Horizontal Tube Spray Film vs Vertical Tube Rising Film for Vapor Compression

Vapor compression (VC) distillation is conceptually similar in design to a heat pump or the more familiar mechanical refrigeration cycle. Major system components include the evaporator, compressor, heat exchangers, deaerator, and pumps. VC is inherently a thermally efficient distillation process, because it recycles a high percentage of the latent heat.

The two common VC configurations are vertical tube rising film and horizontal tube Spray Film®. In the horizontal tube configuration, feed water is normally circulated, using a pump, and then sprayed by nozzles on the outside of the tubes. Evaporation occurs on the outside of the tubes, while condensation is on the inside of the tubes. In the vertical tube design, feed water is naturally circulated (without a pump), inside the bank of tubes, where evaporation takes place, while condensation is on the outside of the tubes.

In the 1940's and 1950's, Aqua-Chem used the vertical tube rising film evaporator for its vapor compression systems. In order to resolve water purity and reliability issues inherent in the vertical tube design, Aqua-Chem developed and patented the horizontal tube Spray Film® evaporators that it manufactures today.

The advantages of Spray Film Evaporator systems over other vapor compression systems are as follows:

High Tube Wetting Rates

The Spray Film® process recirculates up to 7 times the water that is being evaporated. The recirculated water insures that all the tube surfaces are well wetted to prevent dry spots which can lead to loss of capacity and eventual scaling in the low wetted areas of natural circulation systems. The tubes are continually wetted during hot standby which insures that there are no stagnant areas thus complying with cGMP's.

Ability To Handle Varying Feed Water Conditions

With the high wetting rates and the large spray disengaging space inherit in horizontal Spray Film® systems, varying feed water conditions in respect to total dissolved solids does not have a significant effect on the quality of the water being produced.

Evaporation On The Outside Of The Tubes

In the event that hard water is introduced into the evaporator, the process of evaporation on the outside tube surface reduces the possibilities of bridging which will reduce capacity due to surface area reduction. The Spray Film design can be chemically cleaned while tubes that are bridged inside need to be mechanically drilled out.

Evaporator Tubes And Tubesheet Do Not Remain In Concentrated Water During Shutdown Mode

With the Spray Film® process, the tubes and tubesheet are not below the water level at any time. With the concentration of the feed water being as much as 10 times the incoming concentration, corrosion can begin at the tube to tubesheet joint when submerged during the shutdown periods.

Elimination Of Large Evaporator Head And Gasket Joint

With vertical tube evaporators, there are two evaporator heads on the top and bottom of the evaporator. These heads are the same diameter as the shell of the evaporator. They are both sealed with an elastomeric gasket and require periodic changing. These large heads require special rigging and procedures in order to make periodic gasket replacements. With the horizontal Spray Film® evaporator, the heads are less than half the size of the evaporator and are located on the ends of the evaporator. In order to change these gaskets, only a fork truck or simple rigging is required.

Easy To Clean On Line With The Recirculation System

Inherit to the Spray Film® process is a recirculation pump. This pump is also used as a motive force to introduce chemicals for cleaning and passivation. In a vertical tube system, a separate CIP system is required or removal of ports on the evaporator to introduce the chemicals. The spray action from the Spray Film® process insures that the cleaning chemicals are introduced to all areas of the evaporator. Conversely, the vertical tube system can only be cleaned by flooding the evaporator or using the separate CIP system to recirculate the chemicals. Flooding of the evaporator can be a very time consuming and tedious process.

Superior Endotoxin Removal

Endotoxin is accomplished by physical separators and surface area for the endotoxins to adhere to during the process. In a Spray Film® evaporator, the spray action insures that the entire interior of the evaporator is covered with the sprayed water giving a much large surface area for the endotoxin to adhere. With the spray headers above the tube bundle and the physical separators (mist eliminators) above the spray headers, the disengaging space for the steam from the point of evaporation is very large. This large disengaging area is also baffled so that large droplets of water are not carried to the mist eliminators. The combination of a large spray disengaging area, the mist eliminators and baffling prevents high levels of endotoxins from reaching the condenser.

Main Components At Floor Level

Since the Spray Film® evaporator consists of a horizontal tube bundle configuration; all the main components including the pumps, compressor and heat exchangers can be located at the skid edge and at the floor level. Conversely, a vertical tube evaporator requires the compressor to be located near the top of the evaporator well above floor level.

Compressor Is Separate From Evaporator

The compressor in a Spray Film® system is separate from the evaporator which reduces the amount of vibration being transmitted to the shell. Having the compressor separate from the evaporator also allows for easy removal and maintenance.

Phone: (865)544-2065 Fax: (865)546-4330 Email: sales@aqua-chem.com Web: www.aqua-chem.com