Demister Pad Selection and Sizing

EIEPD Free Webinars

Mist Elimination: Solutions for gas-liquid separations and flow conditioning.

In any process where gas and liquid come into contact, the gas will entrain some amount of the liquid droplets. This entrainment can cause process inefficiencies, product loss, and equipment damage.

Mist Eliminators Objectives

Reduce loss of valuable chemicals: Mist eliminators markedly cut glycol, amine, or solvent consumption in absorption and regeneration towers.

Increase throughput capacity: Mist eliminators allow a significant increase in throughput anywhere gases and liquids come into contact in process equipment.

Improve product purity: Mist eliminators prevent contamination of side draws and overheads in refinery atmospheric and vacuum towers and other distillation columns.

Minimize contamination: Mist eliminators can prevent the poisoning of expensive downstream catalysts or provide boiler feed water quality condensate from evaporator overheads.

Provide equipment protection: Mist eliminators protect turbine, blower, and compressor blades, which can eliminate serious maintenance problems.

Reduce air pollution: Mist eliminators help diminish droplet emissions to environmentally acceptable levels.

COMMON APPLICATIONS

1. Knockout Drums

Designing knockout drums to include mist eliminators will reduce capital equipment costs and improve efficiency. Knockout drums relying solely on gravity settling typically remove drops larger than 100 microns. Using an efficient mist eliminator will remove entrainment of all drops larger than 5 to 10 microns. This higher efficiency reduces product loss; downstream corrosion; contamination; and damage to equipment such as compressors, molecular sieve driers, and blowers. Vessel weights can easily be reduced to half, and handling of liquid slugs is improved.

2. Evaporators

Customized mist eliminators reduce carryover of dissolved and undissolved solids to obtain specified steam condensate purity levels below 1 to 50 ppm. This not only prevents product loss, but it also protects compressor internals in vapor recompression systems, provides boiler feed water quality condensate, and prevents potential pollution problems.

3. Steam Drums

Customized mist eliminators reduce carryover of dissolved solids to obtain specified steam condensate purity levels from 1 ppm down to 5 ppb without the need for external separator vessels. Operating pressures can range from 20 to 2500 psig [1 to 170 bar].

In a typical steam drum, mist eliminators properly located below the outlet nozzles assure high steam purity.

5. Refineries

Mist eliminators in fractionators increase throughput capacity and allow deeper cuts for greater yields.

• In atmospheric and vacuum pipestills, reduced entrainment from the wash oil zones allows deeper cuts and greater throughput.

• In downstream crackers and reformers, mist eliminators prolong catalyst life by reducing carbon and metals in side draws.

6.Petrochemical Plants

Mist eliminators are used in the interstage knock-out drums of the compressor trains to extend compressor run length and service life. They are also used in quench towers to prevent contamination and protect downstream equipment.

Other examples include Distillation Towers, Scrubbers, Flue Gas Desulfurization, Gas Absorption Systems, Sulfuric Acid Plants

Sulfuric acid plant.

Well-engineered mist eliminators are critical to the cost-effective operation of every sulfuric acid plant. In the drying, intermediate, and final absorption towers, poorly performing mist eliminators contribute to corrosion of ducting, blowers, heat exchangers, and vessels. Stack emissions can result in environmental non-compliance, fines, and potential closure.

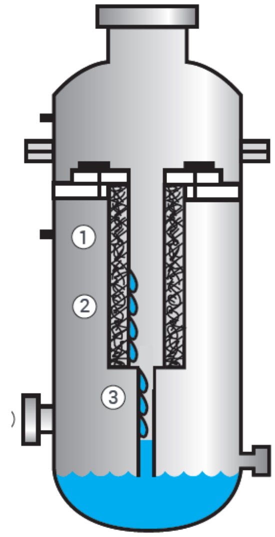
Mechanism of Mist Carryover for Gas-Liquid Mist Eliminator Devices

Mist eliminators are commonly used in gas-liquid separation to aid gravity separation in the removal of liquid so that more efficient, smaller separators may be used. To be effective, a mist eliminator must accomplish two basic functions. First, it must have a means to capture liquid. Second, it must be able to drain the captured liquid without allowing re-entrainment into the gas streams. There are two mechanisms of liquid carryover from a mist eliminator. In the first mechanism, carryover is due to droplets of mist which are simply not captured by the device. The droplets might be too small to be captured or velocities are too low, causing low efficiency for impaction-type mist extractors. The second is re-entrainment of liquid after it has already been captured in the mist eliminator.

The majority of separator failures are caused by re-entrainment. This is the mechanism that occurs as the gas throughput is increased beyond the tolerable limit. Gas moving through the mist extractor exerts a drag force on the liquid film of the mist eliminator, causing it to be pulled toward the trailing edge of the device. If the drag is excessive, the liquid will be torn off the element and carried away by the gas stream. As flow rate increases, the contact efficiency of most mist eliminators improves. Therefore, increasing gas flow yields improved droplet capture, but also increases re-entrainment which results in liquid carryover and limits separation capacity.

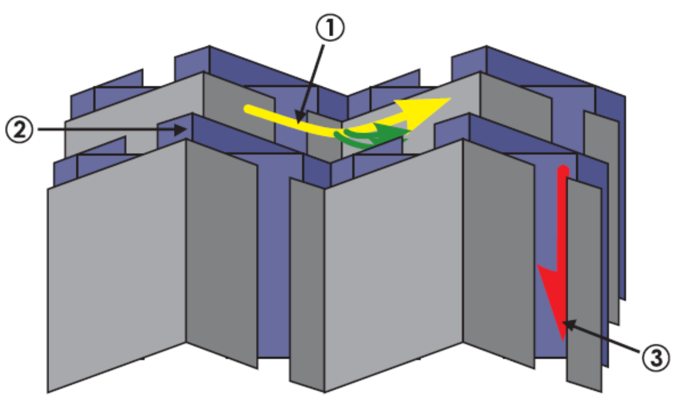
The most common style of mesh mist eliminator used in gas processing is a 100 mm to 150 mm thick crimped wire mesh pad with 144 to 192 kg/m3 bulk density. High droplet removal efficiency for droplets 10 microns and larger is common for the above design. Other designs include fiber mesh, mixed wire and fiber mesh, multiple mesh density layers, and special drainage channels. The goals are either to increase removal efficiency at lower droplet diameters, promote better drainage and in turn less carryover, increase throughput for a given mist eliminator area, reduce fouling, or a combination of the above. Mesh pads are not recommended for dirty or fouling service as they tend to plug easily.

Proper drainage of the mesh mist eliminator is essential to the operation of the unit. As the gas velocity increases at a given inlet liquid loading, the liquid continues to drain until a limiting load point is reached, at which point substantial liquid will carry over with the gas flow. Most mesh mist eliminator designs are based on the load point velocity. The load point will depend on the mist eliminator orientation, since the drainage mechanism is different as the pad orientation changes.

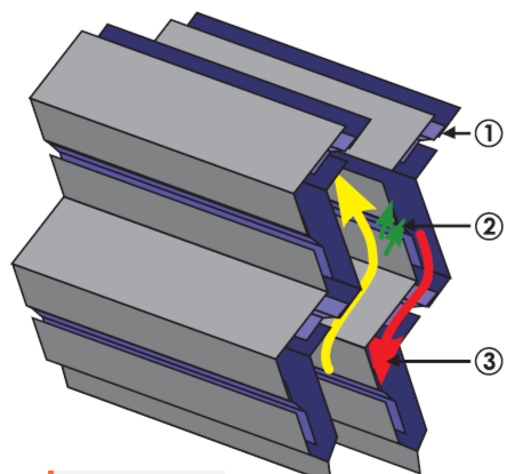


Vane Mist Eliminators

Vane or chevron-type mist eliminators (vane-pack) use relatively closely spaced blades arranged to provide zig-zag gas flow paths. The changes in gas flow direction combined with the inertia of the entrained liquid droplets cause impingement of the droplets onto the plate surface, followed by coalescence and drainage of the liquid to the liquid collection section of the separator. Vane packs may be installed in either horizontal or vertical orientations. Various vane styles are available, including those with and without pockets (both single and double pockets) to promote liquid drainage.



Horizontal gas flow.



Vertical gas flow.

Vane packs can be used instead of wire mesh for the following reasons: fear of fouling of the wire mesh, where corrosion and life of the demisting device requires a more robust design than mesh pads, to reduce separator size and cost compared to mesh, too high a liquid load for mesh.

Vertical separators with vane packs have a moderate turndown ratio, are suitable for slightly fouling service (straight or some single-pocket vanes only). Vane separators are less efficient overall than wire mesh in most applications. Vertical separators with vanes are best utilized below 4825 kPa (ga). Higher efficiency can be obtained at pressures above 4825 kPa (ga) by using double pocket vanes. Vanes can tolerate higher liquid load than mesh pads. However, they are sensitive to slugs and require adequate bulk separation upstream, similar to mesh pads. Vane elements have a relatively low pressure drop typically 100 Pa to 1 kPa (ga)]. Vertical separators with vanes are a common alternative to mesh mist eliminators for reciprocating compressors because of their more robust mechanical design, which is advantageous in pulsating service.

Vanes packs may be supplied as part of a package which includes the pressure vessel and internals, or as the vane element alone. Each supplier has proprietary vane pack styles and design correlations.

The drain pipe(s) is submerged below the liquid level. Several different vane configurations may be used in a vertical separator: vertical flow of gas through the vanes, horizontal flow, inline separator with horizontal flow.

1.Vertical Flow Vane Separator

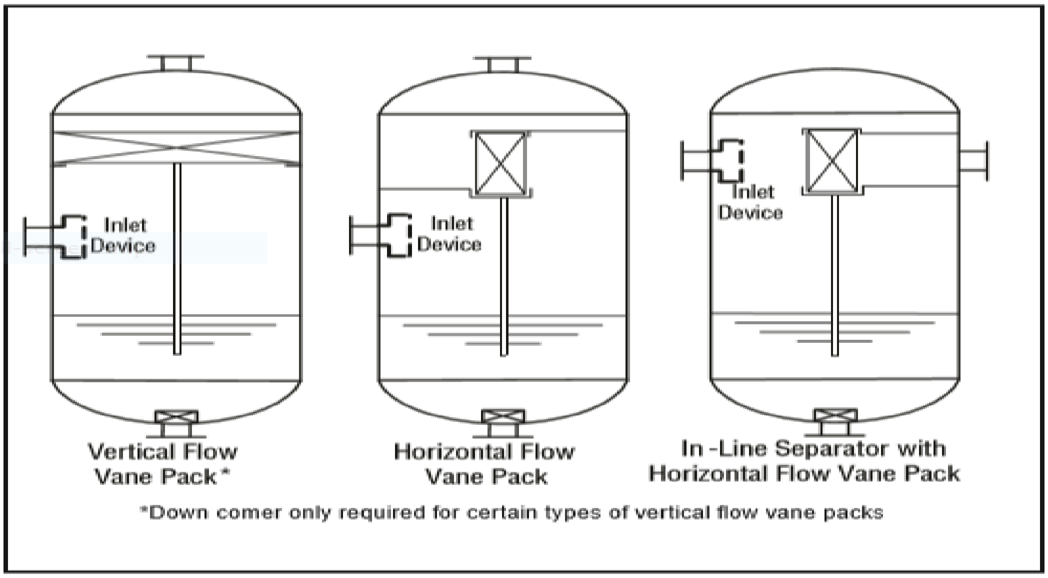
This configuration is similar to that of a vertical mesh separator. There is a liquid knockout section below the vane section which can handle higher liquid loads during upsets or small slugs. Vertical flow vane separators have the advantage that the gas flow path is vertical after the inlet and does not have to change direction to pass through the vane pack.

2.Horizontal Flow Vane Separator

In this configuration the gas flows vertically up from the inlet section and then must make a turn to flow horizontally through the vane pack, hence proper spacing must be allowed for good gas distribution. Typically, the height of the vane pack is larger than the width, which permits a smaller vessel diameter than the vertical flow vane design. In horizontal flow the allowable K value is often higher depending on the style of vane used. The horizontal flow vane separator is a common configuration for reciprocating compressors since it is compact and lower in cost.

3.Horizontal Flow Vane Separator (In-Line)

This is the most compact vertical vessel using a vane pack. However, the design cannot handle significant liquids or slugs during an upset.



Vertical Gas-Liquid Separator Comparison Chart

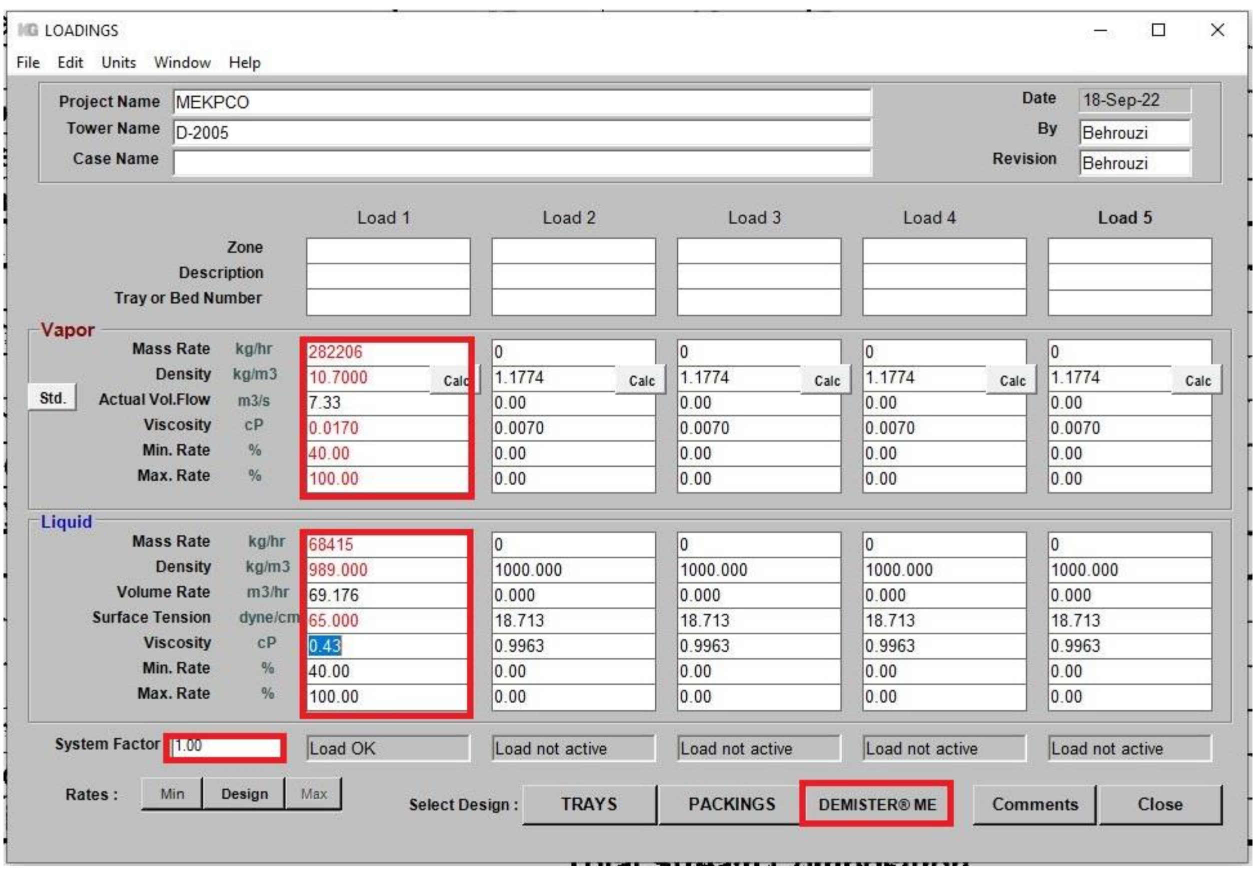
Separator Type:	No Demisting Internals	Mesh Pad	Vert. Vane Pack	Horiz. Vane Pack	In-line Vane Pack	Axial Flow Multi-Cyclone	Horiz. Flood Mesh/ Vane	Vert. Flood Mesh/Vane	Flood Mesh/ Multi-Cyclone
Gas Handling									
Capacity	Low	Moderate	High	Very High	Very High	Very High	Very High	Very High	Very High
Turndown Capability	∞	4:1	3:1	3:1	3:1	2:1	4:1 or higher	4:1 or higher	4:1 or higher
Liquid Removal Efficiency									
Efficiency Overall	Low	Very High	Moderate	Low/Mod	Low/Mod	High	Moderate	High	High
Efficiency – Fine Mist	Very Low	Very High	Moderate	Moderate	Moderate	High-Very high	Very High	Very High	Very High
Liquid Handling Capacity									
Slugs	High	High	High	Very High	Very Low	High	High	High	High
Droplets	High	High	Moderate	Moderate	Low	High	High	High	High
Fouling Tolerance									
Particulate	Very High	Low	Moderate	Moderate	Moderate	Moderate	Low	Low	Low
Fouling Material	Very High	Very Low	Moderate	Moderate	Moderate	Moderate	Low	Low	Low
Pressure Drop	Very Low	Very Low	Low	Low	Low	High	Low	Low	High

Example: Imagine you are working as a process designer in an international project and you are supposed to select a Koch-Glitch model for a separator at the compressor suction with the following operating condition:

Parameters	Gas	Liquid	Unit
Mass Rate	282206	68415	Kg/hr.
Density	10.7	989	Kg/m3
Viscosity	0.017	0.43	cP
Surface Tension		65	Dyne/cm

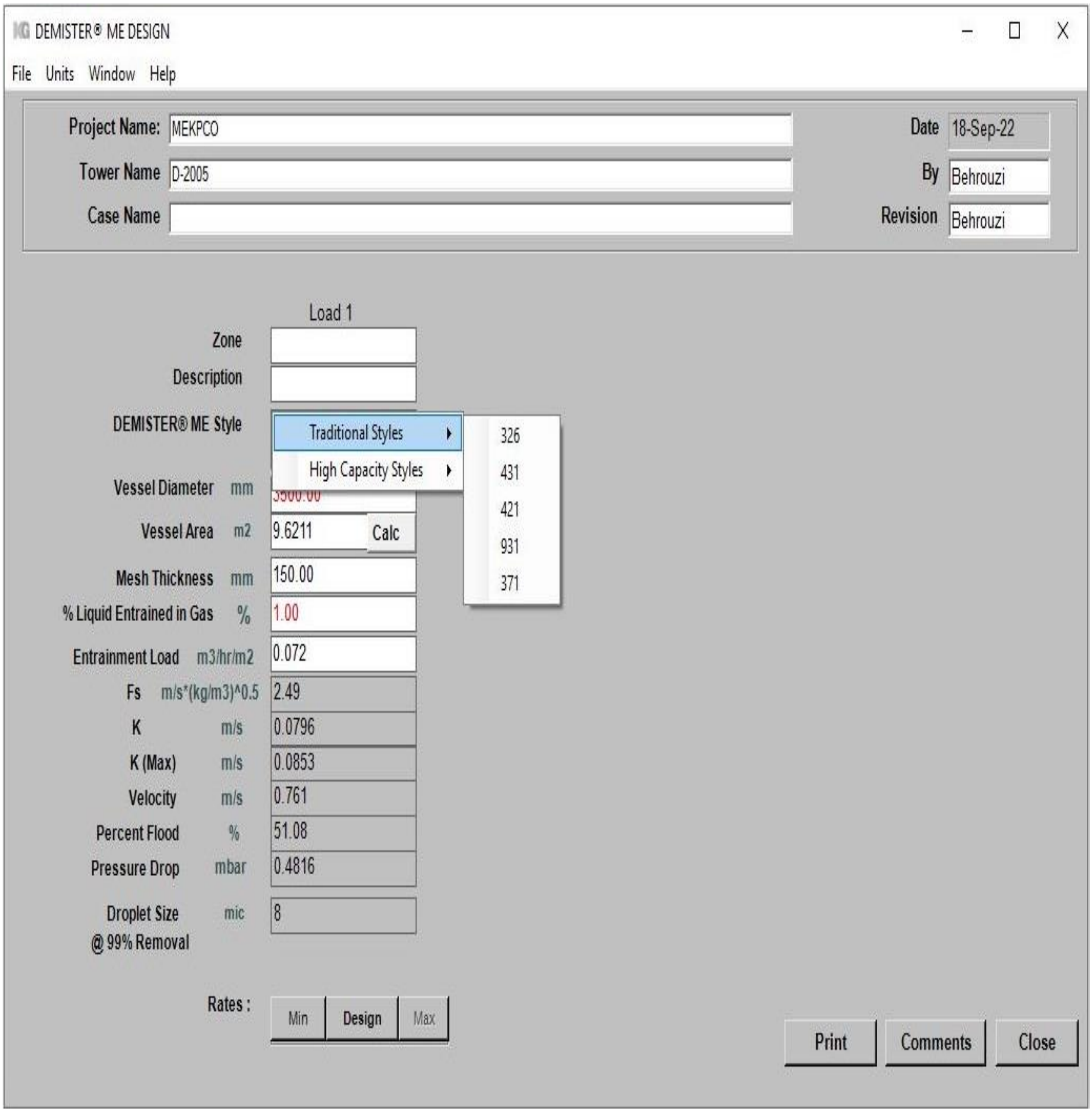
Solution: Here are the steps to be taken

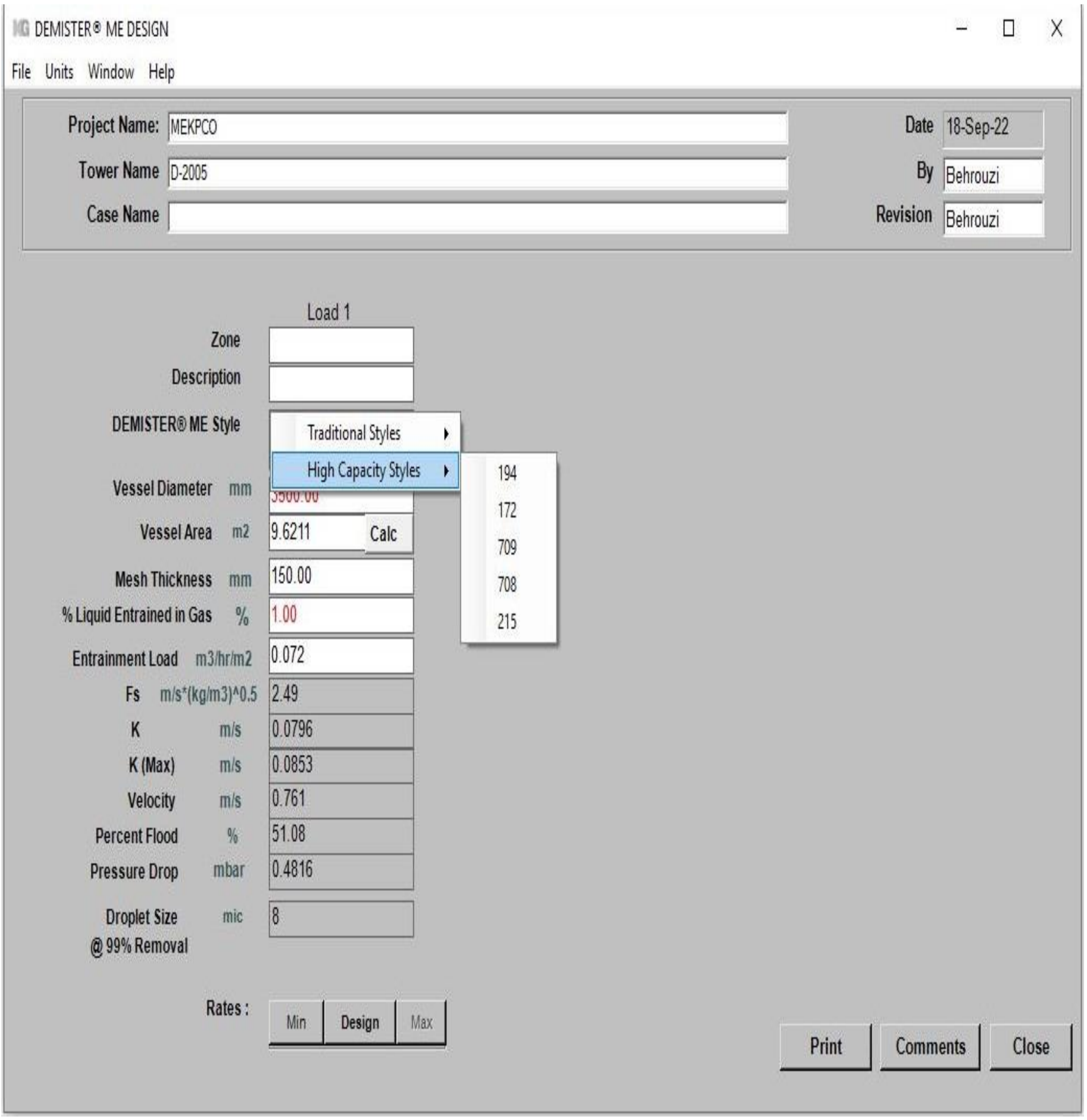
1.Put operating data as input like below

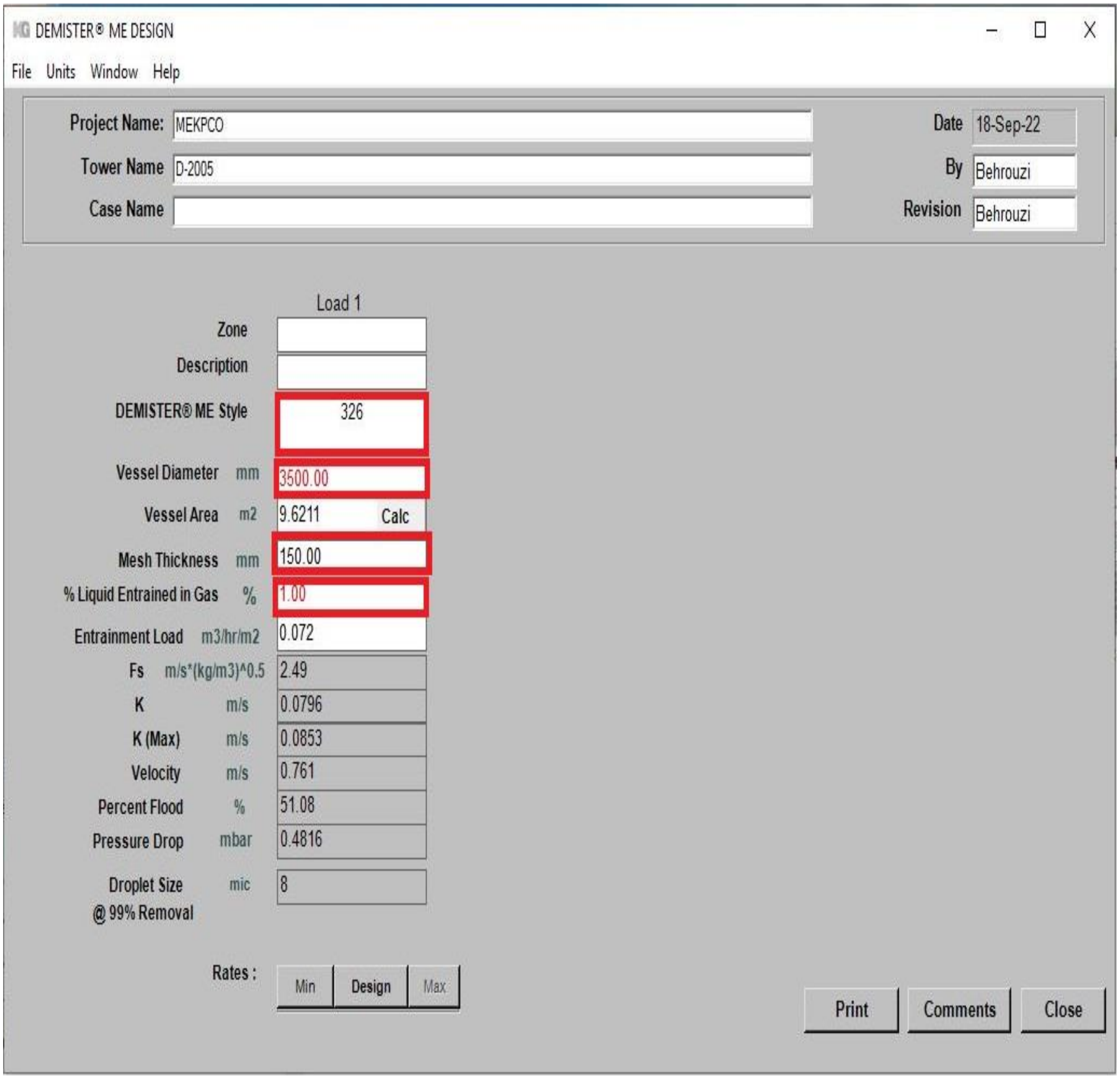


2. In Koch-Glitsch products there are two types of demister pads:

    1. Traditional demister pads
    2. High efficiency demister pads




DEMISTER® ME DESIGN
File Units Window Help
Project Name: MEKPCO
Tower Name D-2005
Case Name
Date 18-Sep-22
By Behrouzi
Revision Behrouzi
Load 1
Zone
Description
DEMISTER® ME Style
Traditional Styles
High Capacity Styles
194
172
709
708
215
Vessel Diameter mm
Vessel Area m2 9.6211 Calc
Mesh Thickness mm 150.00
% Liquid Entrained in Gas % 1.00
Entrainment Load m3/hr/m2 0.072
Fs m/s*(kg/m3)^0.5 2.49
K m/s 0.0796
K (Max) m/s 0.0853
Velocity m/s 0.761
Percent Flood % 51.08
Pressure Drop mbar 0.4816
Droplet Size @ 99% Removal mic 8
Rates : Min Design Max
Print Comments Close



All types will be selected and the results are compared.

326	421	931	371
3500.00	3500.00	3500.00	3500.00
9.6211 Calc	9.6211 Calc	9.6211 Calc	9.6211 Calc
150.00	150.00	150.00	150.00
1.00	1.00	1.00	1.00
0.072	0.072	0.072	0.072
2.49	2.49	2.49	2.49
0.0796	0.0796	0.0796	0.0796
0.0853	0.1067	0.1067	0.0671
0.761	0.761	0.761	0.761
51.08	49.07	42.31	74.12
0.4816	0.3504	0.1607	11.7727
8	10	18	2
			Warning

High Efficiency Demister Pad

194	172	709	708	215
3500.00	3500.00	3500.00	3500.00	3500.00
9.6211 Calc	9.6211 Calc	9.6211 Calc	9.6211 Calc	9.6211 Calc
150.00	150.00	150.00	150.00	150.00
1.00	1.00	1.00	1.00	1.00
0.072	0.072	0.072	0.072	0.072
2.49	2.49	2.49	2.49	2.49
0.0796	0.0796	0.0796	0.0796	0.0796
0.1067	0.1280	0.1280	0.1280	0.0914
0.761	0.761	0.761	0.761	0.761
49.07	42.31	42.31	42.31	68.37
0.4772	0.2878	0.3220	0.1607	8.0034
8	11	11	18	3

The best options that could be selected seem to be York mesh 172, 709 and 421

About us

Educational Institute for Equipment and Process Design or EIEPD is a leading training platform which have been providing specialized courses and trainings in process and general engineering to engineers around the globe.

At EIEPD we aim to empower process engineering community in different ways including:

1.Provision of Free Videos

2.Provision of Free Webinar

3.Specialized online Courses and Trainings

4.In-Person Trainings

5.Project Consultancy

6.Funding Free Graduation Programs

We at EIEPD are glad that you have started your journey with us. We make and keep our promise to upgrade your competency in process engineering beyond your expectation.

With EIEPD, everything is simple!

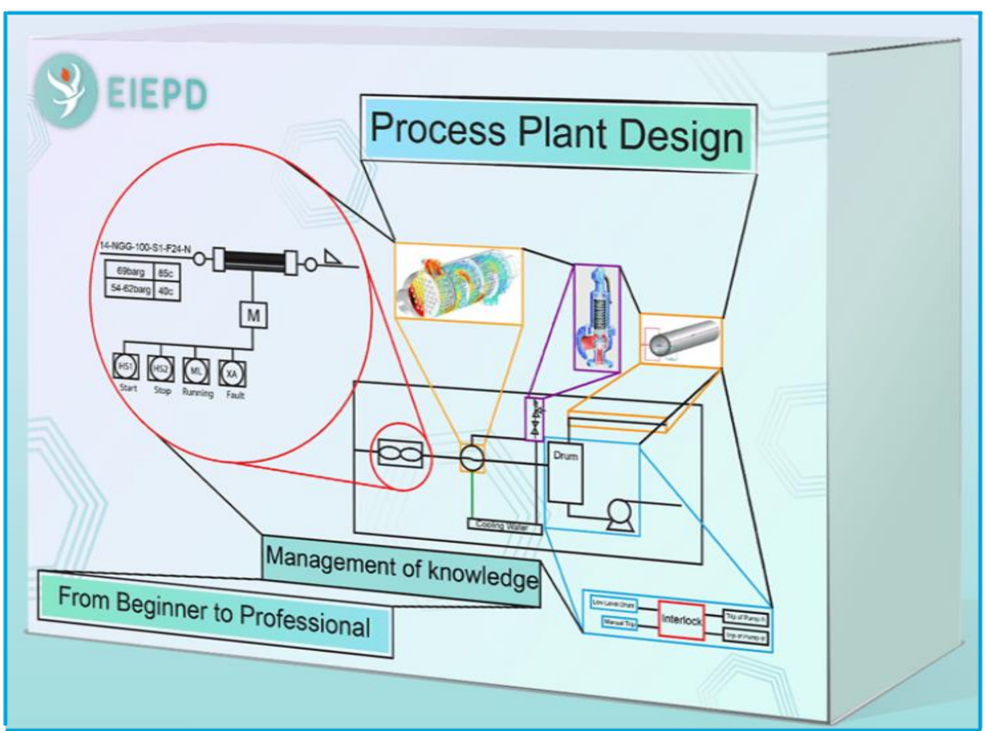
Mohammadreza Behrouzi

The Founder and Instructor at EIEPD

Featured Course

If you are looking for a course to boost your knowledge about basics of process plant design and the preparation of project documents, we highly recommend the “Process Plant Design Course” which covers the followings:

- ✅ Process Design Criteria
- ✅ PFD Development
- ✅ P&ID Development
- ✅ Process Safety Documents
- ✅ Interlock and Logic Diagram
- ✅ Projects
- ✅ Separator Detailed Sizing and Design
- ✅ Shell and Tube Heat Exchanger Detailed Sizing and Design
- ✅ PSV and Control Valve Sizing
- ✅ Pump Datasheet Development



Which Software Training will be included:

- ✅ KG Tower
- ✅ Aspen Hysys
- ✅ Heat Exchanger Software
- ✅ FSM (Fisher Specification Manager)
- ✅ Excel-Sheets

Which Standards Training will be provided:

- ✅ EIEPD Criteria
- ✅ GPSA
- ✅ TEMA
- ✅ API-521
- ✅ Sounders Handbook
- ✅ Fisher Handbook

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https://eiepd.com/courses/process-plant-design

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