AR No. 4

Reuse Cooling Water

Recommended Action

Purchase and install a cooling tower system to reduce water consumption in the canning and pureeing processing lines. A small cooling tower can be installed to recirculate cooling water, eliminating the current single-pass cooling practice.

Assessment Recommendation Summary				
Energy (10^6Btu)	Water Gallons	Cost Savings	Implementation Cost	Payback (years)
49	4,188,800	$5,110	$8,600	1.7

Background

Water is currently used in three areas for product or equipment cooling. The canning production line uses an immersion cooler to remove heat from cooked canned products, the Puree line uses an tube-in-tube system to cool pasteurized product and the freezer/refrigeration system uses water for cooling of the compression equipment. Since the compression equipment is not in close proximity to the production line and would require extensive plumbing work to connect to a central system, it is not being included in this recommendation.

The current cooling practice is to use city water in a single pass to achieve desired cooling of the products. For both lines, the incoming temperature of the product is 210^o F and the desired exit temperature is 100^o F. To cool the product, water with an incoming average temperature of 65^o F is used at a rate of up to 120 gallons per minute. The water exits the cooling equipment after a single pass at an average high temperature of 95^o F. With the addition of a cooling tower, the same cooling function can be achieved by recirculating the cooling water at a higher temperature, saving water use charges.

At present, the company has a permit to discharge this cooling water directly into the city's stormwater drainage system which, in turn, drains untreated into a nearby river. There is currently no direct volume charge for this disposal practice, only a regulatory fee for the permit. While this disposal practice is currently permitted, the presence of endangered or threatened salmonid species in the river may require regulatory changes by the state which will lower the allowable temperature for stormwater disposal. At that time, the company may be required to pay for disposal by diverting the discharge to the municipal sewer system. This recommendation will lessen the financial impact of such a regulatory change.

Proposed Conditions

We recommend that the cooling water be recirculated through a closed-loop, open cooling tower system, with an inlet temperature of 100°F and an exit temperature of 80 °F. At peak production, this range of cooling can be achieved with a sustained water flow rate of 96 gpm. The proposed system will be capable of handling this demand, however, most of the production time will not require this peak load.

A 5 hp circulating pump is used to move the water through the cooling tower loop at a constant flow rate (Q_p) of 96 gal/min. Operating at maximum cooling tower capacity, the required cooling can only be achieved when the wet bulb temperature (WBT) is under 69°F. From the Bin weather temperature data for the Salem area, this is on the average of 8,745 hours annually or 99.8% of the year. Due to the small water flow rate needed for cooling, the minimum-sized cooling tower available will slightly exceed the necessary cooling capacity. This excess capacity ensures adequate cooling even during the 0.2% of the year with a wet bulb temperature greater than 69°F.

To assure water quality in the loop, periodic cleaning of the tower is needed. This will require approximately three hours of labor each month or 36 hr/yr. At a burdened wage of $15/hr, cleaning will result in an additional labor cost of $540/yr. According to manufacturer estimates, only 2% of the proposed flow rate should be added as make-up water to the system due to leaks and evaporation. Thus this recommendation reduces water requirements by 90.6%.

Anticipated Savings

Savings are generated by reduced water costs (WC). Water savings (WS) are as follows

WS	=	WU - WM
	=	6,149 CCF/yr - 549 CCF/yr
	=	5,600CCF/yr

where

WU	=	Current Water Use:
	=	4,600,000 gal/yr
	=	6,149 CCF/yr
WM	=	Water Makeup
	=	Q_p x 2% x OH
	=	96 gal/min x 0.02 x 3566 hr/yr x 60 mi/hr
	=	410,800 gal/yr
	=	549 CCF/yr

Water cost savings (WCS) for reduced water consumption, based on a use fee of $0.80/ccf, is:

WCS	=	WS x Water Costs
	=	5,600 CCF/yr x $0.80/ CCF
	=	$4,480yr

There will be additional electrical demand (D) and energy (E) required to operate the cooling tower's 2 hp fan motor and the 5 hp circulating pump. Demand and Energy Use are summarized in the table below. The Operating Hours for the equipment are 3,566 hours annually.

D = Power Demand (hp) x 0.746 kW/hp x LF / Eff
= (2hp+5hp) x 0.746 kW/hp x 70% / 90%
= 4.0 kW

where,

LF = motor load factor: 70%
Eff = average motor efficiency: 90%

Annual energy requirements are:

E = D x Operating Hours
= 4.0 kW x 3,566 hr/yr
= 14,264 kWh

The demand and energy costs were taken from your current rate schedule. The annual demand cost savings (DC) and the annual energy cost savings (EC) are given below. According to your utility, the demand cost is $4.10/kW-mo and the energy cost is $0.03035/kWh.

DC = D x Demand Cost x 12 mo/yr
= 4.0 kW x $4.10/kW-mo x 12 mo/yr
= $197

EC = E x Energy Cost
= 14,264 kWh x $0.03035/kWh
= $433

The total annual operating (OC) are

OC = DC + EC
= $197 + $433
= $630

Demand and Energy Use

	Demand (kW)	Demand Cost	Energy (kWh)	Energy Cost	Total Cost
Cooling Tower	1.1	$54	3,923	$119	$173
Circulation Pump	2.9	$143	10,341	$314	$457
Total	4.0	$197	14,264	$433	$630

Annual savings (TS)will be:

$$
\begin{aligned}
TS &= WCS - OC \\
&= \$4,480 - \$630 \\
&= \$3,850
\end{aligned}
$$

The following is the Savings Summary Table.

Savings Summary			
Source	Quantity Units	Waste Gallons	Cost $
Water Consumption	4,188,800 gallons	4,188,800	$4,480
Electric Energy	14,264 kWh	0	($433)
Demand	4 kW	0	($197)
Total		4,188,800	$3,850

Implementation Costs

According to manufacturer estimates, a cooling tower package that will fill the company's needs can be purchased for $6,300. In addition to the cooling tower, a 5 hp, 100 gpm circulation pump and approximately 100 feet of PVC piping must be purchased. Costs for each are shown in the table below. We estimate that the system can be installed in three working days or 24 hours. At $50 per hour, the installation cost is $1,200.

Implementation Costs		
	Quantity	Cost
Cooling Tower	1	$6,300
Circulation Pump	1	$1,000
Piping	100 ft	$100
Installation	$1,200	
Total		$8,600

The cost savings will pay for the implementation costs in 2.2 years.

Note: In considering the proposed conditions, it was assumed that cooling the water to 80°F is adequate for the process, and that the current inlet and outlet temperatures were a result of cooling water supply and disposal constraints. It is possible to further cool the water during some fraction of the year, depending on desired operating conditions. A more detailed analysis is recommended before this measure is implemented.