiple phases (see Figure 1). Properly designed vessels are lower in cost, easier to ship/assemble and may require less piping for field connections. HMT engineers know that size and weight of separation equipment are key factors of the commercial value of a new development project. Our compact separation vessels provide state-of-the-art separation technologies and internals for on shore and off shore separation. The design minimizes space and weight while optimizing separation efficiencies. For existing installations, the equipment can provide separation solutions that lead to increased production and improved efficiencies.

HMT programs can interface with Aspen HYSYS®, UniSim®, ScimSci for accurate predictions on full life cycle performance and effect on downstream equipment.

Where are they used?

These vertical separators are commonly used in oil and gas refinery/production, petrochemical and chemical plants, compressor systems for air or gases, as well as throughout gas pipeline transmission. Their performance and operating range is determined by the process data, characteristics of the fluids being separated, the size of the vessel, and the state-of-art internals selected and installed. Experience shows optimization of these vessels can increase production while protecting against downstream corrosion and erosion when all liquids are removed in the gas stream. There are clear benefits to selecting Enhanced Type V Separator Vessels. They handle light to moderate entrained liquid streams such as upstream of dehydrators or compressors and gas furnaces ensuring entrained mist is removed from the gas stream prior to reaching the dehydrator, compressor, or furnace. In this two phase gas/liquids vertical vessel, the gas stream enters through an inlet device, which causes an initial bulk separation of the liquid from the gas stream and uniform flow upward. As the stream moves upward through the vessel to the demisting section, it slows and the heavier liquids drop to the bottom as the gas rises. High efficiency mist eliminators capture all of the smaller liquid particles that remain entrained in the gas. The gas exits the top of the vessel clean and in specification. There are numerous sizes, configurations, and pressure ratings (see V1–V5 on back). Rugged in their design, they perform efficiently and reliably with little to no maintenance required.

Debottlenecking and Retrofitting

Increasing production capacity and more stringent purity specifications at existing facilities are a big challenge. HMT provides the capabilities to troubleshooting and debottlenecking separation vessels to maximize the throughput, efficiency and reduce maintenance of existing process equipment. Our solutions in separation and retrofitting processing facilities can enable higher production rates and increased purity without welding to vessel walls.

Customers have overcome production loss due to lack of efficiency of existing equipment, enhanced liquid recovery, handled changing gas/liquid ratio as demand increases or new regulations are mandated.

HMT identifies the needs and options for production improvement and undertake troubleshooting through data analyses and CFD studies. The resulting design and report contains recommendations and a proposal for the technology needed along with upgrading internals with state-of-art equipment specially design to meet desired performance including costs and expected installation time.

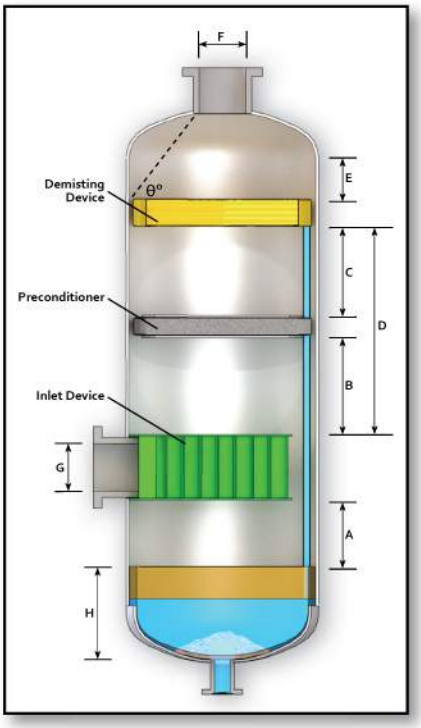
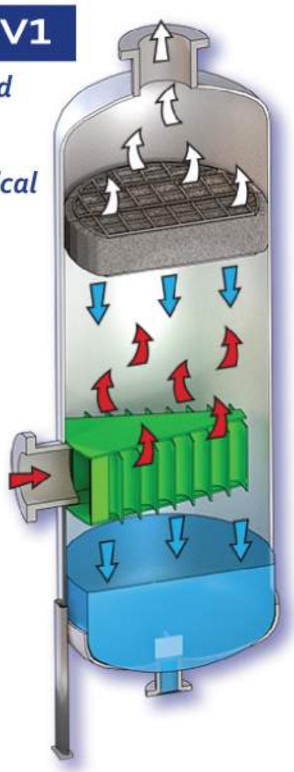


Figure 1

HMT designs all six sections of two, three, and four phase vertical vessels.

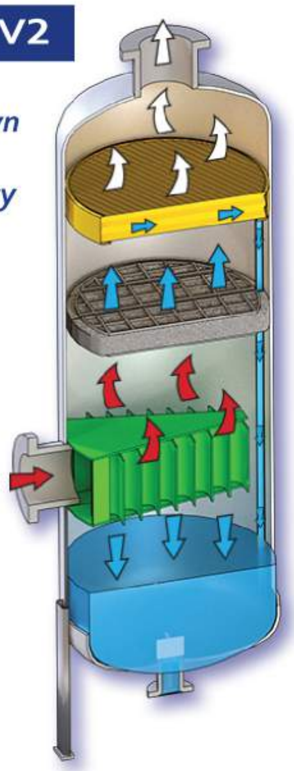
Type V1

- *Standard design*
- *Most economical*



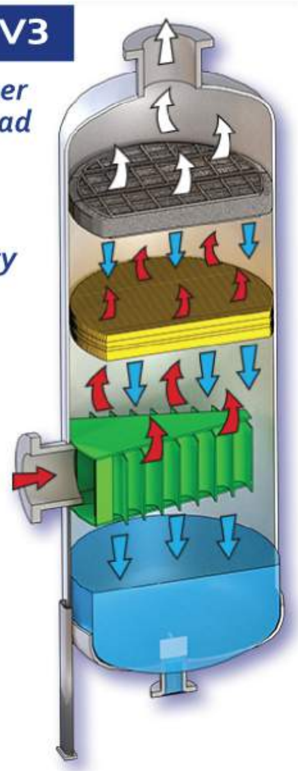
Type V2

- *Wider turndown*
- *Good efficiency*



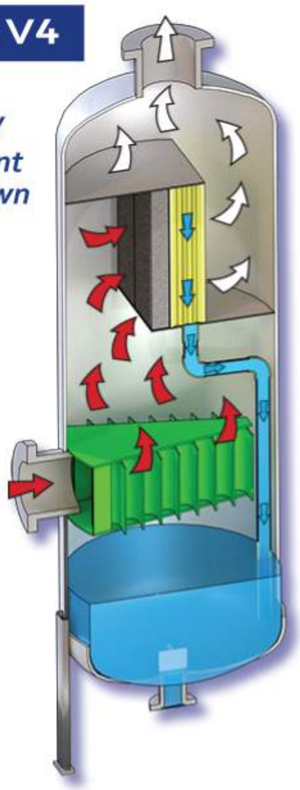
Type V3

- *For higher liquid load and/or solids*
- *Good efficiency*



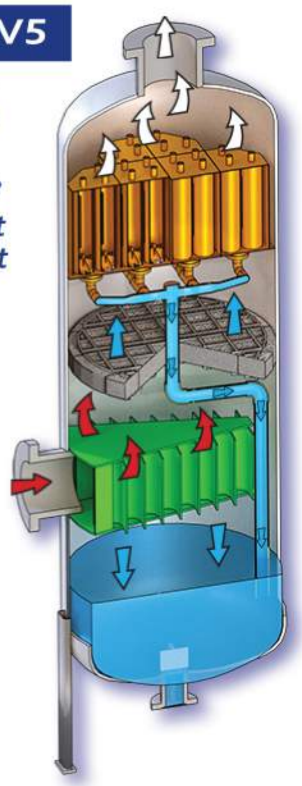
Type V4

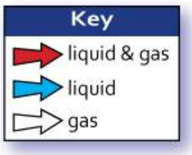
- *High velocity*
- *Excellent turndown*



Type V5

- *Highest velocity at high pressure*
- *Smallest footprint*





New Construction

New projects or evaluation of an existing separator starts with client's process data and clear required performance specifications. HMT provides process package and vessel design complete with state-of-art separation internals selected to guarantee stated performances at given operating conditions.

Included in the scope of supply:

- **Process and mechanical calculations**
- **Vessel layout**
- **Material and quality certifications**
- **Installation procedures**
- **Process guarantee**

With our local partners, HMT offers supply of new Enhanced Type V Separation Pressure Vessels to ASME Code, CE marking, Chinese Pressure Vessel Code, or Korean Pressure Vessel Code in carbon steel or alloy up to 14 feet in diameter, 150 feet long and up to 2-1/2" wall thickness.

Enhanced Type H™ Separation Vessels

Features

- ***Handles high gas and liquid rates***
- ***Reduce size and weight of pressure vessels***
- ***Reduce foot print, support structure and ancillary equipment***
- ***Lower installation and project cost (may be stacked to further minimize space)***
- ***Protect downstream corrosion and erosion***
- ***Ideal for both upstream and downstream applications***

Compact Reliable Separation

Enhanced Type H Separator Vessels are *horizontal* vessels generally ideal for high gas-oil crudes, foaming crudes, for liquid-liquid separation, or for a diverse range of situations and flow rates. Experienced process engineers use proprietary software to simulate and optimize all six sections of a horizontal vessel (see Figure 1). Properly designed vessels are lower in cost, easier to ship/assemble and may require less piping for field connections. HMT engineers know that size and weight of separation equipment are key factors in the commercial value of a development project. Our compact separation vessels provide state-of-the-art separation technologies for onshore and offshore separation. The design minimizes space and weight while optimizing separation efficiencies. For existing installations, the equipment can provide separation solutions that lead to increased production and improved efficiencies.

HMT programs can interface with Aspen HYSYS®, UniSim®, ScimSci for accurate predictions on full life cycle performance and effect on downstream equipment. These horizontal separators are commonly used in oil and gas refinery/production and petrochemical plants, for applications that separate vapor liquid mixtures, three phase mixtures with immiscible liquids, as well as, four phase mixtures with solids whose turbulence causes foaming. Their performance and operating range is determined by the process data, characteristics of the fluids being separated, the size of the vessel, and the type of internals selected and installed. Experience has proven that improved gas and oil quality, reduced impact of solids or foaming, an increase in gas and oil production, and the optimization of produced water quality are clear benefits of selecting Enhanced Type H Separator Vessels

Produced Water

An important application is in the produced water handling system, which is a key part of most oil and gas production facilities. If the discharge specifications are not met, there may be a significant environmental and economic impact. Additionally, over-designed produced water vessels can take up valuable space, reducing the amount of oil that can be produced.

Enhanced Type H Separator Vessels offer separation technologies to handle the produced water. Our equipment covers the whole range, from bulk separation of water at the well-stream, to the final polishing of the water to meet the most challenging regulations for discharge, including solids handling. HMT utilizes compact technologies for both new build production processes and retrofit into existing infrastructure.

Debottlenecking and Retrofitting

Decreasing reservoir pressure, increasing water production, along with space and weight restrictions at existing facilities are a few of the many challenges that occur during production. HMT provides the capabilities to troubleshoot and debottleneck existing separation vessels to maximize the throughput and efficiency of current production trains. Our solutions in separation and retrofitting processing facilities can enable higher production rates and increased field recovery with no welding to vessel walls.

HMT customers have overcome production loss due to lack of efficiency of existing equipment, enhanced oil recovery, handled changing gas/oil ratio for late-life operations, as well as met new regulations for improved water quality by upgrading existing internals with state-of-art equipment specially designed to meet desired performance.

HMT identifies the needs and options for production improvement and undertake troubleshooting through data analyses and CFD studies. The resulting design and report contains recommendations and a proposal for the technology and equipment needed, including costs and expected installation time.

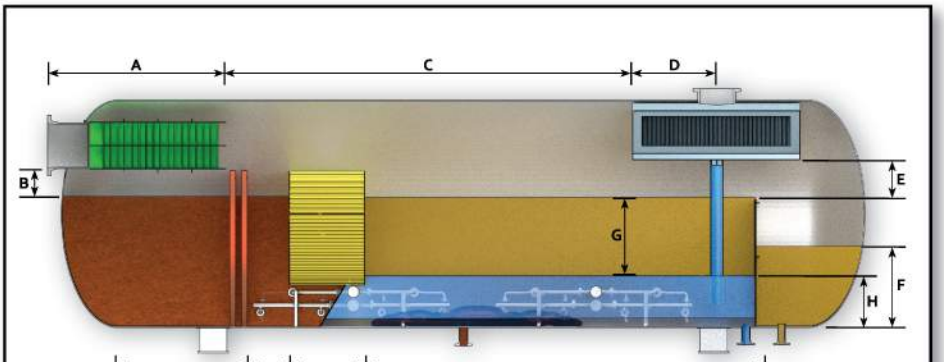
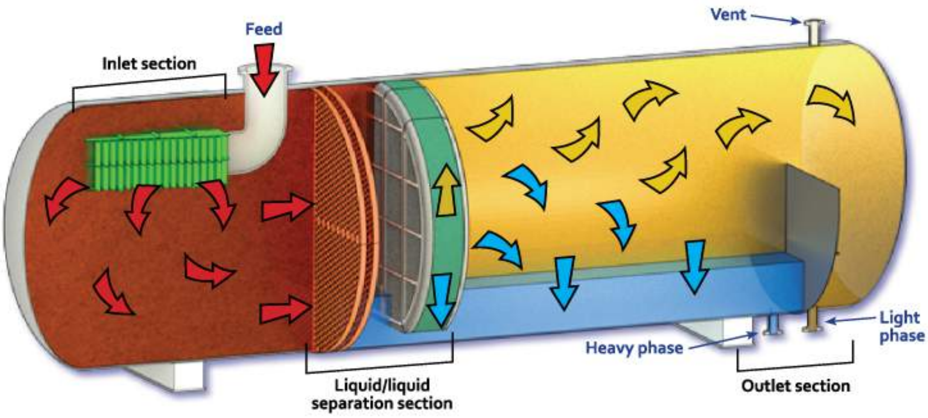


Figure 1 *HMT designs all six sections of two, three, and four phase horizontal vessels.*

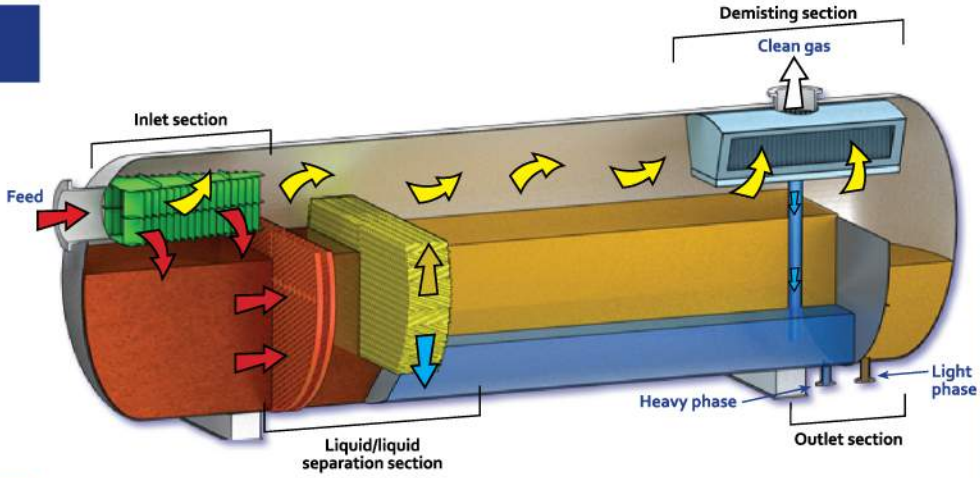
Type H2
Two Phase (Typical)

Key
2 liquids
heavy liquid
light liquid



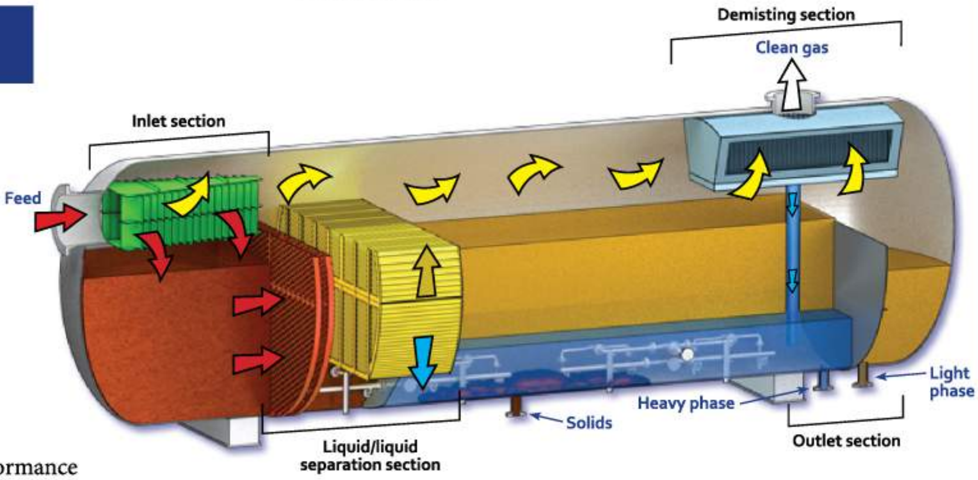
Type H3
Three Phase (Typical)

Key
2 liquids & gas
heavy liquid
light liquid
mist & gas
clean gas



Type H4
Four Phase (Typical)

Key
2 liquids, gas & solids
heavy liquid
light liquid
mist & gas
clean gas
solids



New Construction

New projects or evaluation of an existing separator starts with client's process data and clear required performance specifications. HMT provides process package and vessel design complete with state-of-art separation internals selected to guarantee stated performances at given operating conditions.

Included in the scope of supply:

- **Process and mechanical calculations**
- **Vessel layout**
- **Material and quality certifications**
- **Installation procedures**
- **Operating manual**
- **Process guarantee**

With our local partners, HMT offers supply of new Enhanced Type H Separation Pressure Vessels to ASME Code, CE marking, Chinese Pressure Vessel Code, or Korean Pressure Vessel Code in carbon steel or alloy, up to 14 feet in diameter, 150 feet long and up to 2-1/2" wall thickness.

PLEASE ASK US FOR ANSWERS BY REFERING THE FOLLOWING INFORMATION

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