

Food Processing Evaporator Systems

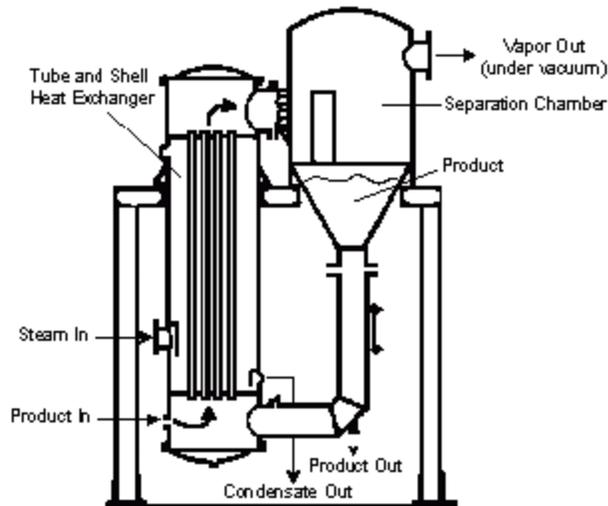
A Pacific Energy Center Factsheet

Evaporator Systems

Evaporators are widely used in the food processing industry to remove a portion of the water from food products. This reduces bulk and weight for subsequent processing, increases solids content (as for jams and molasses), helps preserve the product, provides convenience to the end consumer and concentrates color or flavor.

Many types of evaporators are in use, most with certain common features:

Common Type of Evaporator



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- ?? A heat source (normally steam) that evaporates the water.
- ?? An evaporation vessel where water is driven out of the product as vapor.
- ?? A vapor separation vessel, where vapor and product are separated.
- ?? A vacuum system that draws water vapor out of the separation vessel. This vacuum also reduces pressure in the evaporation vessel, which reduces the boiling point.

Evaporators may operate singly or several may operate in series. Each one is referred to as an effect and in multiple-effect systems, the product output from one effect is the feed for the following effect. Similarly, higher-temperature vapor driven out of the product in one effect is used to heat lower-temperature product in another. Efficiency is gained by using multiple-effect systems.

Energy Efficiency Measures

Several changes can be made to evaporator systems to improve their efficiency. Here are some of them:

- ?? *Installation of additional effects* will generally improve the efficiency of an evaporator system. There is a practical limit to how many effects can be used, as each evaporation vessel must have a lower pressure than the previous effect.
- ?? *Preheating feed product* reduces the heat required to achieve boiling in the evaporation vessel. This requires addition of a heat exchanger appropriate to the characteristics of the feed.
- ?? *Vapor recompression* takes advantage of the significant heating value of the vapor driven out of the product. Vapor can be reused in the same evaporator by increasing its temperature and pressure close to those of the steam injected into the heat exchanger. This can be done using a steam jet or a compressor.

Operations Tips to Improve Energy Efficiency

The following list provides operating practices that can reduce energy consumption in your evaporators:

- ?? *Optimize the venting rate of non-condensable gases* to reduce steam waste while maintaining appropriate evaporation vessel pressure. Non-condensable gases in the evaporation vessel increase pressure, which increases the boiling point and heat requirements.
- ?? *Maintain the optimum pressure profile* as provided in the evaporator's design. Excess pressure inhibits evaporation by raising the boiling point.
- ?? *Condensed steam can be used* to preheat feed product or used in the next effect of a multi-effect system. It can also be fed back to the boiler to offset the use of cold makeup water.
- ?? *Pre-concentration* of the feed will reduce the energy required to operate an evaporator. For some applications, pre-concentration with separation membranes can save up to 90 percent of energy consumption.

Maintenance Tips to Improve Energy Efficiency

Regular maintenance will help ensure that equipment serves a long, useful life and also operates efficiently. The following suggestions will help keep your evaporators operating efficiently:

- ?? *Prevent air leaks* into the evaporators to minimize venting rates. Air is a non-condensable gas and has to be vented to keep evaporation vessel pressure from increasing.
- ?? *Clean heat transfer surfaces* to allow the most efficient use of energy to evaporate water from the product.
- ?? *Inspect and repair or replace* wet or damaged insulation as it is found. Also, make sure insulation is the appropriate thickness.
- ?? *Keep the vapor separation vessel clean* to maintain product yields and pressure profiles.
- ?? *Prevent water leaks* into the system to avoid diluting the product, which defeats the process.

For More Information

Visit PG&E's Food Service Technology Center website at <<http://www.pge.com/fstc>>.

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