

Energy Conservation

Energy is one of the greatest cost factors in rendering. This is especially true today with energy costs, particularly natural gas, at such high levels. Fortunately, there are techniques to reduce energy consumption that are capital cost-efficient, demonstrating reasonable returns on investment and very attractive savings thereafter.

Multi-Stage Operation

Multi-stage cooking is a major technique for energy cost reduction and is made possible because water boils at increasing temperature as its pressure is increased from vacuum to positive pressure conditions. This permits the use of vapor from a higher process pressure stage to be used as the heating medium for a lower process pressure stage to evaporate a portion of the water in that stage. Figure 1 depicts, in highly simplified form, a cooker that has been augmented by an evaporator stage. Details such as pumps, controls, valves, etc., have been eliminated for clarity. In some cases, the cooker is replaced by a second evaporator stage. The specifics of each case will dictate the appropriate equipment selection or modification.

These types of systems are referred to as two-stage systems. In principle, the process can be extended to any number of stages to further decrease energy consumption. It is now evident that the addition of a third stage is often quite practical and results in even greater energy savings. This design is referred to as a triple effect system and is depicted in Figure 2. Note that two levels of process pressure (vacuum) are used. In this instance the lowest process pressure (highest vacuum) stage is designated Stage 1. Both vacuum levels are provided by either separate vacuum pumps or steam ejectors.

The high efficiency screen is used to recycle a fat-rich stream, required for proper fluidization, although this unit may not always be required if the centrifuge is adequately oversized and able to handle the additional flow of fat. Note that in the case of a system with an evaporator final stage the screen also serves to remove larger size particles, thus reducing wear on the centrifuge.

Hot Water Production

Many rendering plants, particularly those integrated with packing operations, require

significant quantities of hot water. The same fundamental reuse of energy via stage operation is applicable. In these instances, vapor is condensed to heat water in lieu of vaporization of a portion of the feed. In some cases, both evaporation and hot water production can be achieved within the same system.

Economics

Consider the following guideline estimates as an indication of energy usage. The basis is pounds (lbs.) of steam per pound of water evaporated. Precise numbers are subject to minor calculation techniques and feed make-up but these values are representative of most typical feedstocks.

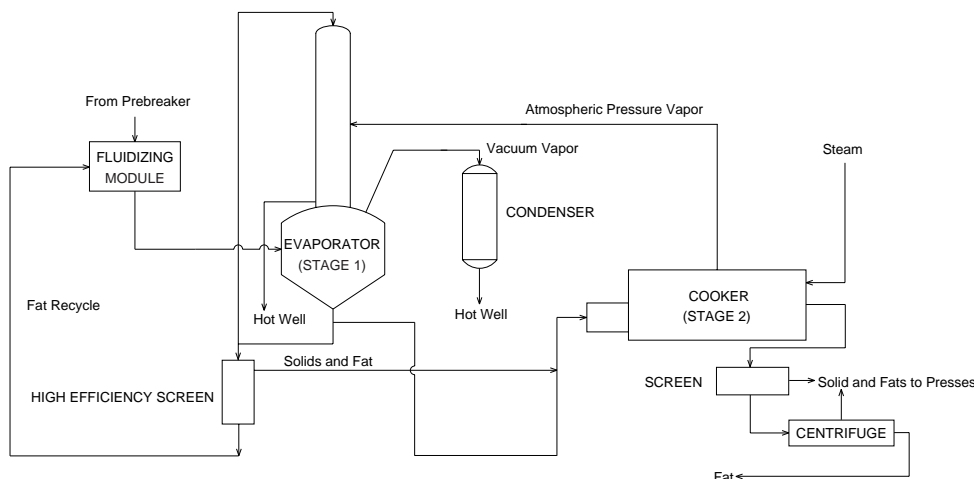
Stage	Lbs. Steam/Lb. Water
1	1.45
2	.74
3	.52

The savings are substantial. Refer to the case study example in Table 1 as typical for many rendering operations. Please note that gross fuel savings are reported. These must be adjusted by additional electrical power and maintenance costs. Depending upon the option, these will typically be five to 10 percent of the gross fuel savings.

Productivity

The introduction of an evaporation stage offers a very attractive prospect for another form of cost savings in addition to energy use reduction. The evaporation stage significantly reduces the heat load on the existing cooker, a unit that can frequently handle a higher throughput hydraulically. By oversizing the evaporation stage, it would be possible to increase plant throughput provided that auxiliary equipment such as the centrifuge and

Figure 1. Cooker Augmented by an Evaporator Stage



presses can handle the higher rate.

The savings potential of this approach is quite attractive. Under these conditions it may be possible to reduce the plant operating time and also reduce aggregate maintenance costs. Generally, the differential cost of adding capacity to a new stage is modest in comparison with the overall cost of the installation. Reduction in operating time (or, as an alternate view, addition to plant capacity) should be given serious consideration as another reason for the addition of evaporation stages.

Equipment

Most evaporators used in the rendering industry in drying processes are of the falling film type. Because of the presence of solids in the process flow, it is necessary to recycle a flow of fat to permit the process stream to flow, a function accomplished in the fluidizing module. These types of evaporators, referred to as carrier fluid falling film evaporators, are used worldwide and have many years of successful processing experience.

Falling film evaporators of this type are vertically mounted with the benefit that they are self-draining. Carrier fluid rates are such that local overheating is minimized, resulting in minimal product burn-on. These factors result in very little cleaning requirement, permitting high utilization rates.

Enhanced Recovery

Some rendering plants direct the steam condensate from the high pressure to a vented atmospheric pressure tank instead of directly back to the boiler. This is quite wasteful because the condensate immediately flashes to atmospheric pressure/temperature with a consequent loss of heating equivalent to 10 percent or more of the fuel necessary to generate steam. Direct return of condensate, as illustrated in Figure 3, results in a very favorable return on investment.

Because dissolved solids accumulate in the boiler loop, resulting in scaling, it is necessary to remove these solids by expelling them from the system. Typically this is done on a continuous basis using

Table 1. Case Study Example

The following is an illustration of a typical rendering case.

Feed Rate: 50,000 lbs. per hour

Feed Composition: 55% water by weight

Natural Gas Purchased Cost: \$5.50 per million Btu

Utilization Rate: 70%

Note: Utilization rate is the effective percentage of full production rate x total hours per year (8,750).

Boiler Efficiency: 80%

Note: This factor accounts for the fact that purchased energy is greater than energy actually absorbed by the process.

Btu per lb. of Steam: 870

Annual Evaporation Rate: $50,000 \times .55 \times .70 \times 8,750 = 168,437,500$ lbs.

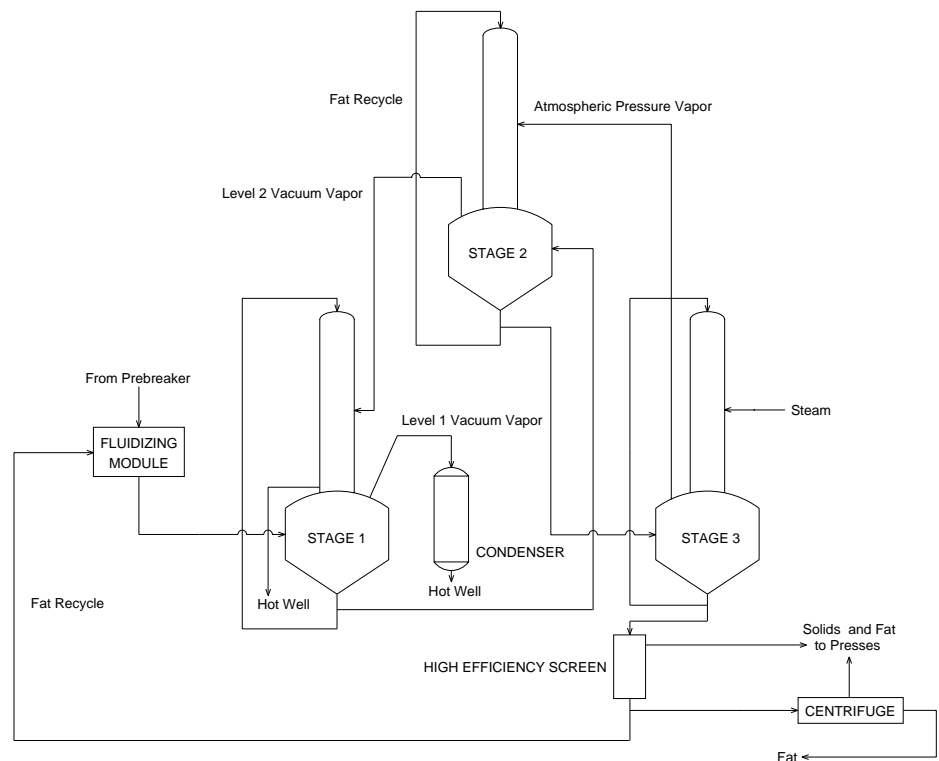
Annual Operating Cost Using Various Stages:

Single Stage: $168,437,500 \times 1.45 \times 870 \times \$5.50/.80 = \$1,460,830$

Two Stage: $168,437,500 \times .74 \times 870 \times \$5.50/.80 = \$745,525$

Three Stage: $168,437,500 \times .52 \times 870 \times \$5.50/.80 = \$523,890$

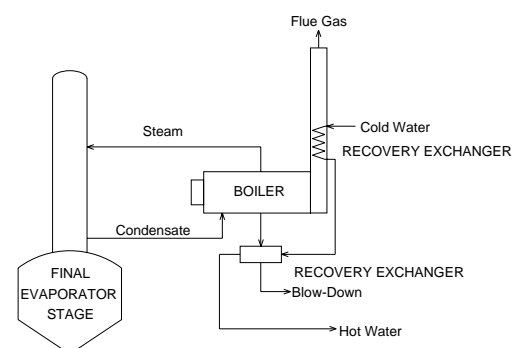
Figure 2. Triple Effect System



conductivity control. The hot blow-down is an excellent and easily recovered source of heat, particularly as applied to heating the associated make-up stream. Again, return on investment is typically very rapid.

Characteristic process plant boiler efficiency is in the area of 80 percent resulting from the requirement to maintain stack exhaust gas at sufficiently high

Figure 3. Direct Return of Condensate



Continued on page 35

temperatures to prevent corrosion in the boiler. Stack gases provide an excellent source of heat to produce hot water for process, cleaning, or boiler make-up purposes. Heat can safely be recovered in a stack heat exchanger. Its construction is such that there will not be an appreciable effect due to corrosive gases.

Conclusion

The techniques outlined herein must be evaluated on a case-by-case basis. However, virtually every rendering plant could benefit from considering an evaluation of its energy utilization. In today's market, energy savings will be a major contributor to profitability. ❖