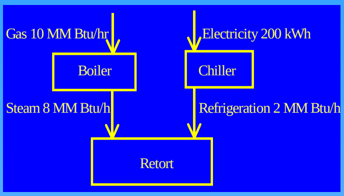
Topping Cycle for Efficient use of Energy in Food Processing Plants

Vision

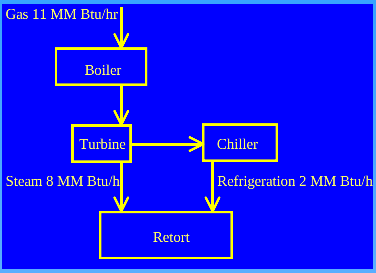
Work with a leading food processor in California to demonstrate the use of topping cycle to

- use high pressure steam to produce mechanical energy
- use low pressure exhaust steam for process heating

Provide an application tool application of this energy efficient technology in food industry at large



Conventional System



Topping Cycle System

Objectives

1) Perform an energy system assessment of a can cooker s to identify opportunities for system optimization

2) Demonstrate application of topping cycle using steam turbine driven refrigeration for process cooling and exhaust steam for process heating at a fruit and vegetable canning plant.

3) Develop a simple technology application tool to allow inexpensive duplication of topping cycle for efficient use of energy in food processing plants in California.

Methods

Thermal processing of fruits and vegetables involves heating the cans in a cooker and then cooling the cans in a cooler. Steam for heating the cans is obtained from gas fired boilers. Chilled water for cooling cans is frequently obtained from electrically driven refrigeration systems. Cooling operation is the bottleneck in the canning process due to heat rejection limitations during summer months when electricity demand is at its peak.

A comprehensive evaluation of energy saving opportunities in the thermal processing operation at Del Monte Plant in Modesto, California was conducted by an energy consultant. Integration of heating and cooling operations using topping cycle concept was selected as the optimal strategy. This involves high-pressure steam turbine driven refrigeration for cooling and low-pressure exhaust steam for heating.

Can Cooker-Cooler Unit

Results

The installation at Del Monte plant involves an Elliot Model 2BYRT steam turbine directly coupled to a Bitzer screw chiller. The plant boiler will supply steam to the chiller at 150 psi. The exhaust steam from the turbine at 60 psi is used to heat the retorts. Chiller supplies cold water at 45 ºF for cooling the retorts.

The Elliot steam turbine is rated at 86 hp at 4,000 rpm and the steam consumption is estimated at 10,000 lb/hour. The cost of the steam turbine and controls was about $30,000. The Bitzer package chiller is rated at 86 tons of refrigeration and cost $56,000 with controls.

Integrated Turbine Chiller Unit

The installation is estimated to reduce the electrical power consumption by 104 kW during the season and 46 kW during the off season. The total electrical energy saving is estimated at 540,000 kWh per year. The natural gas consumption was expected to increase by 20,000 therms due to generation of steam at a higher pressure. However, this was balanced by the replacement of a steam driven feed water pump by an electric feed pump. The net annual savings by the installation is estimated at $45,000.

Impact

Topping cycle involving high pressure steam driven chillers while using exhaust steam for heating can find applications many food processing plants in California.

The topping cycle concept is not limited to chiller operation. It has other application like air compressors and pumps. Final outcome of this project is a technology application that can be used by other food processing industries.

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