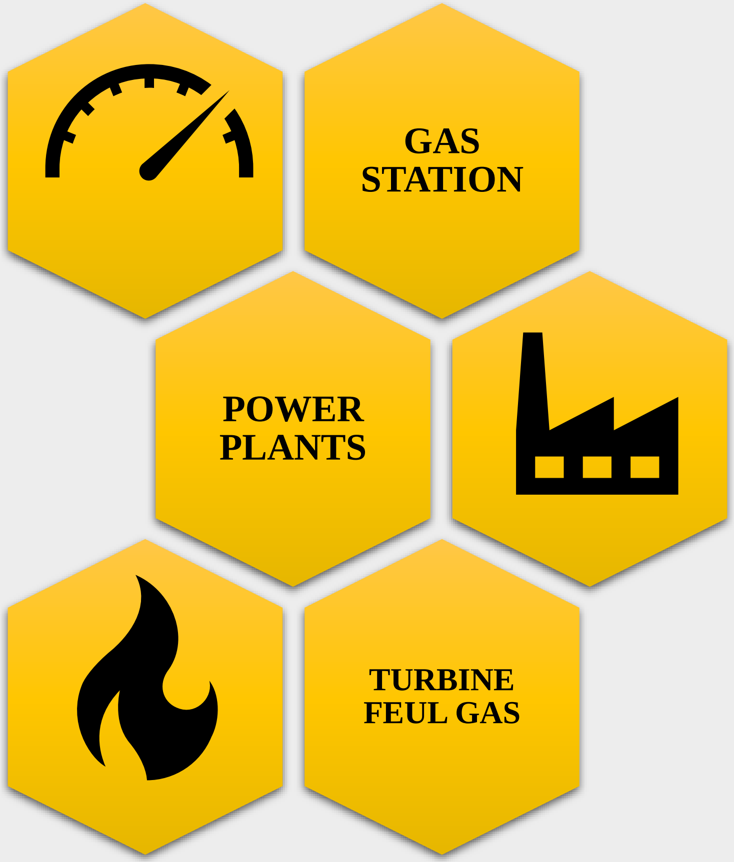
VANE SCRUBBER

APF-VSC

APADANA PETRO FARAYAND

Knowledge is our difference

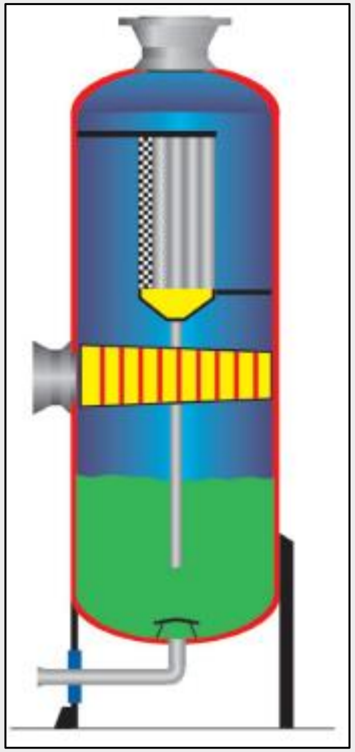
The APADANA PETRO FARAYAND scrubber provide effective, efficient, and economical removal of dust, dirt, scale, rust, and other solid foreign particles from different types of gas streams.



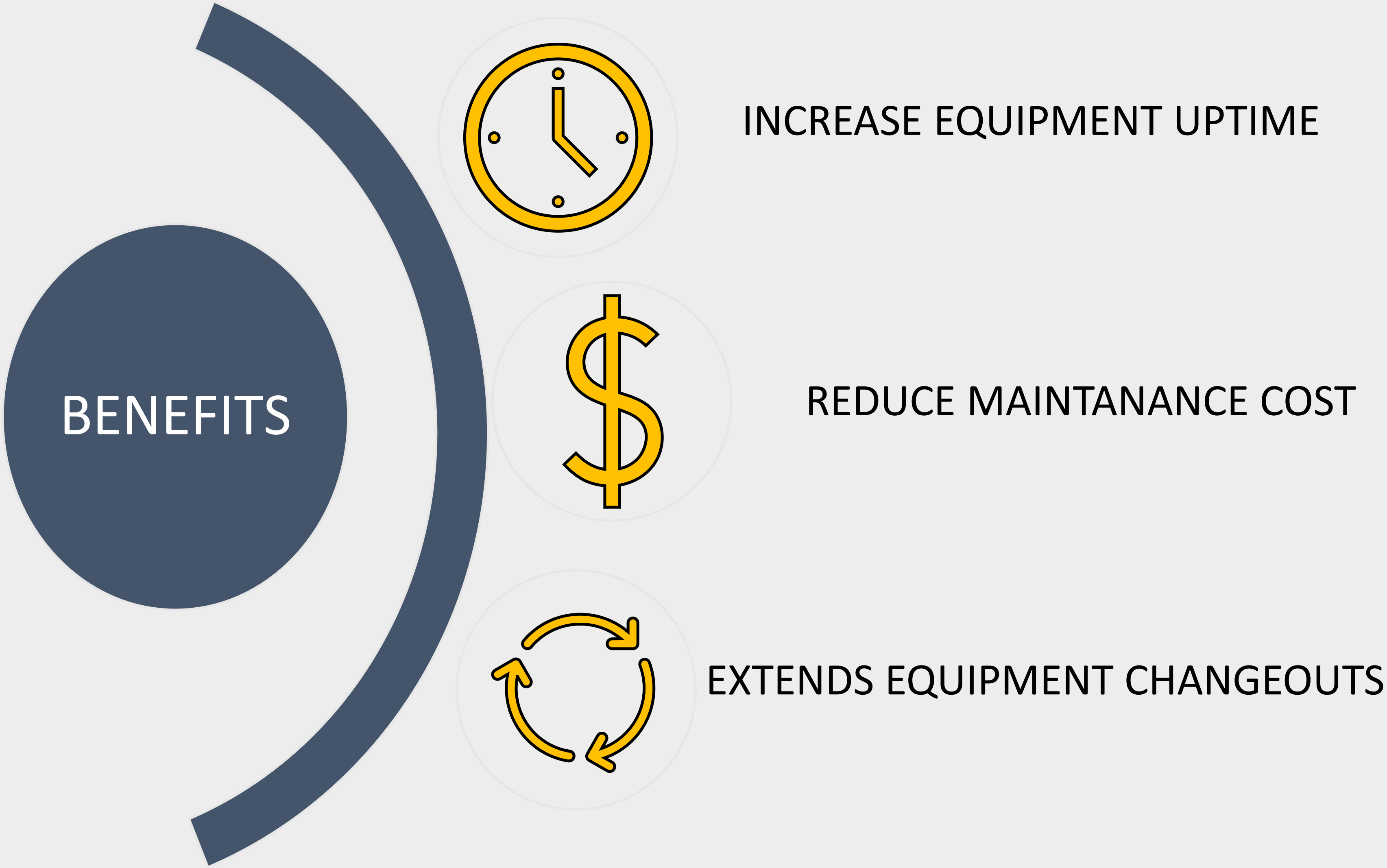
Usage

- ✓ **Gas station**
- ✓ **Gas treatment station for petrochemicals, power plants and industrial factories**
- ✓ **Turbine fuel gas**

Introduction



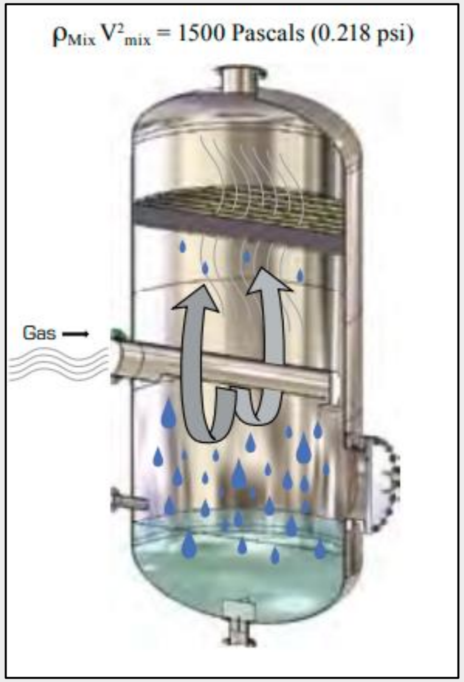
Scrubber or knockout drum is a vessel designed to handle streams with high gas-to-liquid ratios. The liquid is generally entrained as mist in the gas or is free-flowing along the pipe wall. These vessels usually have a small liquid collection section. Vertical separators, are usually selected when the gas-liquid ratio is high or total gas volumes are low. In a vertical separator, the fluids enter the vessel through an inlet device whose primary objectives are to achieve efficient bulk separation of liquid from the gas and to improve flow distribution of both phases through the separator. Liquid removed by the inlet device is directed to the bottom of the vessel. The gas moves upward, usually passing through a mist extractor to remove any small entrained liquid droplets, and then the vapor phase flows out of the vessel. Liquid removed by the mist extractor is coalesced into larger droplets that then fall through the gas to the liquid reservoir in the bottom. The ability to handle liquid slugs is typically obtained by increasing vessel height to accommodate additional surge volume. Level control is normally not highly critical and liquid level can fluctuate several inches without affecting the separation performance or capacity of the vessel. Typical vertical separator L/D ratios are normally in the 2–4 range.


BENEFITS
INCREASE EQUIPMENT UPTIME
REDUCE MAINTANANCE COST
EXTENDS EQUIPMENT CHANGEOUTS

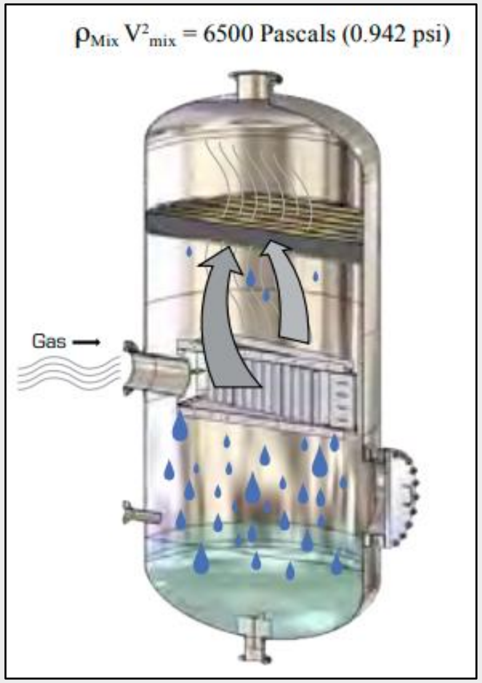
Inlet Devices

The importance of the inlet device with respect to separation performance has been identified only relatively recently, mainly through the use of Computational Fluid Dynamics (CFD) modeling. The main functions of the inlet device are: 1) Reduce the momentum of the inlet stream and enhance flow distribution of the gas and liquid phases. 2) Efficient separation of the bulk liquid phase. 3)Prevent droplet shattering and re-entrainment of bulk liquid phase. There are several different types of separator inlet devices that are commonly use: diverter plat, half-pip, Schoepentoeter

In addition to the inlet device itself, it has been determined that the inlet piping configuration is also important. The Schoepentoeter type inlet devices generally provide improved separation performance compared to the others.



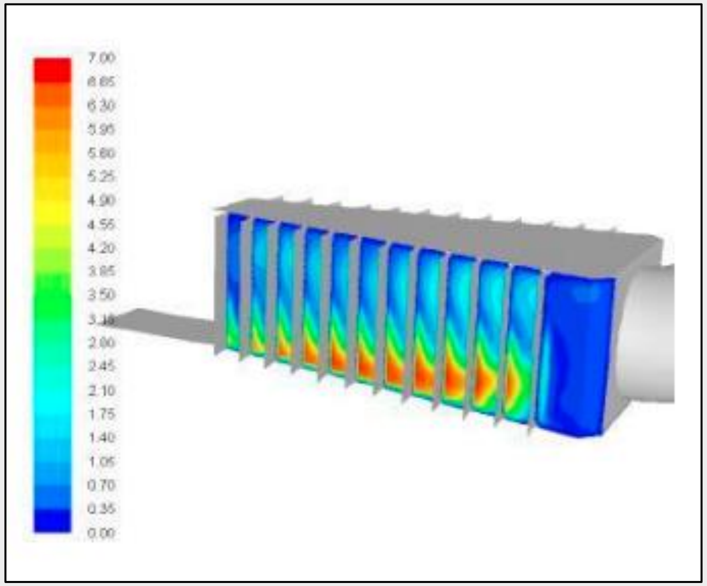
Half-pipe

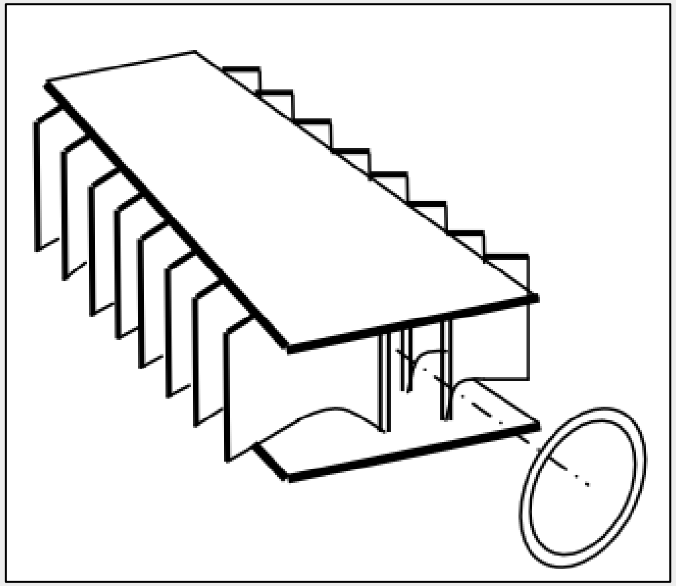


Schoepentoeter

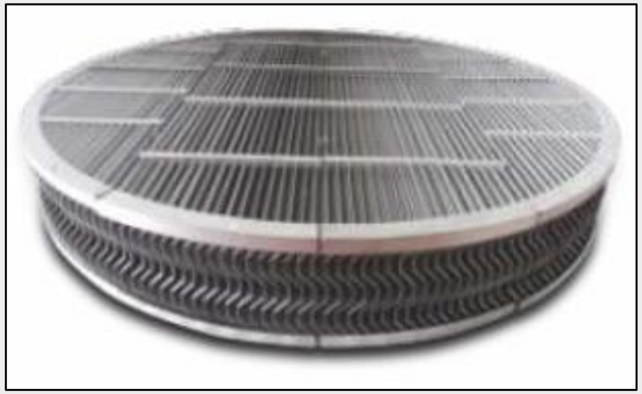
Schoepentoeter

Schoepentoeter was first designed and introduced by Shell company and is a multi-vane inlet device used in horizontal and vertical separators where there is a requirement for good flow distribution with minimum shear and pressure drop. Benefits of this device compared with simpler deflectors include reduced agitation and hence improved 2 and 3 phase operational performance, more stable level control, and reduced foaming. For vertical vessel installations, usually where there is a high gas flow relative to the liquid flow, the Schoepentoeter provides excellent vapor distribution allowing a reduced height to the mass transfer or mist eliminator internals. This device works by smoothly dividing the incoming flow into various segments using an array of curved vanes to suit the overall geometry of the inlet nozzle and distributor length. To achieve this effect the vanes start with a wide spacing and gradually reduce the gap, giving the unit its characteristic tapering shape. The Schoepentoeter is usually constructed from stainless steel and is designed to be installed in sections through a vessel manway and assembled in the vessel.

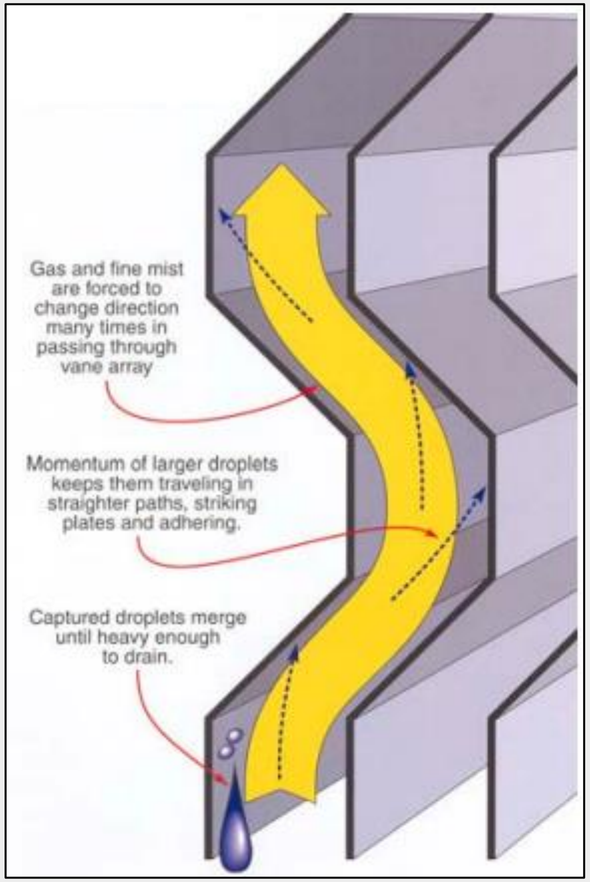


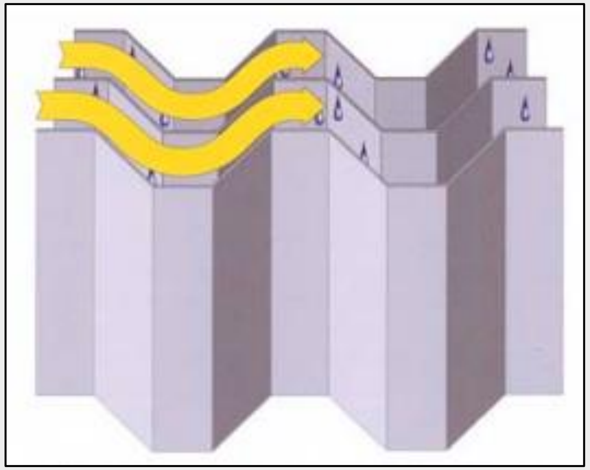


In APF-VSC, we use vane pack as the second part of separation. Vane mist eliminators consist of closely spaced corrugated plates that force mist laden gas to follow serpentine paths. These devices are generally not efficient for mist droplets smaller than about 20 microns, but they are sturdier than mesh pads and impose less pressure drop. Vane arrays can be mounted horizontally or vertically. They are preferred for 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. Standard vanes are available in metal or plastics and have various blade spacings and profiles. Proper application of mist eliminators is based on understanding how they work. Vane and mesh devices both employ the same mechanism known as inertial impaction and thus are subject to the same basic design rules. Fiber mist eliminators, however, capture submicron droplets (those smaller than one micron) by an entirely different phenomenon known as Brownian motion leading to very different behavior.



As shown in figure below, vanes bend the path of mist laden 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 (merge) 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, the liquid trickles down vanes to a drain below. The efficiency of vane mist eliminators is generally acceptable only for droplets larger than 10 or 20 microns in the case of air and water at ambient conditions. Furthermore, a vane unit is generally more expensive than a mesh pad in the same application. However, vanes have certain advantages that dictate their selection over mesh in some situations.





Vane advantages

1. High velocity: Being less susceptible to re-entrainment and flooding than mesh pads, vane units can operate at velocities 30 to 40 percent higher in both vertical and horizontal flow. Higher velocity helps close the efficiency gap with mesh.

2. High liquid load: Vane units typically handle loads about 5 to 10 times greater than mesh pads: approximately up to 10 gpm/ft3, versus 1 gpm/ft3 for mesh (horizontal flow, air and water, ambient conditions).

3. Fouling and clogging: Solid particles and debris that would lodge in a mesh pad, eventually requiring replacement or cleaning, pass through the much larger apertures of a vane unit. In applications that are subject to buildup of deposits, vane units can operate for much longer intervals without cleaning and can be cleaned much more readily than mesh pads.

4. Longer corrosion life: The thickness of vanes gives them a substantially greater service life than mesh with the same corrosion rate. In a given corrosive service, a vane unit made of sheet metal will last much longer than a mesh pad made of the same alloy.

5. Low pressure drop: The relative openness of vanes gives them an edge over mesh in applications where pressure drops of a few inches of water column are crucial.

6. High liquid viscosity: There are a few applications in which high viscosity impedes liquid drainage so severely that a mesh pad would flood at prohibitively low velocities and liquid loads. Vanes can handle much higher liquid viscosities.

7. Rugged construction: When properly secured in place, a typical vane unit withstands violent surges and liquid slugs that would dislodge and even destroy the most rugged mesh pad.

8. Foam accommodation: Because of liquid agitation in mesh pads, those devices are not generally recommended in applications subject to foaming. Vane units, by contrast, not only drain without foaming, but can actually break foam generated upstream. Offshore platforms and long-running processes are prime examples.

Mechanical features

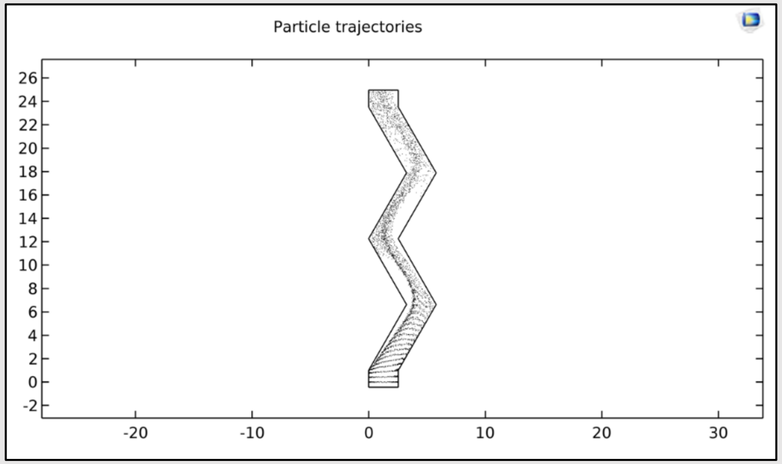
- ✓ Safety opening system
- ✓ Level, pressure and differential pressure gage included
- ✓ Inspection openings
- ✓ Vent and drain valve included
- ✓ Low pressure drops
- ✓ Self-supported and lifting lug included
- ✓ Long life ‘O’ ring sealing design
- ✓ Standard class rating ASME 150,300,600

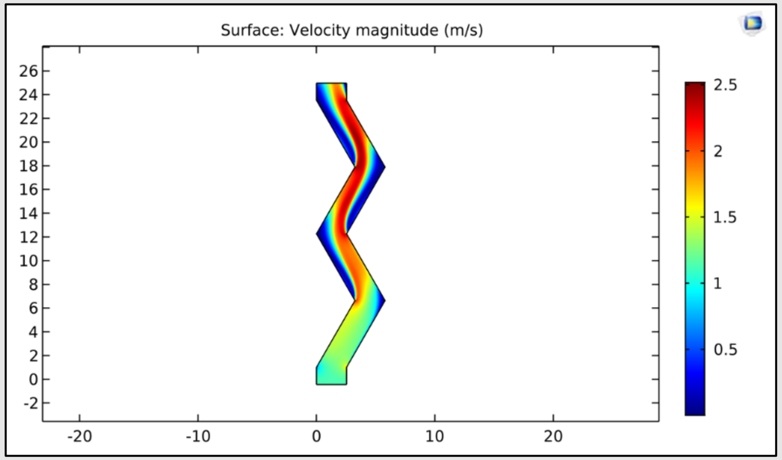
Optional features

- ✓ Design for specific capacity, pressure and temperature
- ✓ Design class rating ASME 900,1500,2500
- ✓ Design for sour gas and corrosive fluid
- ✓ Use of level switch, level alarm, differential pressure alarm, automatic drain system
- ✓ Spare part for commissioning & operation

Knowledge is our difference…

We believe that investment in research and development is an essential component for long term success. Computational Fluid Dynamics is a reliable tool for design optimization, troubleshooting, and product development. Flow distribution is critical in all gas-liquid and liquid-liquid separation vessels. As vessel sizes are reduced or more capacity is expected from existing equipment, traditional design rules for vessel geometry and flow distribution must be reviewed for all elements that can affect separation performance such as flow velocity through inlet and outlet nozzles, spacing between nozzles, internals and liquid levels. CFD modeling is used by engineers at APADANA PETRO FARAYAND to simulate flow conditions and vessel geometry. The modeling provides a close approximation of the fluid flow profile inside the vessel. In the pictures below, we could see velocity contour and particle distribution for flow passing throw a vane channel. These pictures are the result of simulation using COMSOL software.





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