

Coalescer gas/liquid separator designs

By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

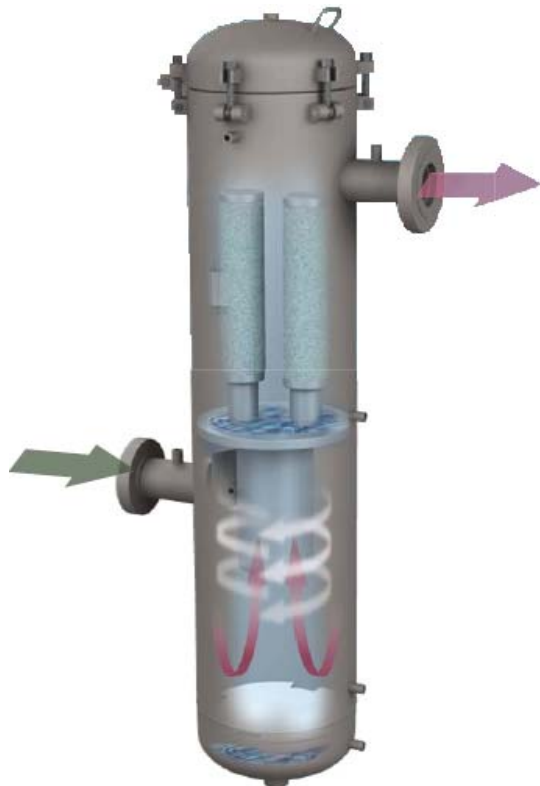
Vortex or centrifugal gas/liquid separators are engineered to remove entrained droplets larger than 10 microns with 99% efficiency and they accomplish this with no moving or otherwise serviceable internal components. Centrifugal separators are self-cleaning in nature and do not require maintenance. The rate of liquid removal is predicated upon the specific design; those with a more complex internal geometry are capable of removing a higher flow rate of separated liquid.

Coalescing separators

Centrifugal separators can be designed to remove droplets finer than 10 microns with 99% efficiency and this style of separator is referred to as a coalescing separator. Essentially an additional separation stage is introduced to coalesce finer droplets into droplets large enough to be removed within the centrifugal vortex stage or purged directly from the separator. This article describes this special type of centrifugal separator and the two basic models we offer.

Vortex Separation

A properly sized separator will create an internal vortex (imagine a mini tornado) powerful enough to propel droplets and particles larger than 10 microns onto the vessel walls based upon the physics of centrifugal force. These droplets coalesce on the internal surfaces, fall to a common drain point and exit the separator via a drain trap, pump or other valved system to prevent the process gas from escaping with the separated liquid. Only droplets finer than 10 microns remain within the center area of the vortex where they can exit through the outlet nozzle of the separator.

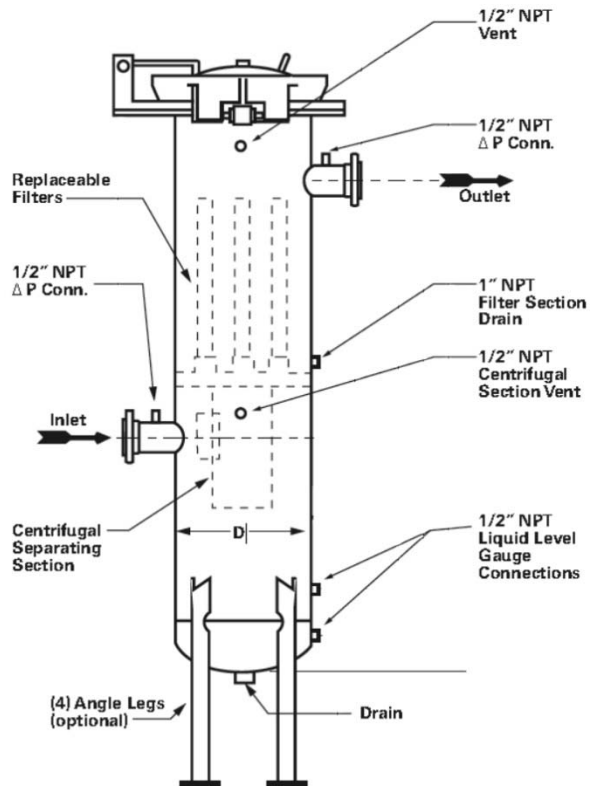


Coalescing stage

In one sense, all centrifugal separators rely on coalescing, however coalescer separators have an additional stage to remove droplets as fine as 0.2 microns depending upon the media used for coalescing. The simplest media consists of a mesh pad and the pad needs to have sufficient complexity to cause 99% of droplets larger than 4 microns to impinge onto the mesh surface such that they coalesce into droplets larger than 10 microns because those are removed in the subsequent vortex stage. The mesh pad and coalescer body is designed such that the additional differential pressure doesn't exceed 0.1 PSI. Therefore, the separator design has to allow for the appropriate demisting pad thickness and complexity for coalescence and also be stiff enough to remain rigidly in-place.



To coalesce droplets as fine as 0.2 microns the mesh pad is replaced with several filter cartridges and this coalescing stage is positioned AFTER the vortex stage. The idea here is that first the coarse droplets are separated and then the special filter cartridges made of epoxy saturated borosilicate micro glass fibers coalesce the finer droplets. These coalescing filter cartridges are created from a matrix of fibers



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and includes drain channels to enable the coalesced liquid to drain from the cartridge and exit the vessel, presumably to the same drainage point connected to the vortex separation stage.

The number of filter cartridges and their size depends upon the separator size, fineness of droplets to remove and the liquid removal rate required for your application. Whereas we'll use a 0.01 micron filter cartridge for 0.2 micron droplet removal, there are other porosities used for coalescing droplets as large as 4 microns.

Design of coalescing separators

The body of a coalescing separator is more complex than a standard vortex style centrifugal separator because internally media needs to be secured and externally the vessel itself has to be designed to provide access to the media for replacement.



While our standard centrifugal separators consist of a fully welded body without need to access the internals, coalescing separators need to have a flanged body and this adds to the cost of the vessel. Internally there needs to be support structures to hold the media in-place and in the case of filter cartridge coalescing, each cartridge needs to be properly sealed and plumbed to drain to a common port which is then routed to the exterior of the vessel and common drain line.

Coalescing separators differ from standard centrifugal separators because they will require periodic maintenance if the process gas or liquid separated contain solids. Such build-up of solids will eventually reduce the open area (increase differential pressure) and affect the coalescing efficiency. Whereas mesh pads are likely cleanable, filter cartridges require replacement. Coalescing separators come standard with differential pressure gauge ports so you can install a gauge and monitor changes in differential pressure.

Applications for coalescing vortex separators

The vast majority of centrifugal separator applications involve removing liquid condensate from steam or compressed air and the removal of droplets larger than 10 microns with 99% efficiency is sufficient. Coalescer separators can be used for steam and air systems if you have a requirement for such fine droplet removal, but they are more often used in refrigeration, petrochemical

and fine chemical processing applications where the droplets are considered the "product to be recovered" or higher removal efficiencies benefit the downstream process, by either protecting piping components or purifying the gas itself.

Application examples

Petrochemical applications include removing water and hydrocarbon liquids from natural gas to improve its quality and protect downstream compressors, turbines, absorbers, heat exchangers and instrumentation from contamination or damage.

Large compressor systems often leak lubrication oil and coalescer separators maximize the volume of such oils recovered. These large compressors are common for many types of industrial manufacturing processes including plastics manufacturing, fertilizer production and any type process using industrial gases that are either used for production or result as a byproduct of the manufacturing process.

CNC machining applications utilizing high pressure coolant generate a high volume of fine oily mist from both heat transfer and high velocity impingement between the tool and the part. Coalescing separators are an important component of air scrubbing systems which ensure the vented air is safe for the personnel and environment.

Custom fabricated design

All of our carbon steel, stainless steel and exotic alloy vortex separators are custom fabricated, which enables us to adjust the nozzle size or orientation, connection types and inspection ports to meet your specific application requirements. All of our custom fabricated separators are designed and engineered in accordance with ASME Code, Section VIII, Division 1 and can be ASME U code stamped.

Information required

To properly size a coalescer separator for your application we need to know the:

1. molecular weight of your gas
2. design (max) temperature
3. lowest operating pressure for which you want to receive performance
4. approximate amount of liquid to remove
5. droplet size targeted for removal
6. volumetric or weight flow of your gas

The next time you have a gas/liquid separation application, reach out to us using one of our [special web-based inquiry forms](#), [send an email](#) or call our office; we will put our experience to work for you!