

Primer on Coalescing and Mist Elimination Media & Process

by

Edward C. Gregor

Coalescing:

Coalescing is accomplished using a device for the separation of a liquid/liquid emulsion of dispersed small discrete droplets from a basically unstable fluid where gravity alone is not sufficient to make the separation. The objective is to form larger droplets, which by their greater mass can readily be separated out. The most common applications are the removal of water from fuel oils, including refinery fuels and other emulsions and the largest single application; the coalescing of aviation fuels immediately prior to be dispensed into an aircrafts fuel tank.

The coalescing process separates emulsions of two intimately dispersed, immiscible liquids, by passing them through a deep-bed fiber matrix such as a nonwoven fabric, felt or fiber mat. In an emulsion, such as water (discontinuous phase) contaminated fuel (continuous or primary phase) passes through the medium, water drops are intercepted when they impact fibers of the medium. Surface tension causes the water droplets to be stripped from the emulsion and to be captured by the fibers and to each other. As more water droplets impact those already captured, they continue to grow together or coalesce until the droplets reach such a mass that they become dislodged from the fibers and eventually, as the heavier of the two phases, drop with gravity. The lighter fuel phase migrates through the coalescing device and ultimately rises to complete the separation from the water phase. Conversely, should water be the continuous phase, then the fuel would be coalesced from the water.

As a rule, coalescers begin to lose efficiency when the difference of any two constituent fluids interfacial tensions (IFT) fall below 18-20 dynes/CM and become very difficult under 6-8 dynes/CM, although one manufacturer is now claiming to be able to make separations as low as to 1 dyne IFT difference. The key is to use an optimum fibrous medium when separating low and/or close IFT fluids. Efficient coalescence also requires the coalescing medium be chemically compatible with the fluids being coalesced.

Coalescers are sometimes designed as a multi-stage system. The first stage, is typically a pleated element, which serves to act as a prefilter to remove solid particulate, which otherwise might plug the coalescers pores. For difficult to extremely pure separations, distillation process are sometimes employed following a coalescer to complete a process.

Mist Elimination:

Mist eliminators remove extremely fine liquid droplets from industrial gases to improve efficiencies of distillation columns and scrubbers. Also, to protect ducts and exhaust fans from corrosion and prevent product loss. Air, generally laden with mist particles, passes through the separation medium. The droplets are intercepted and collected on the surface of the medium and form larger droplets, which continue to build on themselves and grow to form a liquid “coalesced” stream on or within the separator, which then falls with gravity and is carried away.

There are three principle configurations or styles of mist eliminators. Chevron metal panels are used for particles larger than 12-15 microns. Droplets impinge on vane-like surfaces eventually forming a liquid stream, which gravity feeds into a sump. Wire mesh pads, usually of a knitted wire mesh nature, have a large surface area and can be used when droplets are as fine as 2-3 microns in diameter. The knitted pads are often constructed of a 0.006” or 0.011’ diameter stainless steel wire and sometimes a combination of wire and multifilament synthetic yarns, with metal structural support members to maintain the pads shape. Both the Chevron and the pad configurations are closely related in operational performance when separations of high-mass, high-velocity, droplet laden streams are required. Low mass, low velocity streams, are used when droplets are smaller than 3 micron. They are captured within a densely packed fiber mat configured in either a deep-bed or candle style shaped element. This capture is largely based on Brownian diffusion.

Mist eliminators typically protect turbines and compressors, aid in salt reductions, remove sulfuric acid, reduce oil concentrations from factory compressed air-lines, asphalt and plasticizer operations and are critical to environmental compliance in many other industrial operations.

Both coalescing and mist elimination is an important part of the filtration and separations industry process, but remain little understood and a mystery to many whose primary work has been on the filtration side of the business, which typically is in the removal of solid particles from liquid and air streams.

Edward C. Gregor, Edward C. Gregor & Associates, LLC, Charlotte, NC is a management and business development consultant to the filtration, textile fiber and polymers industries.

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