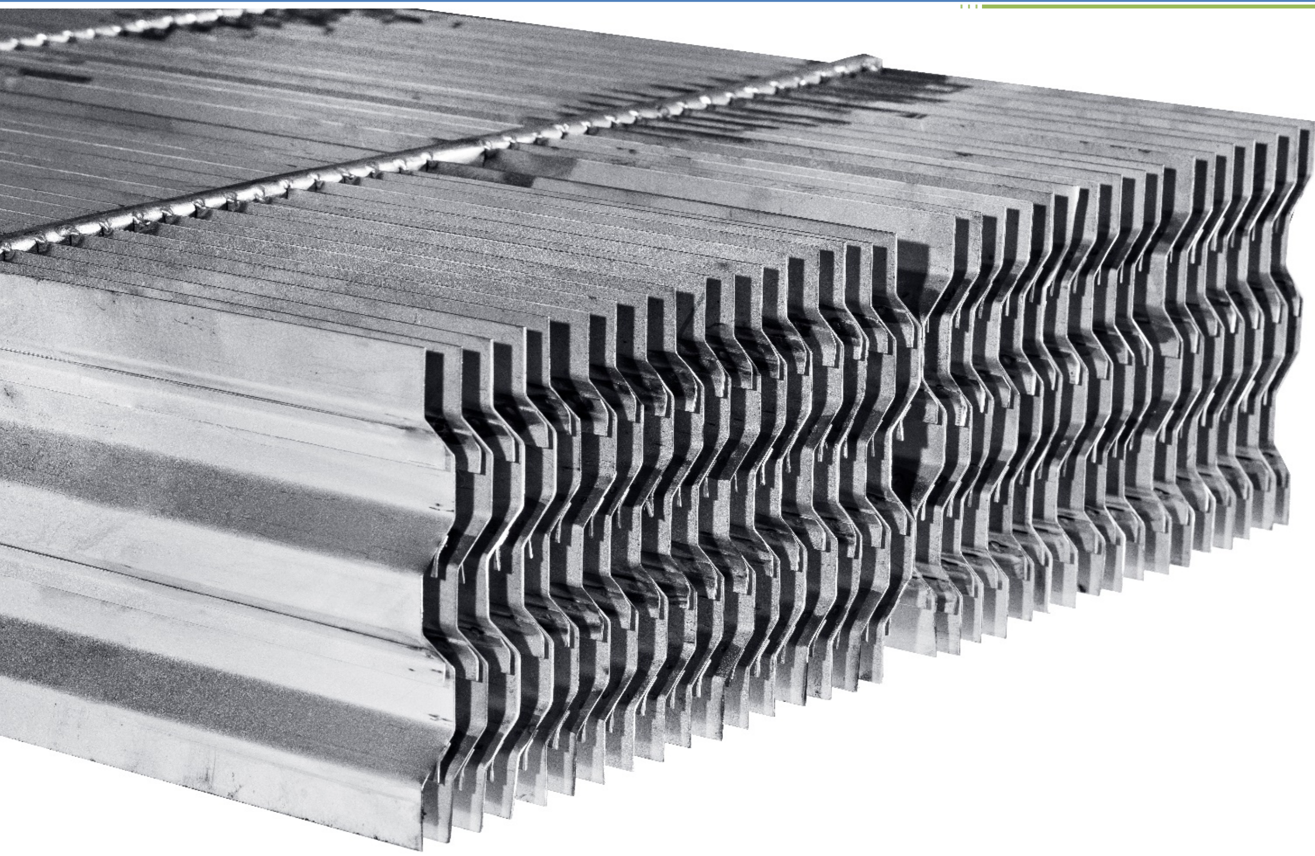
VANE MIST ELIMINATOR



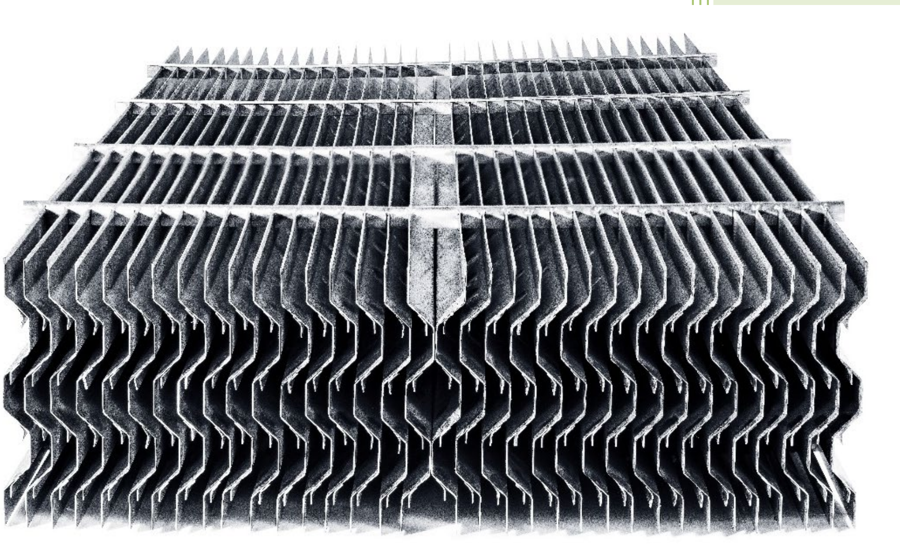
CHEM GROUP

AZAR ENERGY Co.

Vane mist eliminators consist of closely spaced corrugated plates that force mist-laden gas to follow serpentine paths. These devices are generally not efficient for mist droplets smaller than about 20 microns, but they are sturdier than mesh pads and impose less pressure drop. Vane arrays can be mounted horizontally or vertically. They are preferred in applications involving high vapor velocities, low available pressure drop, viscous or foaming liquids, lodging or caking of solids, slugs of liquid or violent upsets. Like mesh pads, vane units are usually round or rectangular. They are sometimes used in combination with mesh pads for optimum performance in special situations.

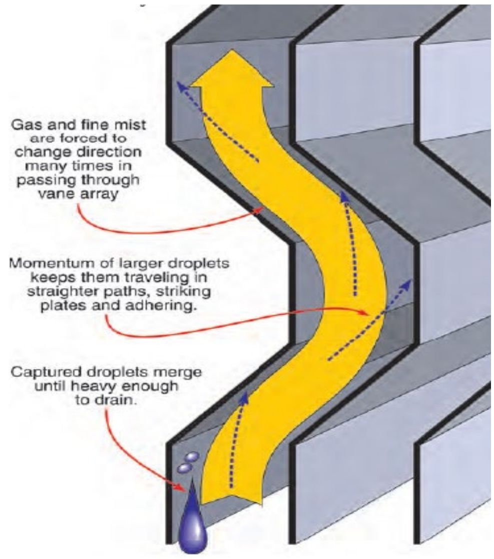
Compared to mesh demisters, vane type demisters offer the following advantages:

- Higher capacity
    - Blades with a smooth profile will give 30% more capacity than a mesh demister
    - Blades with hooks will give 100% more capacity than a mesh demister
- Higher liquid loading
- Less risk of fouling
- Lower pressure drop
- Longer lasting in service
- Suitable for foaming systems
- Suitable for high liquid viscosity systems
- Stronger construction

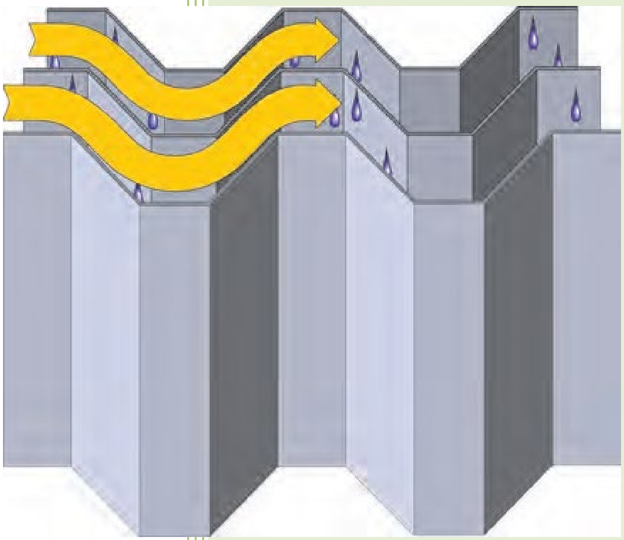


Inertial capture in vanes

As shown in Figure 1(a), vanes bend the path of mistladen gas into relatively tight curves. As the gas changes direction, inertia or momentum keeps mist droplets moving in straighter paths, and some strike adjacent vanes. There, they are held by surface forces and coalesce with other droplets, eventually trickling down. If the vane material is wettable, a surface film promotes coalescence and drainage. In the case of upward flow, coalesced liquid disengages from the bottom of the vanes as droplets large enough to fall through rising gas. In the case of horizontal flow (Figure 1(b)), the liquid trickles down vanes to a drain below.



(a)



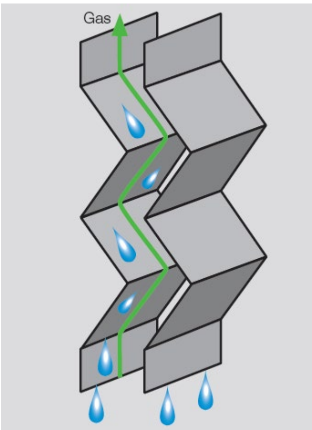
(b)

Figure 1. Capture of mist droplets in a vane array (a) with vertical flow (b) with horizontal flow

The AZMIST range is divided into a number of categories depending on direction of gas flow and the complexity of the vane profile.

The simple range

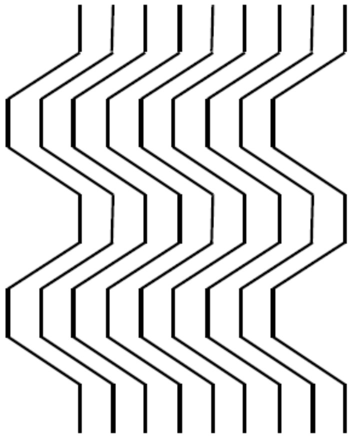
Simple AZMIST vane profiles separate liquid by impingement, coalescence and drainage on the vane surface with no disengagement of the liquid from the gas stream. They are particularly suitable for applications with a significant risk of fouling due to solid particles or high viscosity liquids in the feed but have relatively low gas handling capacity.

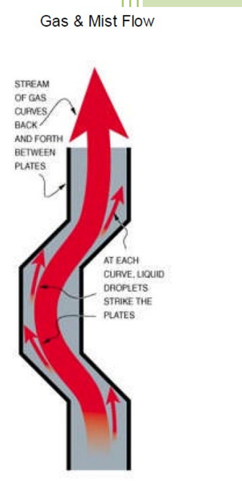


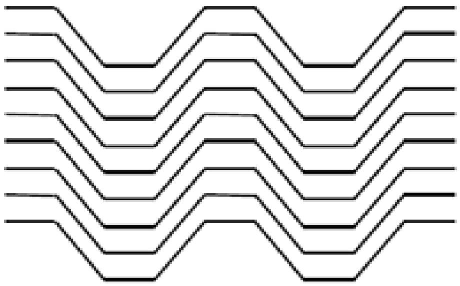
Simple AZMIST vane profile with countercurrent drainage of liquid from vane surface

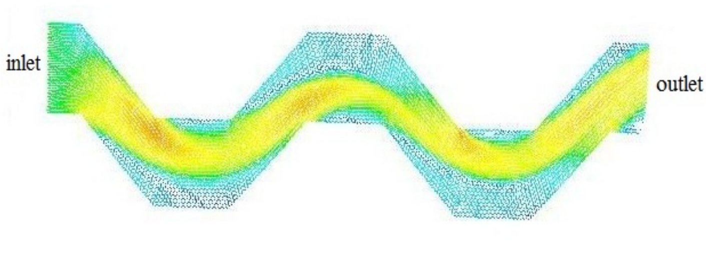
The "VV" Range

The AZMIST VV is an efficient style of vane mist eliminator commonly used for removing entrained liquid from vapor flowing vertically upwards, and for fouling services. In this configuration, liquid droplets impinge and coalesce on the vanes as the vapor flow is deflected around the vane profile. The liquid collected on the vanes drains downwards under gravity so long as the vapor velocity is not high enough to cause reentrainment. The graph overleaf shows the relationship between vapor rate and the droplet size range which is effectively removed (typically 99% removal). Vane assemblies are fabricated in sections sized to fit through vessel manways. Generally they are supported on an annular ring welded to the vessel wall with additional midspan supports being required where the vessel diameter exceeds approx 1000mm. Hold down bars should be fitted to cleats welded to the vessel wall to secure the pack. The principal applications for this style of droplet separator are the removal of coarse entrainment with high liquid load and also services of a fouling nature. For severe fouling duty e.g. containing dust, the unit could be installed together with a spray system designed to wash out collected solids.





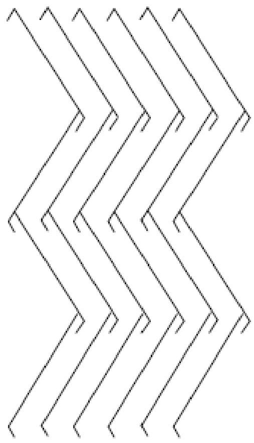




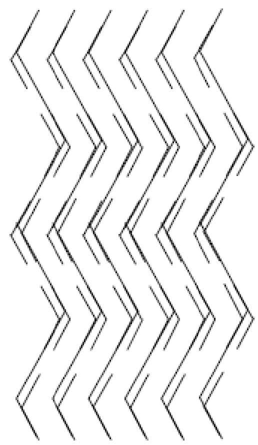
CFD Study

The "VH" Range

The AZMIST VH is a vane pack for efficient droplet removal and resistance to fouling suitable for high rate horizontal vapor flow. Entrained liquid droplets impinge on the vanes and collect in pockets that trap the coalesced liquid which then drains from the unit rather than being blown through by the vapor. Collection efficiency is a function of both vapor velocity and the difference in density between the vapor and liquid. The graph below shows the relationship between vapor rate and the droplet size range which is effectively removed (typically 99% removal). Azar Energy offers a hooked (VH-1) design as standard and a pocketed (VH-2) design for more arduous applications in clean service. VH vane packs are fabricated in sections sized to fit through vessel manways.



AZMIST VH-1



AZMIST VH-2

Azar Energy's different vane pack styles with their characteristics are shown in the table below

Type	Simple Range	VV Range	VH-1 Range	VH-2 Range
Flow Direction	Vertical	Vertical or horizontal	Horizontal	Vertical or horizontal
installation	No housing	No housing	Housing and drainage system required.	Housing and drainage system required.
Gas handling capacity (K-values)	0.14 – 0.17 m/s	0.17 – 0.2 m/s	0.27 m/s	0.17 – 0.45 m/s
Turndown capability	30 - 50 %	30 - 50 %	30 - 50 %	30 - 50 %
Removal Range	30 – 50 µ +	30 – 40 µ +	15 – 30 µ +	10 – 15 µ +
Liquid load capacity	Moderate to High	Moderate	High to Very High	Moderate to High
Solids handling capacity	Moderate to High	Moderate to High	Low to Moderate	Low
Liquid viscosity	Suitable for high viscosities/waxes	Suitable for high viscosities/waxes	Prone to fouling with viscosities/waxes	Prone to fouling with high viscosities/waxes
Typical applications	Desalination, general use, fouling service	Vacuum, general use, fouling service	Horizontal scrubbers	Debottlenecking, off-shore, clean services, gas & steam processing
Pressure drop	Low	Very low	Low	Moderate

Vane Mist Eliminator Design

The design of vane mist eliminators depends on many factors, but a preliminary sizing can be undertaken relatively easily using proprietary K factors in the same way as for wire mesh demisters.

Face Area

Although it should be treated with caution and confirmed with AZE before actual use, the following procedure may be used:

$$v_{vme} = K\sqrt{\frac{\rho_l - \rho_v}{\rho_v}}$$

Where:

V_{vme} = Max velocity in vanes, m/s
K = K-Factor, see Table above, m/s
ρ_L = Density of liquid, kg/m3
ρ_V = Density of vapor, kg/m3

And:

$$A_{vme}\left(m^2\right)=\frac{Q\left(m^3/s\right)}{v_{vms}\left(m/s\right)}$$

Pressure Drop

The disadvantage of using the more expensive, pocketed designs is that the pressure drop is higher. To estimate the pressure drop, the following method can be used:

$$\Delta P = C\left(\rho_l-\rho_v\right)K^2$$

Where:

ΔP = Pressure drop, Pa
C = Vane design factor

Simple style, C = 10
V-V style, C = 10
VH-1 style, C = 15
VH-2 style, C = 20

Typically, the pressure drop will be in the range of 0.2 – 0.8 kPa (approx 20 to 80 mm water gauge).

Fine Mist Removal

Removal of very small droplets can be achieved using a two stage mist eliminator by fitting a mesh pad to the upstream face of the unit to coalesce droplets as small as 3 to 5 microns into droplets in the size range which are easily removed by the vane separator.