Non Implemented Case Study– Energy Conservation Measure

Measure
Mechanical vapor recompression in wort kettles of breweries
Equipment
Steam System
Industry / Sector
Brewery
Year of Implementation
-
Cost Benefit Analysis
◊ Type of Measure: High investment
◊ Annual Energy Savings: 300 kL of furnace oil
◊ Total cost savings: Rs.22.00 lakh
◊ Investment required: Rs. 50 lakh
◊ Payback: 2.4 years
Implementation Highlights
▭ Huge energy savings are achievable by implementing the measure. ▭ Well proven in abroad but no installation in India has mechanical vapor compression. ▭ Even in India this concept is proven in other sector industries such as food processing, dairies, etc. ▭ Though this measure was suggested in many of the breweries and plant management principally agreed on the concept and energy savings achievable but no industry has implemented this measure. ▭ The major causes for the non-implementation are: ☾ High investment required. ☾ No case study or success story with in the country. ☾ Many of the brewery owners wants to implement only after seeing the results else where.

Summary

Recovery of vapors during wort boiling in wort kettle by installing a mechanical vapor re-compression unit will significantly reduce steam and water consumption. This will save total cost of energy at least by 50%.

Background

Plant has three package boilers of rated capacity 2 x 4 tph and 1 x 8 tph. During the normal operation of the plant one 4 tph and 8 tph boilers are operated to meet the steam demand of brewery and distillery.

Brew House of the plant has one Wort kettle, Mash kettle, DM water tank and cooker for soft water heating. All these units use steam at pressure of 2.0 kg/cm^2 and the heating is carried out indirectly.

The wort kettle is of 340-hl capacity, in which steam is given in the jacket side to boil the wort. At present three batches of wort (i.e., 340 hl in each batch) is produced in a day. In each batch is of 2-2.5h duration, about 31.5 hl of water is evaporated and the vapour is exhausted.

The vapour and the heat in vapour can be recovered by using mechanical vapour re-compression unit (MVR unit).

MVR system came into vogue in breweries in western countries as a result of search for energy savings opportunity and improvement in quality of beer. Installation of MVR for wort boiling will result in increased production, reduction in water consumption and reduction in total energy consumption by 50%.

The vapors from the wort kettle are compressed through the compressor to increase the pressure (external steam is supplied as supplement or during start up). The steam from compressor is passed through heat exchanger in which wort is circulated. In this system the jacket heating is avoided by circulating the wort through heat exchanger. The condensate from the heat exchanger can be used in the process.

Techno-economics:

Particulars	Present system (per batch)		Proposed system (per batch)	
	Energy consumption	Cost Rs.	Energy consumption	Cost Rs.
Steam	5481kg	Rs.3458	770 kg	Rs.486
Electricity	8 kWh	Rs.38	120 kWh	Rs.570
Total	-	Rs.3496	-	1056
No of wort boiling batches	3 per day			
No of wort boiling batches	900 per year			
Total operating cost per year, Rs.	-	31.50		9.50
Total cost savings, Rs. lakh	Rs. 22.00 lakh per year			
Investment required, Rs. Lakh	Rs. 50.00 lakh			
Payback period	2.4 years			

Principle

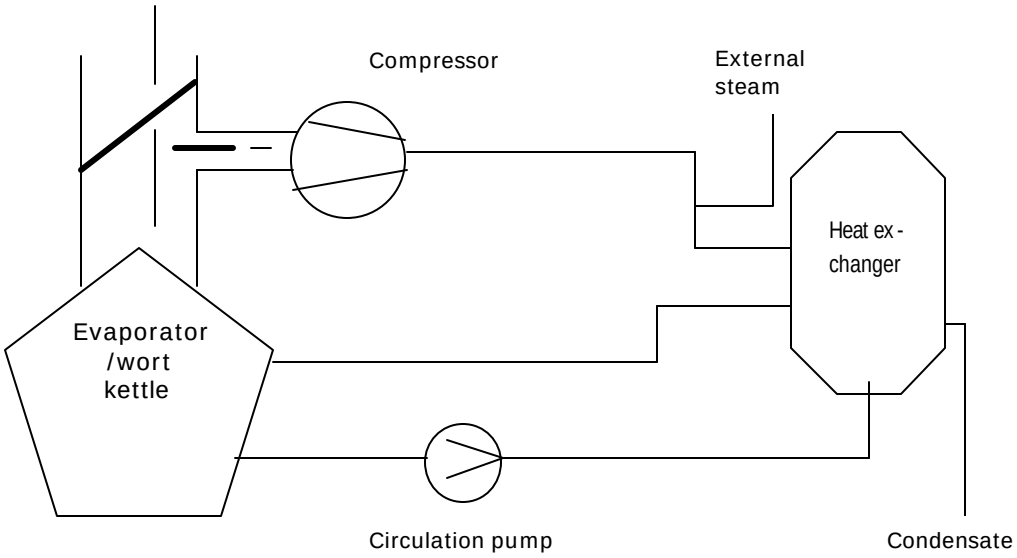
Vapor compression was described as an open heat pump process where the compressed vapor is used as a medium of heating.

The development of sufficiently sized external boilers was necessary in order to achieve low compression ratios. Vapor compression devices are widely used in many types of industries.

Most of them are built as mechanical compression units, merely every compression unit consists of a roots-compressor combined with an electric motor.

The conditions required to achieve high-energy efficiency in this process are the vapors (to be compressed) should be at atmospheric pressure and the increase in the pressure should be small.

Schematic Diagram of Mechanical Vapor Recompression:



The above figure shows the use of Mechanical Vapor Recompression unit for evaporation of water from the process liquid. The principle of operation of a MVR system is that water vapors at a lower pressure are mechanically compressed into higher-pressure steam. The above diagram illustrates water from a boiling fluid in the large vessel being captured and compressed into steam by a compressor. The steam exchanges heat with the fluid in an external calendria. The fluid is kept in circulation by a pump. The calendria can be provided with external steam during start-up operation.