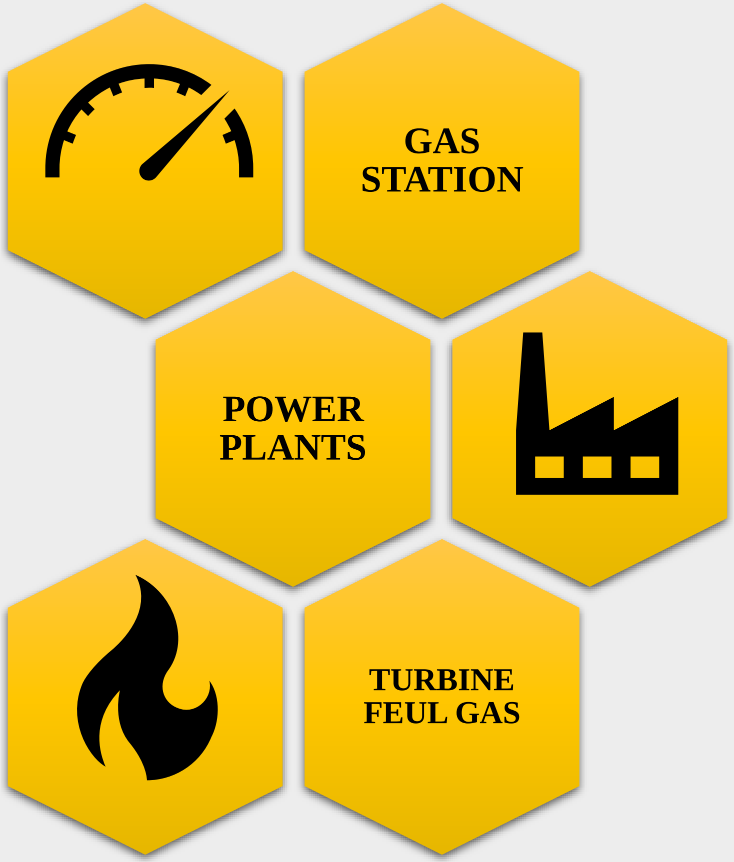
VANE FILTER SEPARATOR
APF-VFS

APADANA PETRO FARAYAND

Knowledge is our difference



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

Usage

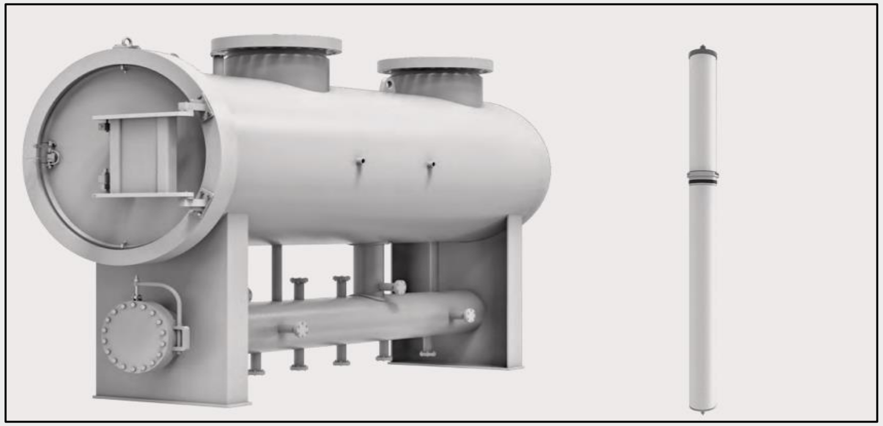
- ✓ Gas station
- ✓ Gas treatment station for petrochemicals, power plants and industrial factories
- ✓ Turbine fuel gas

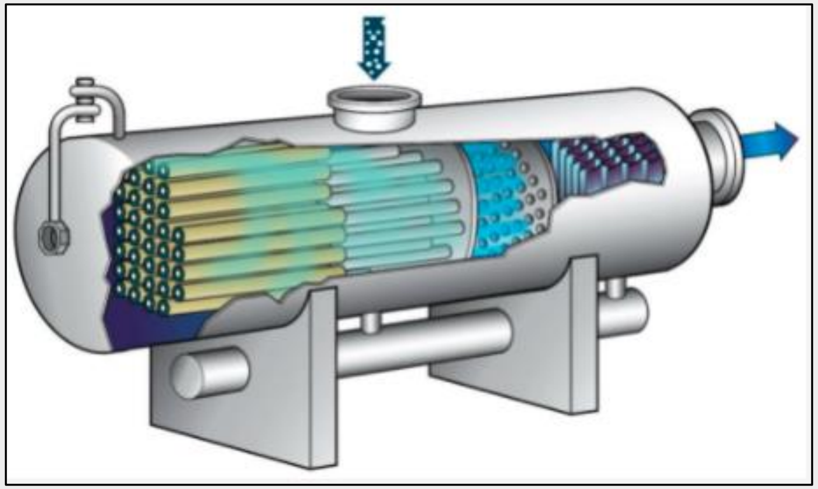
Introduction

A filter separator usually has two parts. The first part contains filter elements while the second usually contains a vane type, swirl tube or wire mesh mist extractor. As the gas flow through filter elements, the liquid droplets coalesce into larger particle and fall to the center core. While gas moves toward second part, remaining particles removed. The second part usually contain wire mesh or vane type separator. Filter separator also contains a lower barrel for liquid storage. Separation of oil, water, hydrocarbons and solid particles in the gas stream is critical to protecting downstream equipment and can prevent major damage to equipment such as compressors and valves in downstream units. Due to the very small pores in the filter elements, this equipment also acts as a filter for solid particles.

A cartridge filter consists fiberglass as a filter material. A perforated support body ensures optimum strength and perfect protection for the filter fleece. The filter element can filter out very fine dirt particles of 3 to 50 microns. Due to the large surface, the filter elements are capable to eliminate contaminate with a low-pressure loss, high-volume flow and long service life.

Flow of the gas is from the outside to the inside of the filter cartridge. Thus, the contained dirt particles remain adhered to the surface of the filter medium. The cleaned gas is discharged from the filter cartridge and returned to the system.





The pressure drop in the filters is due to two phenomena. Pressure drop due to fluid passing through the filter and pressure drop due to solid remaining on the filter. The following equation illustrates this point.

$$\Delta P = \Delta P_r + \Delta P_s$$

To estimate each of these two parameters, there are many equations. One of them has shown below.

$$\Delta P_r = K_r \eta \upsilon$$

$$\Delta P_s = K_s \eta h(t) \upsilon$$

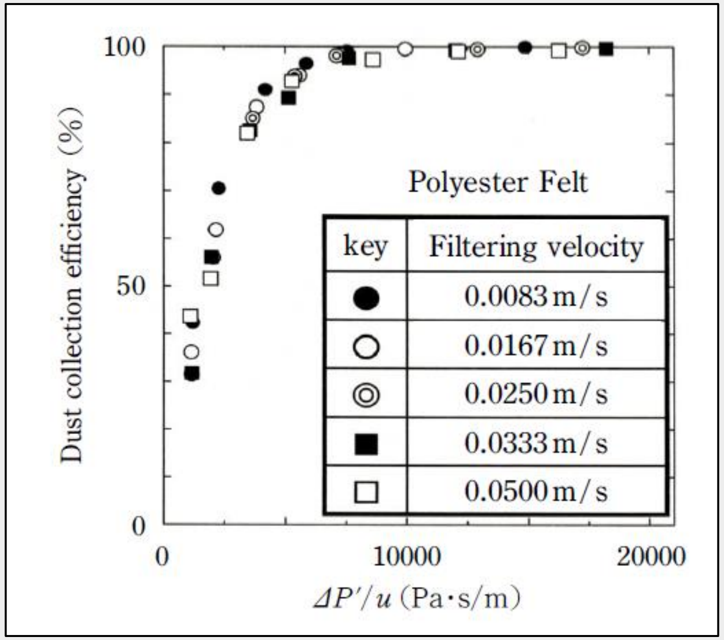
In the above equations, K_r and K_s are the coefficient of resistance of the filter and the solid respectively, η is the dynamic viscosity of the gas, υ is the velocity of the gas inside the filter and h(t) is the solid thickness left on the filter. The K_r and K_s coefficients are available in handbooks and articles. Very few studies have been performed on changing the efficiency of the filter by increasing the residual solid on the filter. In one of these studies, the change in efficiency of polyester filters in terms of pressure drop is expressed as the following equation.

$$\eta = 1 - \exp\left(-1.36 D_p^{\frac{2}{3}} \left(\frac{\Delta P}{u}\right)^{\frac{6}{5}}\right)$$

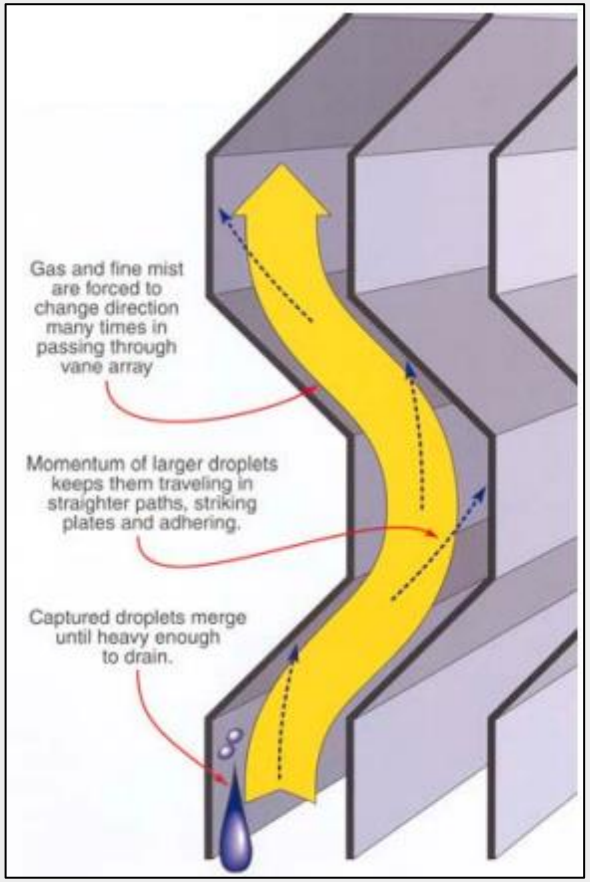
In the above equation, D_p is the particle diameter in meters, ΔP is the filter pressure drop in Pa and u is the filtration rate in m/s .

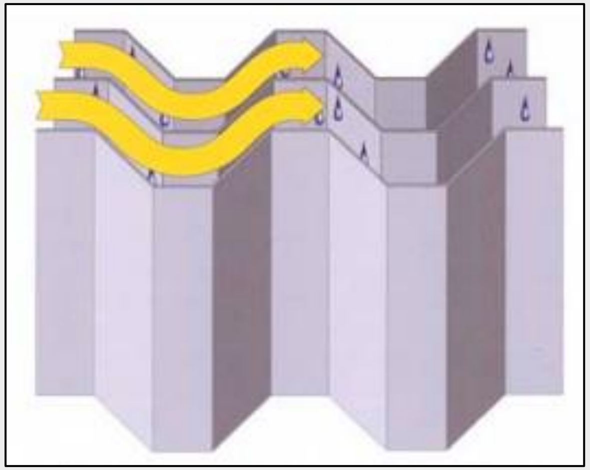
As an example, for a particle size with a diameter of 0.4 microns, the efficiency change diagram due to the change in the ΔP/u parameter is shown in the figure below. As can be seen, the efficiency value for ΔP/u greater than about 10,000 is equivalent to 1. Typically, filtration speeds in industrial units are 0.1 meters per second and the minimum pressure drop is equivalent to 2 psi. Thus, the minimum ΔP / u in industrial units is 137895 Pa.s/m. Thus, in industrial units, the efficiency for all values of pressure drops depending on the particle size is about 1. After using the filter for a while, a layer of solid covers the surface of the filter, and this solid layer helps to improve the efficiency of the filtration.

In APF-VFS, 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 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. 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.

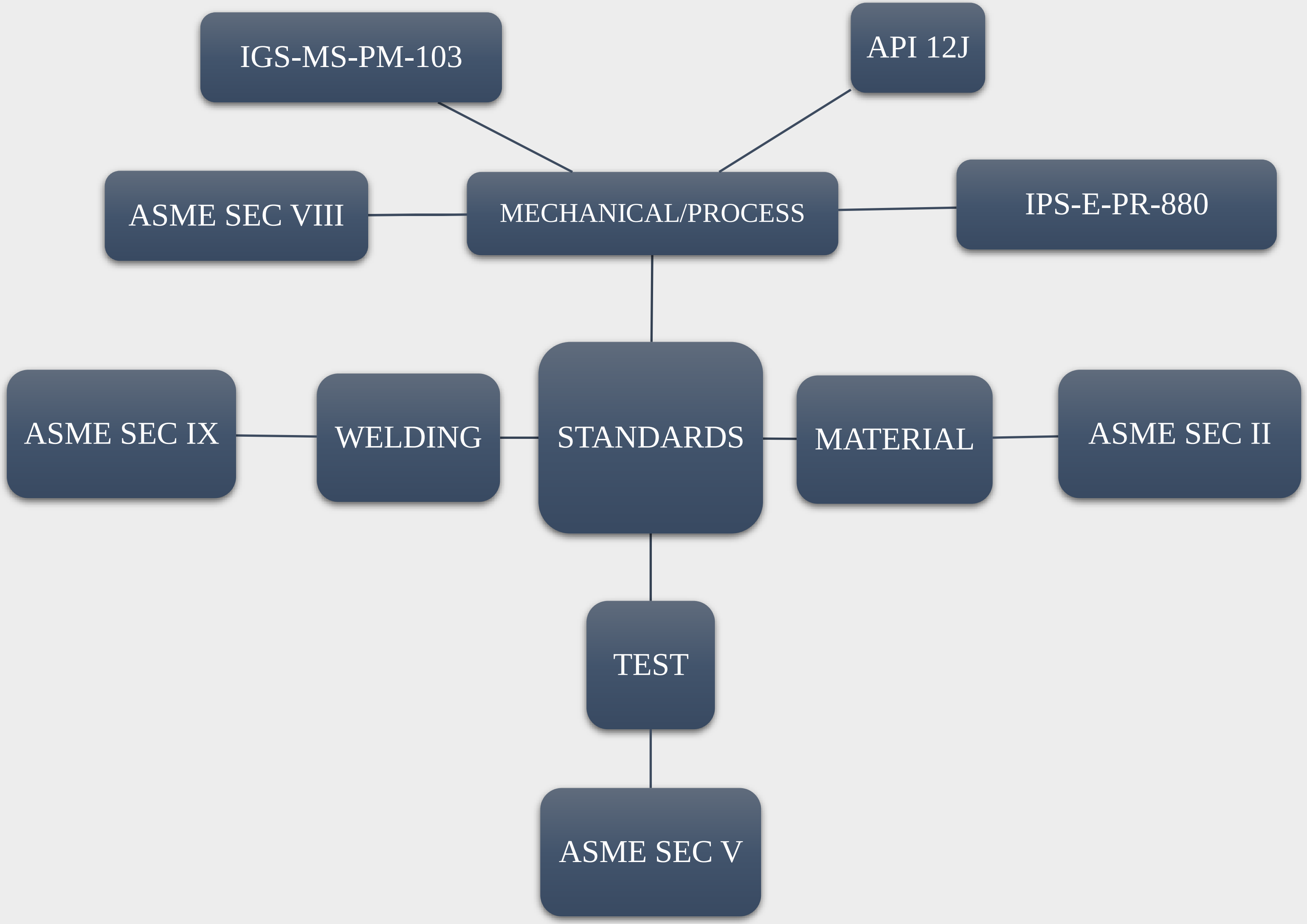
4. Longer corrosion life: The thickness of vanes gives them a substantially greater service life than mesh with the same corrosion rate. In a given corrosive service, a vane unit made of sheet metal will last much longer than a mesh pad made of the same alloy.

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.

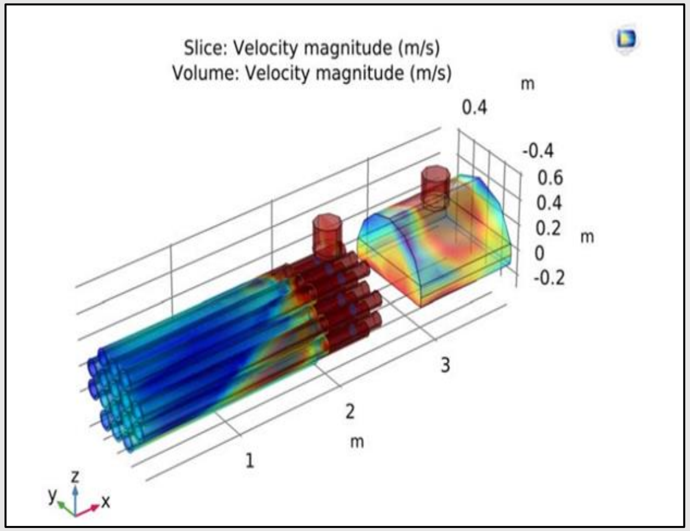

IGS-MS-PM-103
API 12J
ASME SEC VIII
MECHANICAL/PROCESS
IPS-E-PR-880
ASME SEC IX
WELDING
STANDARDS
MATERIAL
ASME SEC II
TEST
ASME SEC V

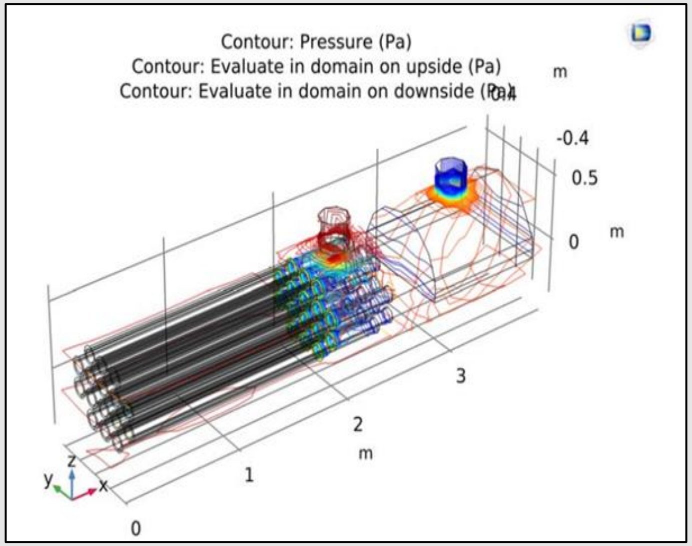
Optional features

- ✓ 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

Mechanical features

- ✓ ASME type quick opening closure
- ✓ 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

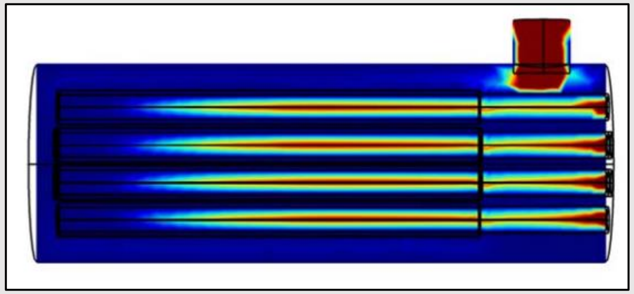


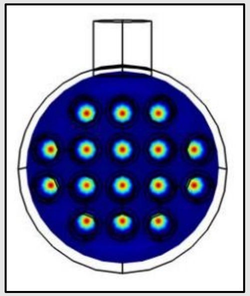


Knowledge is our difference…

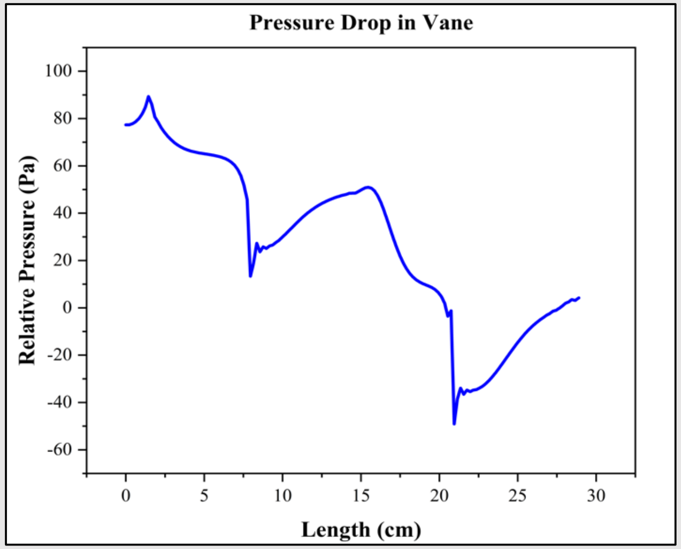
We believe that investment in research and development is an essential component for long term success. Computational Fluid Dynamics is a reliable tool for design optimization, troubleshooting, and product development. Flow distribution is critical in all gas-liquid and liquid-liquid separation vessels. 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, using COMSOL software, velocity contours are shown along the length and cross section of the filter elements.

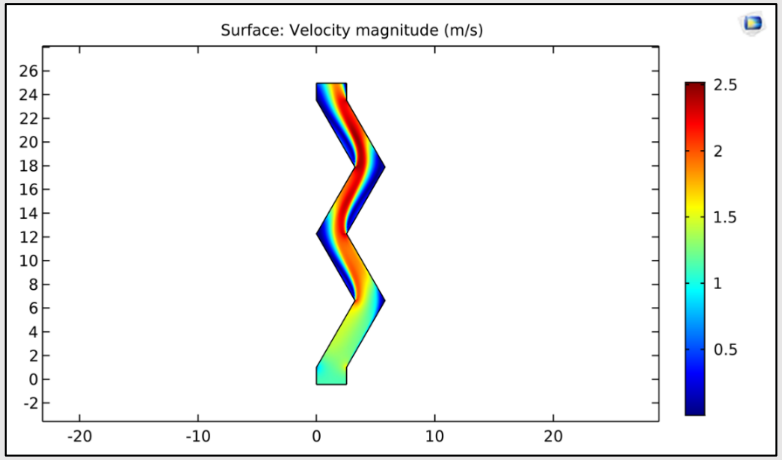


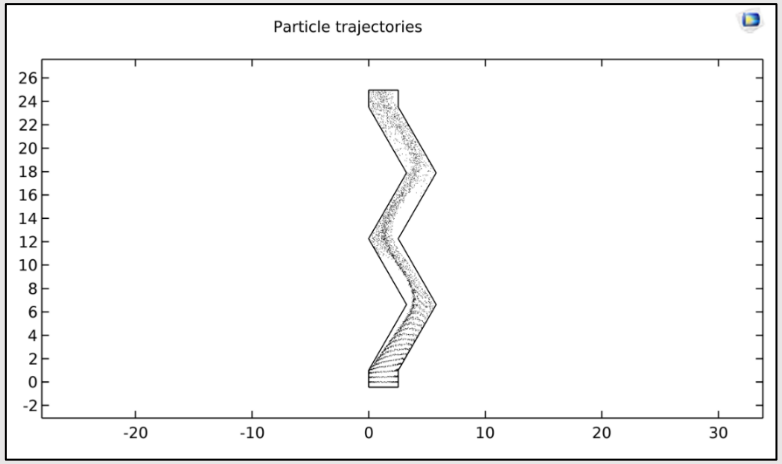


The following picture shows the pressure change diagram versus vane lenght using COMSOL software.



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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