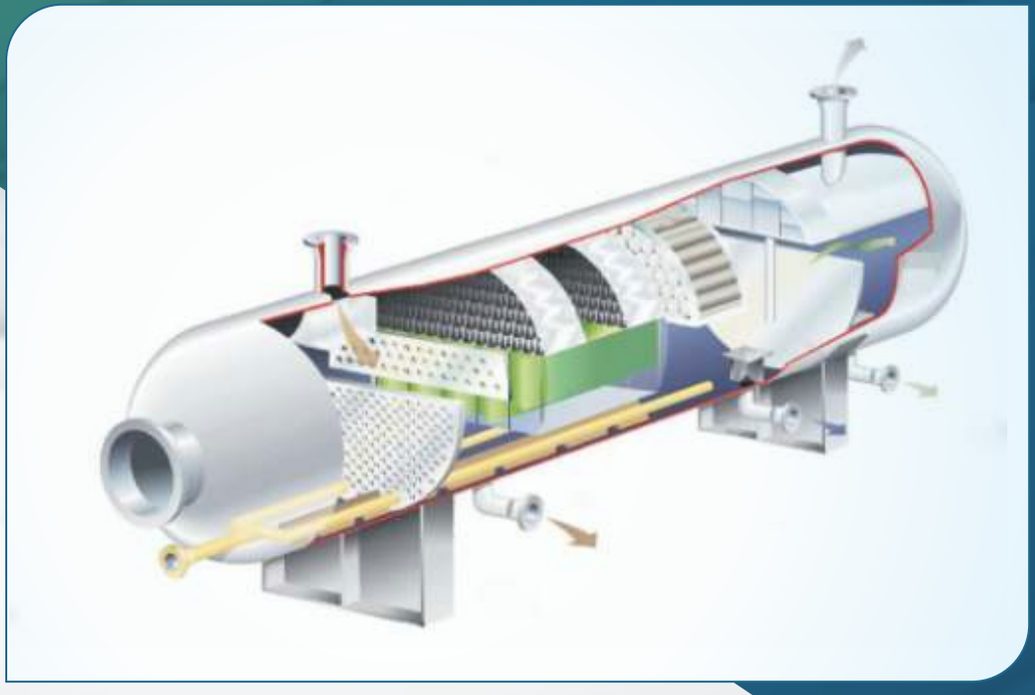
OIL & GAS
SEPARATOR INTERNALS



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SEPARATIONS TECHNOLOGY

In any industrial process there are many instances where free liquids and solids come in contact with gases. These free liquids and solids cause a number of undersirable effects within any process and they need to be eliminated from the gas flow as soon as possible for technical as well as economic reasons.

Free liquid droplets, droplet clusters and liquid slugs are generated through various mechanisms which are either forced or occur naturally. These liquids which get carried along with the gaseous phase may cause a number of problems like loss of product, equipment damage, process inefficiency etc. and must be separated quickly.

Finepac Structures in association with **Kirk Process Solutions (UK)** offers a full range of specialist internals, design services and software support for your engineering and procurement activities, vessel sizing and optimization, process performance prediction and internals selection. Our expertise in separation is evidenced by hundreds of operational vessels installed worldwide including a number of state of the art separation technologies and their design.

The separation of gases and liquids relies primarily on physical difference in phases. A separator may be defined as a vessel used to remove well stream liquids from gas components. Two phase separators remove the total liquid from gas, whereas 3 phase separators remove water from the hydrocarbon liquid.

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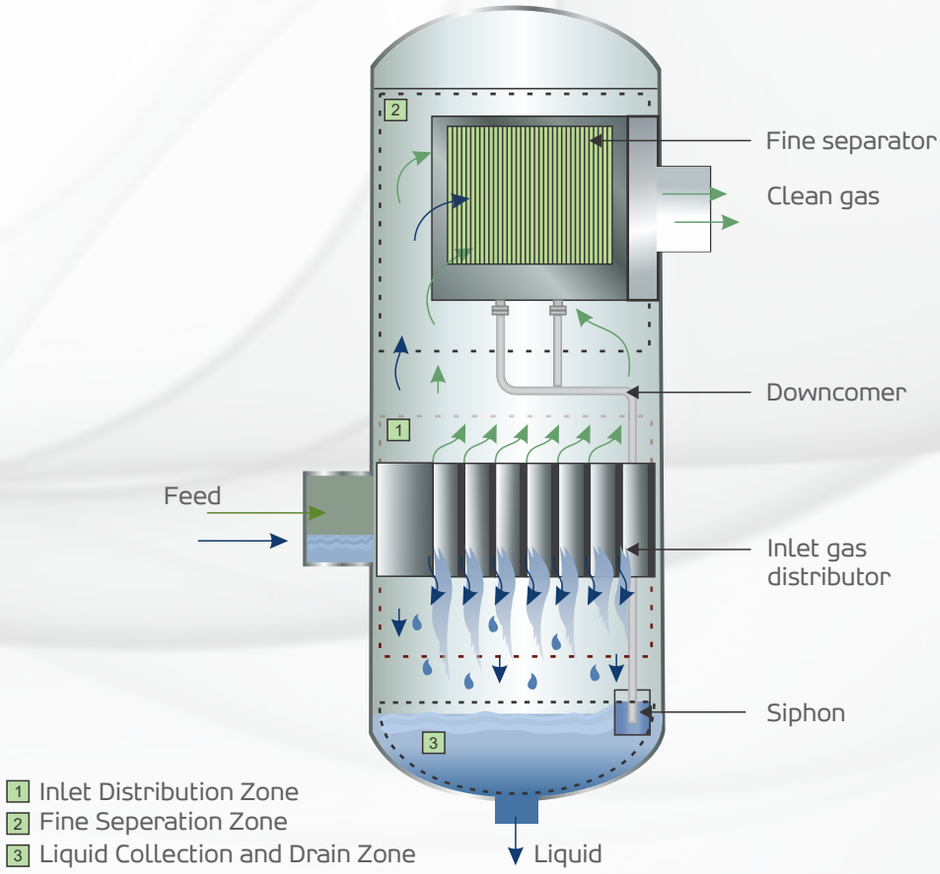
KNOCKOUT DRUMS
GAS-LIQUID SEPARATION



Knockout Drum

The knockout drum is a powerful tool to remove the combined liquids from a gas stream. Depending on the flow rates and the required separation efficiencies we design and fabricate knockout drums to suit your operational requirements. These can be made available in both vertical as well as horizontal configurations.

The feed first passes through the inlet distribution zone installed with internals like the inlet gas distributor or open half pipe. Here majority of incoming liquid is knocked out. From there the gas with the entrained liquid passes into a fine separation zone where all the remaining liquid is removed from the gas flow. The pre-separated liquid from the inlet distribution zone and fine separation zone is collected and drained off.

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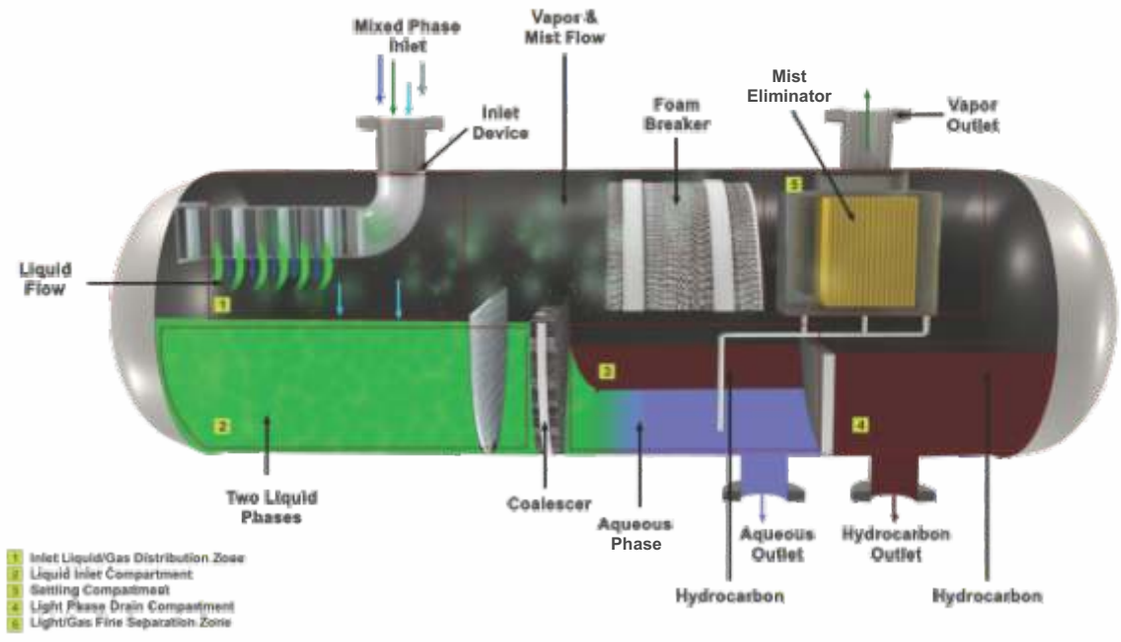
3 PHASE SEPARATORS
GAS – LIQUID – LIQUID SEPARATION



3 Phase seperator

The purpose of a 3 phase separator is to split the oil-water-gas stream into its individual components – A gas phase free of liquid carryover droplets, an oil phase free of gas carry under and water droplets and a water phase free of gas carry under and oil droplets.

The effectiveness of gas/liquid and liquid/liquid separation is a function of many factors like individual phase density, viscosity etc. Various design features and internal devices are employed to enhance, accelerate or otherwise improve the efficiency of the separation process from the knowledge of the above mentioned factors.

Finepac provides the engineering, design and fabrication of 3 phase separators & internals. The design of internals includes the design & engineering of inlet gas distributors, distribution baffles, foam breakers, mist eliminators, sand jet systems and other performance enhancing internals.

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3 Phase Separator Information and data table

Application – Efficient separation of primary liquid / liquid dispersions and removal of liquids from gases

Industry – Crude oil production plant

Pressure Vessel Information Table	
Design Code	ASME Section VII Div. 1, Codes available on request
Materials of Construction	Stainless steel, Special alloys, Carbon steel etc.
Shells	Cylindrical well construction
Heads	Flat, ellipsoidal or hemispherical
Nozzles	Straight or conical, main inlet and outlet, drain, vent and instrumentation
Connections	ANSI standards B16.47, B16.5 or other standards
Fixation	Saddles
Access to internals	Manhole to access all internals
Separator Internals data table	
Inlet devices	Facilitate better distribution of feed into the inlet compartment
Distribution baffles	Even distribution of liquid in the separation zone
Coalescing Internals	Agglomerates the dispersed phase to a required droplet spectrum downstream of the coalescer
Foam breakers	Installed upstream of liquid gas separator to prevent foam formation
Mist eliminators	Removal of liquid entrainment from gas stream
Specialised Internals	Internals performing specific functions to further enhance separator performance.
Performance Data Table	
Over liquid carryover will not exceed 0.1 USG/MMSCF	
The water content of hydrocarbon outlet stream 0.2% v/v	
The hydrocarbon liquid content 2000 mg/L	

Finepac provides the process guarantee for the following

- Removal efficiency of liquid droplets in gas stream
- Maximum liquid content in the outlet gas stream
- Maximum content of water in the oil phase
- Maximum level of hydrocarbon liquid in the water outlet flow.

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FINEPAC SEPARATOR INTERNALS

For a high efficiency separation performance

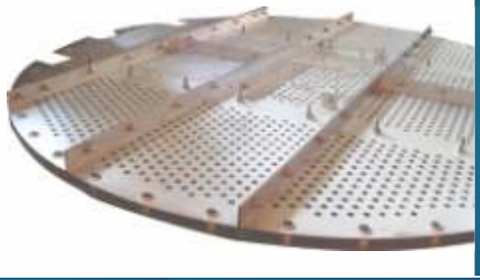
Inlet Devices

Applications

- Broad range of gas/liquid separation operations
- Vacuum towers
- Knockout drums
- Scrubbing system

Inlet devices dissipate the momentum of the incoming fluid, help initial separation without increasing turbulence

Distribution Baffles



Applications

- Broad range of gas/liquid separation systems
- Steam drums
- Knockout drums
- Scrubbing systems

The primary function of the baffles is to provide a barrier & distribute the liquid evenly from turbulent inlet zone to calm separating zone

Foam Breakers

Applications

- Broad range of gas/liquid separation systems
- Knockout drums
- Scrubbing systems

Prevent the formation of continuous layer of foam in the oil.

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Mist Eliminators

Applications

- Broad range of gas / liquid separation systems
- Flue gas desulphurization
- Distillation systems
- Steam drums

Mist eliminators bring about the coalescence of remaining liquid droplets in the gas phase.

Liquid-Liquid Coalescers

Applications

- Broad range of gas/liquid separation systems
- Inert gas scrubbers
- Knockout drums

The coalescing internals help in maximizing liquid separation

Specialised Internals

Applications

- Broad range of gas/liquid separation systems
- Scrubbing systems
- Knockout drums

These internals ensure smooth separation performance or enhance the separator performance by performing a specific function.

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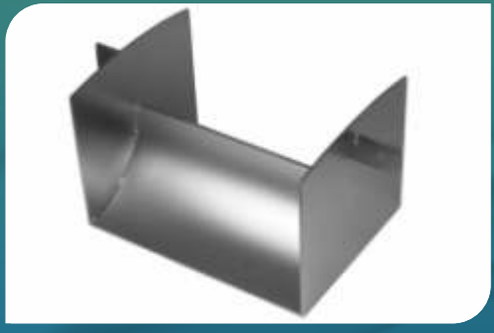
INLET DEVICES

Reliable solutions for challenging applications

The inlet device has the purpose of dissipating the momentum of the incoming fluid, aiding initial separation without increasing turbulence. The inlet stream entering through the nozzle is smoothly divided into a number of equal streams each of which is approximately deflected by 90° to create a centrifugal gas/liquid separation effect. The streams then impinge against the vessel walls and enter the bulk fluid phases to absorb the momentum.

Bi - Vane Inlet distributor



This is generally used as a low momentum inlet device. The inlet stream entering through the inlet nozzle is smoothly divided into 2 equal streams each of which is deflected through 90° to create a centrifugal gas / liquid separation effect. The streams then impinge against the vessel walls and enter the bulk fluid phases to absorb the momentum.

Vane Inlet Diffuser

This is generally used as a medium to high inlet momentum device. The inlet stream entering through the inlet nozzle is divided into a number of equal streams each of which is deflected through 90° to create a centrifugal gas / liquid separation effect. The streams then impinge against the vessel walls and enter the bulk fluid phases to absorb the momentum.

Cyclone Inlet Defoamer

The inlet stream entering through the inlet nozzle is introduced tangentially into a vertical cyclone tube to create a centrifugal gas/liquid separation effect. The liquid stream impinges against the cyclone walls and falls, entering the bulk fluid phase via a cross baffle to absorb the momentum. Gas exits the cyclone via a top exit.

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DISTRIBUTION BAFFLES

Systems for uniform liquid distribution

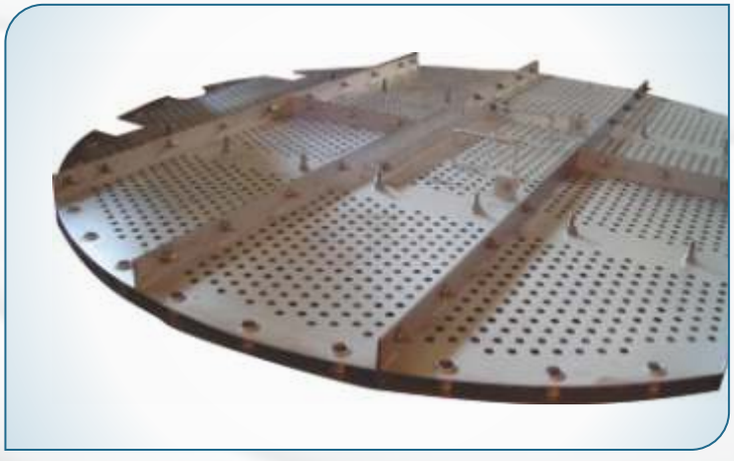
After passing through the inlet device the liquid passes through distribution baffles which may be single or matched pair of transverse perforated baffle plates in the liquid zone. Its primary purpose is to provide a barrier and distribute the liquid evenly from the turbulent inlet zone into the calm separation zone.

The distributor also acts to dampen adverse liquid waves and surges which may be caused by incoming slugs. Occasionally, for long separators and/or where the gas velocity is high, additional baffle plates (wave breakers) are installed at the gas/liquid interface along the vessel to prevent wave build-up.

Single Perforated Baffle plate (Standard design)

This is a perforated baffle with typically 25-30% open area extending from the base of the vessel to the high liquid level (HLL) or high high liquid level (HHLL). It is used in standard separator applications.

Dual Perforated Baffle Plate (Enhanced design)



This is a pair of perforated baffles with typically 15-30% open area extending from the base of the vessel to the high liquid level (HLL) or high high liquid level (HHLL). It is used in more difficult separator applications or where the liquid velocity is excessively high.

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LIQUID-LIQUID COALESCERS

Internals for enhancing separation performance

After leaving the initial distribution baffle the liquid enters a settling zone in which gravity separation causes entrained gas bubbles to rise to the oil/gas interface and join the continuous gas phase. Oil and water droplets rise or fall to join their respective continuous phase.

To meet the process guarantees it is sometimes necessary to fit coaslescing media which maximises the liquid/liquid separation by reducing the effective distance that the dispersed phase droplets need to travel before encountering a coalescing surface.

Flat Plate Pack (Fouling service)

Flat plate packs achieve a good coalescing performance whilst being resistant to fouling so are the preferred choice for coarse separation performance in separators. Various styles are available to suit the service including a special fouling resistant style.

Matrix / Coalescer Pack (High performance design)

The packing is manufactured in corrugated sheets making it light and strong and well suited for this application. Liquid droplets directly impinge on the irregular surfaces allowing coalescence to take place. The larger droplets then flow either up or down through the packing and separate out into their respective phases.

Dual Meshpad (High performance polishing service)

The coalescer is manufactured from either co-knit metal/plastic filament weave or combining layers of different mesh properties. Liquid droplets directly impinge on the fine wire surfaces allowing coalescence to take place. It is usually used in cleaning service for polishing applications.

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SAND JETTING SYSTEMS

Specialised Internals for protection against clogging

Over the years considerable effort has been taken on the development of sand or sludge removal systems. However, no single Sand – Jet system has evolved as clearly superior. Rather, there are a number of design features to choose from depending upon the application requirement. Finepac provides Sand Jet systems based on a wide range of features to provide the perfect solution for the application in the most economic way.

A sand jet pipe system can be fitted along the bottom of the vessel running up to a sand retention baffle or a weir plate. High pressure water will fluidise any solids settled in the base of the vessel so they can be flushed away into the sand removal nozzles. A sand pan to prevent clogging and blockage is also usually supplied.

High – header with spray nozzles

One or more H – header systems can be fitted so that the two parallel headers run along the base of the separator in the solids settling zone. A single inlet header feeds these spray headers.

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FINEPAC MESHPAD MIST ELIMINATOR

Mist Eliminators for high efficiency mist elimination

The Finepac meshpad mist eliminators remove droplets by impingement on the wire surface. The liquid collected on the filaments drains off under gravity. They provide almost complete removal of droplets down to about 3-5 microns. They provide a turndown range of vapour rate of around 3:1.

At excessively high velocity the liquid droplets that impinge on the wire surface are sheared off by the vapour and entrained before they are able to drain. At very low vapour velocities all but the larger droplets are able to follow the vapour path through the mesh and thus avoid impingement. However, the inherent design of the separator vessel means that in most applications an effective turndown of 10:1 can be achieved.

Finepac meshpad mist eliminators can provide liquid entrainment solutions in a variety of equipments including

- Scrubbers & distillation columns
- 3 phase separators
- Knock out vessels
- Evaporators
- Falling film condensers
- Desalination plants
- Stream drums
- Gas dehydration plants

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General Meshpad Configuration

Wiremesh meshpad mist eliminators consists of a pad of knitted metal or plastic wire mesh usually sandwitched between grids for mechanical support. Units above 600 mm diameter are normally split into sections in the range of 300 to 400 mm to facilitate installation through a normal vessel manway. The pads are cut slightly oversized to ensure a snug fit and eliminate possibility of a vapour bypass either between sections or between pad and vessel wall. Each meshpad is formed from crumpled layers of fabric knitted form a monofilament with the direction of crimp rotated 90° in each adjacent layer to provide a uniform voidage with a high ratio of filament surface.

Single unit mist eliminator

Segmented mist eliminator

Material of Construction

Stainless steel, Nickel based alloys, Titanium, Polypropylene, PTFE, Copper, Kynar.
Other special materials available on request.

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MIST ELIMINATOR DESIGN

Meshpads should be designed so that the face area provides a vapour rate of approximately 80% of maximum allowable re-entrainment velocity. For the purpose of estimation, suitable design velocities occur at a K-factor of 0.107 m/s for vertical flow or 0.150 m/s for horizontal gas flow (due to better drainage) where,

$$Vs = K\sqrt{(\rho_L - \rho_V) / \rho_V}$$

where, Vs = Actual vapour velocity (m/s)

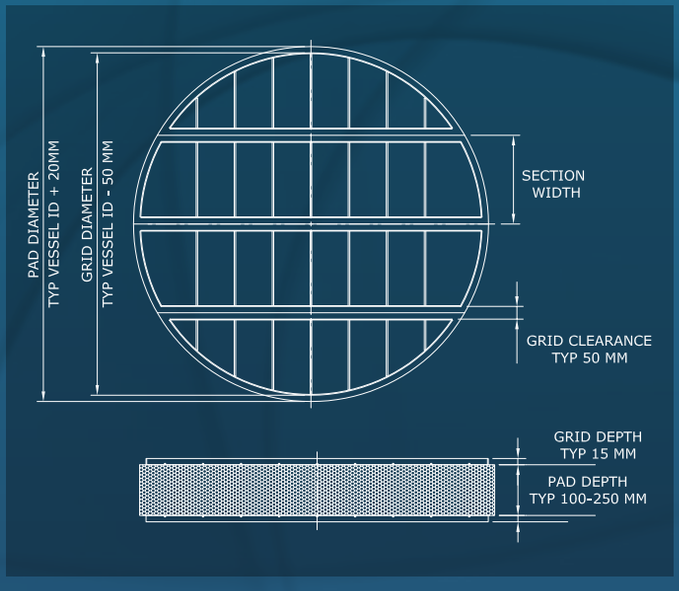
ρ_v = Vapour density (kg/m^3)

ρ_L = Liquid density (kg/m^3)

An approximate pressure drop can be estimated from the following formula.

$$\text{Wet } \Delta P \text{ (kPa)} = C.\ (\rho_L - \rho_V)\ .\ K^2\ .\ t$$

Where C = 0.20 for a typical meshpad demister, and t is the pad thickness in meters. Note that the dry pressure drop is half of the wet figure.



Finepac meshpad mist eliminators can be installed for either vertical or horizontal vapour flow. The meshpads are generally 100-150 mm thick for vertical vapour flow and 150-200 mm for horizontal vapour flow. Where meshpad thickness exceeds 300 mm, the unit is usually divided into 2 separate layers so that the section will pass through normal vessel manways and in these cases wire screens are fitted between layers to maintain pad integrity during installation.

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FINEPAC WIREMESH MIST ELIMINATOR SPECIFICATION SHEET

Mist Eliminator Table

Application	Material	Style	Wire Diameter (mm)	Mesh Density (kg/m^3)	Surface Area (m^2/m^3)	Normal Micron Rating*
Very high efficiency in clean service	Metal	FP-HE-A1	0.15	195	650	3µ
Fine droplet removal in clean service	Metals	FP-HE-A2	0.15	145	480	4µ
General purpose clean service	Metal	FP-HE-A3	0.15	112	375	5µ
Optimum efficiency and pressure drop	Metal	FP-GP-B1	0.274	195	355	5µ
General purpose not totally clean	Metal	FP-GP-B2	0.274	170	310	6µ
Heavy duty e.g. Oil& Gas separators	Metal	FP-GP-B3	0.274	145	265	8µ
Light fouling	Metal	FP-DS-C1	0.274	110	200	10µ
Moderate fouling	Metal	FP-DS-C2	0.274	80	145	12µ
Heavy fouling e.g. evaporators	Metal	FP-DS-C3	0.274	50	90	15µ
Acid mists	Polypropylene	FP-HE-A1P	0.25	75	1120	5µ
Mist removal of polar and non-polar mixtures	Metal + Polypropylene	FP-HE-A1MX	0.25	200	625	3m
Chemical scrubber towers	Polypropylene	FP-GP-B1P	0.25	50	750	6µ

For optimum designs, the K factor should be modified to take into account the operating pressure, liquid viscosity, surface tension, liquid entrainment etc.

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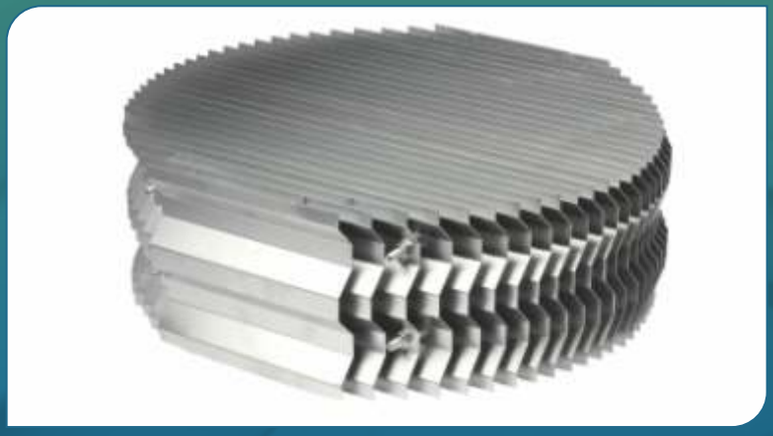
FINEPAC VANE TYPE MIST ELIMINATORS

Mist Eliminators for low pressure drops

Vane type mist eliminators consist of a series of vane modules appropriately spaced to provide passage for vapour flow. They consist of an angled profile to provide sufficient change of direction for liquid droplets to impact, coalesce and drain of the vanes.

Plain Vane Type Mist Eliminators



The plain vane type mist eliminators are generally used for removing entrained liquids flowing vertically upwards and for fouling services. In this type of a mist eliminator, liquid droplets impinge, coalesce, and drain off the vanes as the vapour flow is deflected around the vane profile. These are generally used in applications involving course entrainment with high liquid load and fouling services.

Characteristics

- Low pressure drop
- Resistance to fouling
- Good turndown
- Effective in applications involving high liquid load
- High vapour capacity.

Material of Construction

Stainless steel, Nickel based alloy, Titanium, Carbon steel, Polypropylene, Fluoroplastics
Other special materials available on request.

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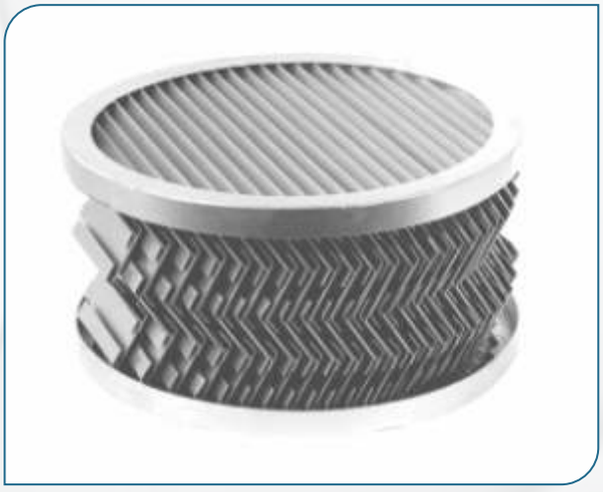
Custom engineered for efficiency

Hooked Vane Pack



Pocketed Vane Pack

The high capacity vane type mist eliminators provide efficient droplet removal and resistance to fouling for high rate horizontal vapour flow. They can also be designed for vertical vapour flow. Entrained liquid droplets impinge on the vanes and collect in pockets that trap the coalesced liquid which drains from the unit rather than being blown through by the vapour. The collection efficiency is a function of vapour velocity and the difference in density of liquid

Characteristics

- Low pressure drop
- Effective function at high pressure
- Sturdy and durable operation
- Effective resistance to fouling

Material of Construction

Stainless steel, Nickel based alloys, Titanium, Carbon steel, Polypropylene, Fluoroplastics
Other special materials available on request.

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SPECIALISED INTERNALS

Performance enhancing internals

These internals perform specific functions in a separator that either ensure a smooth functioning separator or further enhances the performance characteristics of a separator.

KSME Axial Cyclones

Specialist design by Kirk Process Solutions

Our highspeed Swirltube Axial cyclones are used for high capacity mist elimination in a range of gas treating applications. Their high capacity and wide operating pressure range mean they are particularly useful for vessel size reduction or retrofit applications.

Vortex Breakers

The separated liquids are drawn from the bottom of the vessel at the furthermost position from the inlet as possible. Effective vortex breakers ensure that the oil is not contaminated with the gas or the water with oil. These devices are normally manufactured by the vessel fabricator.

Weir Plate

The submerged weir is the most effective method of ensuring minimum contamination of the produced water and oil. The heavier water layer is held behind the weir and only the upper and cleanest part of the oil layer flows over to the oil outlet compartment. This arrangement allows maximum oil/gas residence time to aid degassing and improve level control stability.

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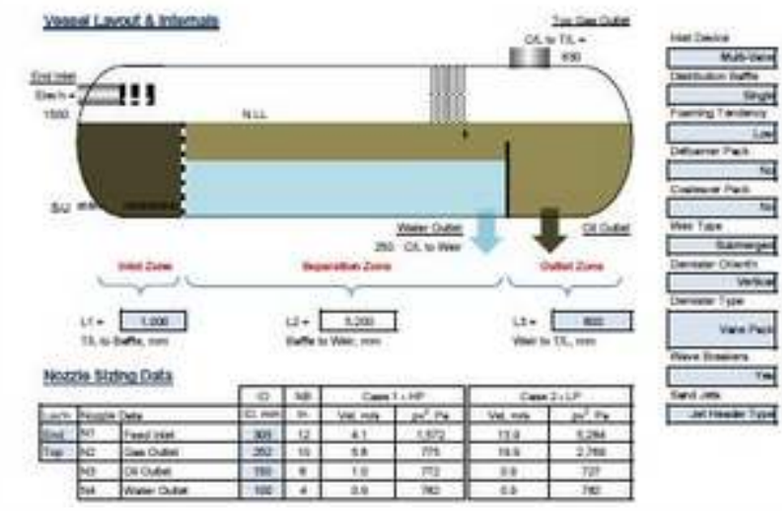
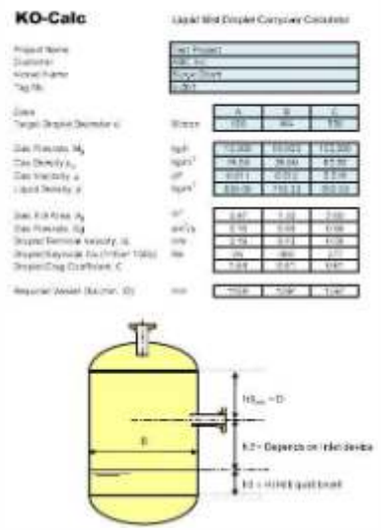
PROCESS DESIGN & SUPPORT

In association with Kirk Process Solutions

Finepac in association with **Kirk Process Solutions (UK)** provides a full scope of engineering and specialist design services to support your engineering activities for vessel sizing, performance optimization and internals selection. Using the software **SEP-Calc** (Proprietary of Kirk Process Solutions) the operating conditions for the particular application are simulated in a variety of separator arrangements to optimize the design concept, vessel sizing and internal components to meet the required performance characteristics.





After initially simulating the operating cases using standard separator design methods we then carry out a series of incremental design drawings upon a range of internal options to evaluate the performance improvements, finally optimizing the overall vessel and nozzle sizing to deliver the best performing and cost effective design to match the targeted performance.

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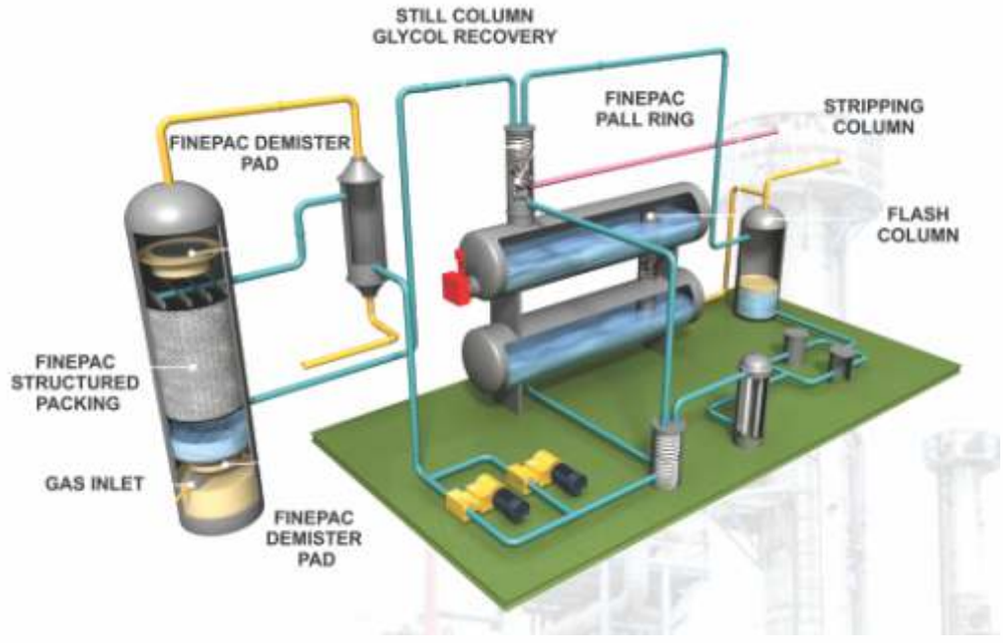
GAS PROCESSING SYSTEMS

Triethylene Glycol (TEG) & Amine Contactors

Gas dehydration is an important process in gas processing. The produced gas is saturated with water and other impurities which must be removed. If not removed they can create problems like corrosion, water condensation and plugs created by ice or gas hydrates. Gas dehydration avoids dangers associated with pipeline transportation and processing of wet gas.

Triethylene Glycol (TEG) dehydration systems are one of the most popularly used dehydration systems and not only are efficient at removing water from the gas stream but also benzene, toluene, ethylbenzene and other volatile components.

In addition, hydrogen sulphide, carbon dioxide, and other components are often found in natural gas streams. H_2S is a toxic gas and is corrosive to carbon steels. CO_2 is also corrosive to equipments. Gas sweetening processes using **Amine Contactors** remove these contaminants to make the gas suitable for transportation and use.



Gas Processing Systems

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Finepac Triethylene Glycol (TEG) Contactors

In natural gas streams, water vapour needs to be removed to reduce pipeline corrosion and eliminate line blockages caused by hydrite formation. If acidic gases are removed by amine treatment, then the gas will be water saturated and will need to be dehydrated before entering the pipeline.

Working Principle

The gas dehydration process has a simple approach. Wet gas contacts dry glycol and glycol absorbs water from the gas.

Wet gas enters the tower at the bottom and flows upwards. Dry glycol flows down the tower from the top through the packing material to remove upto 10 ppm of moisture in dry gas. Finepac structured packings are used for efficient moisture removal. The dehydrated gas leaves the tower at the top and goes to other processing units. The water rich glycol leaves the tower at bottom and goes to a reconcentration system consisting of a stripper and a regenerator. In this system Finepac random packings are used. Water escapes as steam and purified glycol returns to tower where it contacts wet gas again.

Finepac Amine Contactors

Natural gas streams may contain corrosive gases like H_2S, CO_2 etc. which need to be removed. Amine contactors remove these gases from the natural gas stream and make it fit for downstream processing.

Working Principle

The sour gas enters the contactor tower and rises through the descending amine solution. The amine solution absorbs the corrosive gases. The amine contactor is equipped with Finepac structured packings. The purified gas flows from the top of the tower. The amine solution carrying the absorbed acidic gases leaves the tower to a regenerator to strip off the H_2S and CO_2. In this column the Finepac random packing is used. Stream and acid gases separated from the rich amine are condensed and cooled respectively in a reflux condenser. The regenerated amine is recycled back to the amine absorber to once again carry out the gas sweetening process.

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VESSEL FABRICATION

Benchmark for quality in vessel fabrication

To compliment its range of column internals and oil & gas internals Finepac also provides precision engineered ASME Pressure vessel design & fabrication. Services for over 20 years we have partnered our expertise in vessel fabrication with customer requirements to produce quality products.

We fabricate process equipments from all grades of stainless steel, carbon steel, high alloy steel, copper, alluminium etc. We guarantee international quality fabrication inspected by reputed third party inspection agencies.

We provide for

- World class manufacturing facility
- Customised design and fabrication services
- Vessels certified with U stamp, S stamp and ASME certification
- Vessels fabricated in accordance to nationally recognised standards including TEMA standard

Core Competencies

Design

Finepac's services provide the experience of industry leading design and engineering to help ensure that our solutions exceed customer expectation. We also provide for full technical support for your project from concept through to installation.

Fabrication

Craftsmanship and quality are our hallmarks. Our ASME certified welders & inspectors use the latest technology to ensure that every product meets our rigid quality standard. Our fully equipped facilities allow us to fabricate all our products inhouse which helps us to control the delivery time as well as the possibility to fabricate any vessel large or small.

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Finepac offers fabrication solutions for the following process equipments.

Columns

Heat Exchangers

Pressure vessels

Reactors

Other fabrication solutions available on request.

Quality Assurance

Quality of our products is of paramount importance to us at Finepac. We design our products to utmost precision, manufacture them to ensure optimum degree of quality & test against a rigid set of internal inspection procedures. In addition we also provide for third party inspections by reputed inspection agencies like Ceil, Beaureu Veritas, TUV etc.

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