LULJETA XHAGOLLI[1], *JOZEFITA MARKU*[2]

Scientific paper
UDC.620.97:662.94

Efficient use of energy and resource through conservation and recovery in breweries

Breweries are relatively large scale plants and highly energy consuming industry. Basically, beer production is divided to three processes, Brewing, Fermentation and Packaging. Brewing requires high heat consumption, particularly the wort kettle consumes one third (1/3) of steam consumption of entire plant. Fermentation with maturation process consumes large cooling energy by refrigeration system. This process consumes 60 to 70% of entire cooling capacity. Packaging process also consumes a lot of heat energy (steam). In general, steam consumption of packaging process is 70 to 80% compared to brewing process for steam consumption.

Efficient use of energy consist on conservation and recovery. Energy conservation, reduce the amount of pollution created in the production or use of energy (e.g., CO_2, NO_X, SO_2, ash, etc.). From the other hand pollution prevention measures reduce the energy requirements for waste handling and treatment, as a result a reduction in energy consumption is an important consideration in lowering the operational cost.

There are several methods of energy recovery that can be considered by breweries to reduce energy consumption; however, most are expensive and should only be considered once measures for reducing energy consumption have been made first. The recovery of vapors condensate represent a major saving in energy consumption for a brewery. Utilization of CO_2 and NH_3 energy during transformation from liquid in gaseous form, is also a well known procedure in water cooling for compressors towers.

***Keywords**: energy, conservation, recovery, synergy, heat, steam, cooling energy.*

1. INTRODUCTION

The objective of this paper is to provide information for identification of energy efficiency opportunities available for breweries. Our energy efficiency case study is compared with references to technical literature. Our findings suggest that given available technology, there are still opportunities to reduce energy consumption cost-effectively in the brewing industry. Brewing companies have and are expected to continue to spend capital on cost-effective energy conservation measures in order to meet quality, safety and economic requirements. For individual plants, further research on the economics of the measures, as well as their applicability to different brewing practices, is needed to assess implementation of selected technologies.

All this work was performed during implementation of RECP program (UNIDO project), at “Stefani & Co” brewery (Albania).

Author's address: [1]University of Tirana. Faculty of Natural Sciences. Department of Industrial Chemistry; Tirana, Albania, [2]University of Tirana. Faculty of Natural Sciences. Department of Industrial Chemistry, Tirana, Albania

Received for Publication: 06. 01. 2014.

Accepted for Publication: 14. 04. 2014.

2. GENERAL DESCRIPTION

Breweries are large energy users. The overall specific consumption of energy used in a brewery, will vary with the mix of package types, processes and equipment employed, the brewery's size, age, and the overall level of efficient energy utilization. It is very important, that every brewery strives to improve its energy consumption ratio within its limitations and means.

There are still opportunities to reduce energy consumption cost-effectively in the brewing industry. Some measures [2-6] are:

- Procedural and technical changes
- Energy audits
- Maintenance improvements
- Operational changes and/or control
- Minor capital investment
- Major capital investment
- Continual improvement through monitoring

Heat consumption is influenced by process and production characteristics such as packing method, pasteurization technique, type of equipment, by-product treatment, etc. In a brewery (without a heat recovery system from boiling wort), heat consumption can be two to three times higher than a well run brewery [5]. Heat consumption in a well run brewery is 150-200 MJ/hl. Electricity consumption, in a well run brewery, is about 8-12 kWh/hl, depending on process and production characteristics. Some breweries consume up to twice as much due to inefficient production.

3. MONITORING AND REPORTING

Monitoring of parameters listed in this document were carried out at least once per month, or more frequently. Monitoring data were analyzed and reviewed at regular intervals and compared with the operating standards. The required legislative standards are applied managed and controlled based on HACCP, Occupational Health and Safety, ISO 14001-2000 and ISO 9001. The reported average results are the “Stefani & Co” data, taken during 2006-2010 period and publicities to the responsible authorities and relevant parties, as required.

3.1. Energy production and Consumption at “Stefani & Co” Brewery

Energy input

Energy at “Stefani & Co” brewery is supplied in the form of oil, gas, steam, high temperature water and electricity.

Energy output

Energy is discharged from the brewery: to the air in the form of hot flue gas, and steam; as warm wastewater; as moisture with the trubs and the spent grain.

3.2. Options for Energy Efficiency

3.3.1. Energy Conservation

Energy conservation, reduce the amount of pollution created in the production or use of energy (e.g., CO_2, NO_X, SO_2, ash, etc.). From the other hand pollution prevention measures reduce the energy requirements for waste handling and treatment, as a result a reduction in energy consumption is an important consideration in lowering the operational cost. To reduce energy consumption we implement the following conservation strategy, based in terms of electricity, thermal energy and fuel [1].

3.3.2. Electricity conservation strategy

- use of more efficient equipment when replacing old equipment;
- use of fluorescent lights and/or lower wattage lamps;
- implementation of good housekeeping measures such as turning off equipment and lights when not in use;
- installation of timers and thermostats to control heating and cooling; and,
- preventative maintenance of operational processes and pipes to improve efficiency and minimize losses;
- installation of computerized controllers to better regulate motor output;

3.3.3. Thermal Energy conservation strategy

- perform strictly the preventative maintenance to reduce leakages and avoid steam trap bypass;
- improve or increase insulation on heating or cooling lines, pipes, valves or flanges, refrigeration systems, bottle washers and pasteurizers;
- use of more efficient equipment;
- ensure a systematic maintenance of process operations to ensure their efficiency;
- use a hot water tank of appropriate size to optimize hot water production;

Fuel conservation strategy

- reducing the consumption of fuel (e.g., oil, natural gas,) can be reduced through minor adjustments to operating processes;
- implementing the preventative maintenance program;
- implement the preventative maintenance of steam pipes which represent a significant opportunity to reduce;

3.3.4. Energy Recovery

Energy recovery consist on reuse of energy on various operational processes; thus reducing the requirements for new resources and the amount of energy being discharged as waste. Resources recovery is based on three main procedures:

1. Continuous Maintenance
2. Effective management
3. Good Housekeeping

There are several methods of energy recovery that can be considered by breweries to reduce energy consumption; however, most are expensive and should only be considered once measures for reducing energy consumption have been made first. The recovery of vapors condensate in ”Stefani & Co” brewery represent a major saving in energy consumption for a brewery The vapors condensate produced during boiling represents a significant source of energy and water consumption, odors and Volatile Organic Compounds emissions, it’s recovery helps to minimize the release of environmental pollutants such as odors and VOC emissions [3]. (the loss of 1 m^3 of vapors condensate at 85^0C is equivalent to the consumption of approximately 8.7 kg of oil). Utilization of CO_2 energy during transformation from liquid in gaseous form, is also a well known procedure in water cooling for compressors towers.

4. CLEANER PRODUCTION APPLICATION

Some of the most energy efficient techniques implemented at the brewery are:

At brewhouse:

- Vapour heat recovery
- Reduction in wort boiling time
- Insulation of process plant
- Heat recovery from wort cooling

At steam producer

- Insulation of pipes, valves and flanges
- Condensate recovery

At air compressor heat recovery

- Generation of air only when it is needed with a minimum required pressure

At refrigeration system;

- Coolant heat recovery

At packaging sector

- Optimization of equipment running and continuous maintenance
- Variation of keg washing procedure with size of kegs (30l and 50 l kegs)
- Optimizing bottle washing machine running

At electrical system

- Evaluation of motors efficiency and motor replacement where it is possible
- Use of variable speed pumps and fans
- Automatic switch off of pumps and fans

Other measures

- Automatization of fermentation-maturation-filtration process to minimize losses and to take accurate temperature values
- Insulation to process sectors (brew house, fermentation etc)

Regarding energy consumption which is equal to 4 % of the production costs of beer for 2012, we have a significant decrease from 2008. We have a slightly increase for 2012 as a result of a higher electrical energy price and the use of natural gas at the furnance which is more expensive than oil.

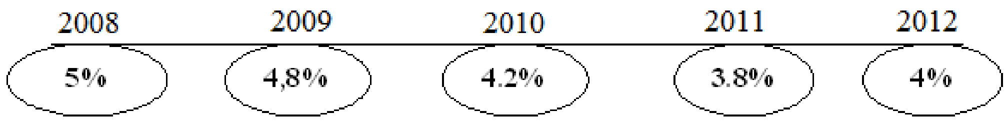

Figure 1 - Percentage of energy on beer production cost for 2008 to 2012

The vast majority of thermal energy is used in brewing operations and pasteurization, while electricity consumption is more evenly divided among fermentation, beer conditioning and space and utilities. 64% of thermal energy is used in brewing.

Table 1 - Energy in “Stefani & Co” brewery

Year	2010	2011	2012	Unit
Electricity	13	11.8	12	kWh/hl
Heat	200	190	185	MJ/hl

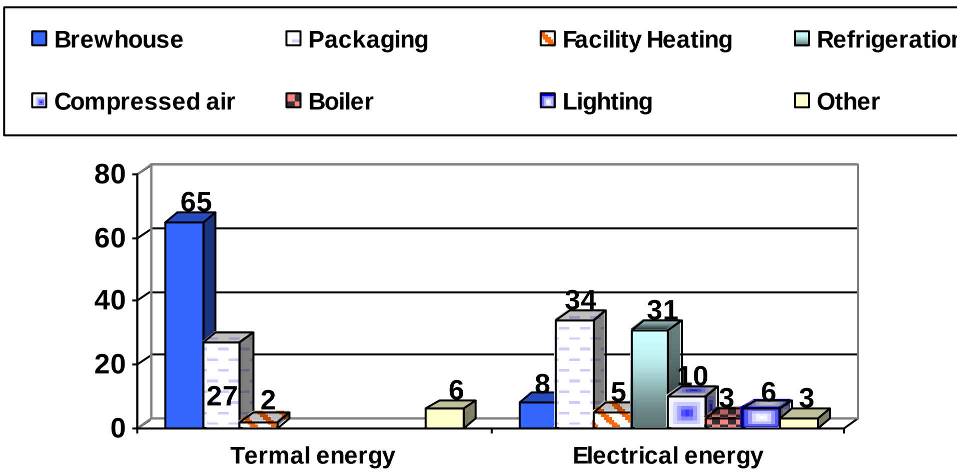

Figure 2 - *Percentage of energy contribute of various processes in the brewery for 2012.*

The specific electricity consumption for “Stefani & Co” is rather high compared with international benchmarks and could be subject to a separate assessment. Indicatively, the electricity costs for the site is 19,5 mill LEK/yr (140.000 €/yr). Compared to good performers within the sector, the specific consumption could be reduced by almost 40%.

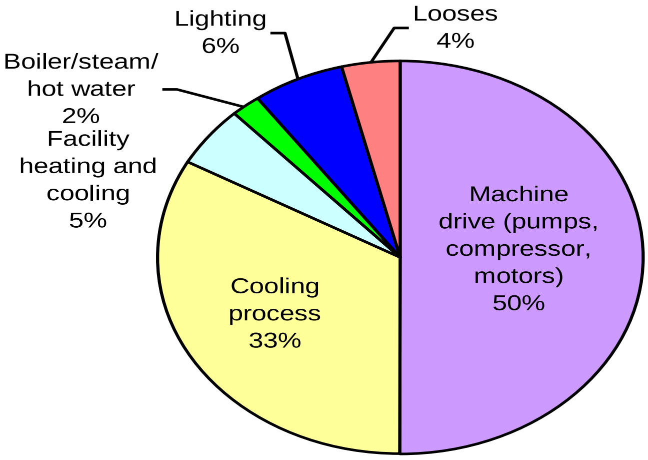

Figure 3 - Electric energy defragmentation in the brewery for 2012

4.2. Energy efficiency at the facility

4.2.1. Heat

The heat consumption at the brewery for the period 2009 – 2012 has the following figures.

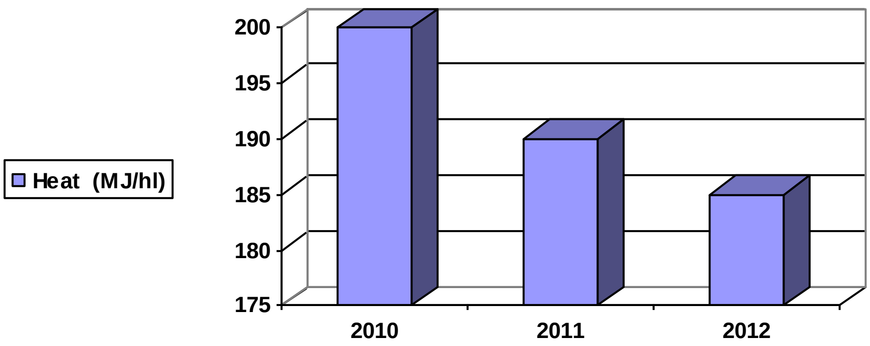

Figure 4 - Heat consumption for 2010 – 2012 period

For a well run brewery optimal figures are in the range of 100 – 200 MJ/hl. The consumption is decreased as a result of conservation techniques implemented to the brewery [7]. The most important measures undertaken in the facility consist on improving energy balance in the main heat consuming processes.

1. Minimizing evaporation rate (ER) in the wort cattle (1% of ER result in around 2 MJ/hl wort reduction). Evaporation rate is reduced also through controlling inlet and outlet extract of the wort. From 12% ER at 2007 at the brewhouse at 2010 ER was 6%. Continuous control of wort extract in the boiler enable to stop the boiling when the objective is reached.
2. Shortening boiling time with 30 minutes (from 90 min boiling time is 60 min).
3. Optimizing wort producing process through automatization and control of the process. At 2010 wort production process is fully automatizated.
4. Proper insulation and good maintenance level.
5. Applying steam condensate recovery. At the brewery the vapors are used to boil the wort. The heat in the vapor condensate is recovered by producing hot water which is used to preheat the wort. In the mashing process, waste heat can be captured from the mash or from the hot water tank [3]. This heat can be used for either mashing or for other processes. Our brewy use a hot water tank of roughly 75°C to inject the water into mashing operations. This tank has an overflow stream that can be used during pasteurization to heat the water to 60°C. If more heat is needed, steam or hot water can be blended to make water at the temperature needed. Steam at a temperature of 170°C is used to heat the mash vessel. However, hot

water of 95-98°C generated from heat recovery can be used to partially heat the mash thereby reducing steam or hot water generation requirements at the facility. The mash tun needs to be refitted with a heat transfer area to recover this waste heat. There exist several opportunities exist to recover thermal energy and use it in various brewery operations. High-grade heat maybe recovered from kettle vapors using heat exchangers. The heat from the vapor is used to pre-heat the incoming wort, while the heat from the vapor condensate is used to produce hot water for cleaning or other applications in the brewery. Steam savings resulted from shortening the wort heating time by preheating the incoming wort, reducing the steam input into the wort pan container hot water tank steam inline heater, and by reducing mixing time. Savings were estimated to be 1 % of steam consumption.

6. Flash pasteurization of beer instead of tunnel pasteurization reduce energy consumption. Flash pasteurization is used for in-line heat treatment of beer prior to filling the kegs [8]. Flash pasteurization rapidly heats the beer for a short period of time to a high temperature and then rapidly cools the product. As opposed to conventional tunnel pasteurization, flash pasteurization requires less space, steam, electricity and coolant. The optimum heat recovery is 94-96%, by plate systems Operation and maintenance cost estimates for flash pasteurization systems are 70% cheaper compered to tunnel pasteurizers.
7. As most breweries, “Stefani and Co” has a process integration system for recovery of waste heat from process, used for heating water. The site has an installed chiller capacity of 700kW (electric) applying ammonia as refrigerant. The majority of the site demand for thermal heat is below 80°C. Heat recovery from chillers could provide the site with approximately 1 000 kW of heat at 65°C which would reduce the costs for cooling water and gas correspondingly. The energy recovered could by used for CIP, keg wash, box wash and pasteurization.

Boiler is the most potential air pollution equipment. Technical characteristics of this boiler are: Fuel consumption (oil) = 50 – 60 kg/h; Inner diameter of outlet emission tube = 0,5 m; Highness of emission outlet = 7,5 m; Temperature of gases = 194^{0}C.

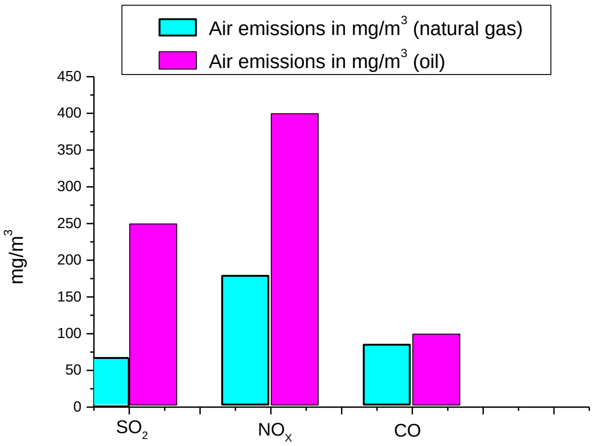

Figure 5 - Air emissions parameters at boiler outlet

For now, in Albania the most cost effective product is oil, because gas is very expensive and there is not an infrastructure for gas distribution. From the other hand there exist a lot of problems with gas quality.

In an effort to make the boiler more eco-friendly, is recommended to replace the oil steam boiler with an electric steam boiler to reduce the cost of energy [2].

4.2.2. Electricity

The electricity consumption at the brewery for the period 2010 – 2012 has the following figures:

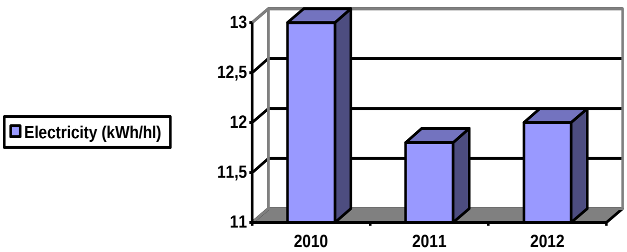

Figure 6 - Electricity consumption for 2008 – 2010 period

For a well run brewery optimal figures are in the range of 7 -12 kWh/hl. In Albania electricity is cheap compared to European’s country [7]. For this, during transition period, Albanian industries paid low attention to electric energy costs. For 2011 electric energy was 10% more expensive than 2009. Albanian industries are looking now for new options and procedures for better utilization and conservation of electric energy.

The site has a distribution of -5°C glycol system based on R22. The chillers have a capacity of 550kW electric and use a dry cooler as condenser which reduces the performance and increase the specific energy consumption. The electricity consumption of this system should be monitored with respect to Coefficient of Performance (COP) and "Stefani and Co" could consider applying a evaporative cooling tower or heat recovery system in order to improve the COP. The glycol chiller system is likely to be the largest single consumer for the site and the performance is thus important to monitor.

The NH_3 chillers (160kW) apply an evaporative cooling tower and we recommend motoring of the COP as well. If the facility has the opportunity to use direct expansion of ammonia instead of glycol, operational costs will be reduced around 18% and also running costs will be lower.

The most important measures undertaken in the facility for electric energy conservation consist on:

1. Improving efficiency of equipments through better production planning and non-stop running of equipments. Especially packaging lines and cooling plant which are the bigest consumers of the plant.
2. Optimising and better control of the processes.
3. Lowering condensing temperature or use a higher evaporating temperature in the cooling plant. The increase of evaporating temperature with 1^0C reduce the electricity consumption for cooling plant with 3 %. Decrease of 1^0C (this is a function of outside conditions) reduce the electricity consumption for the cooling plant with about 2%.

Stefani has also two lines of ADS G62 PET blow moulding machines. Both machines are supplied with 40 barG compressed air from a SIAD Tempo 610 compressor (118 kW). Many suppliers of compressors offer after sales services where recovered air at e.g. 25bar can be returned to the compressors and thus reduce the specific electricity consumption. Similarly, the PET blow mould machines could be investigated for recovery of air at 25 bar for use as pre-blow (typically 17 bar) or for supply air to the air compressor.

4.2.3. Intervention on tecnological diagram of beer production (Unitank fermentation process)

Unitank fermentation is a very important CP intervention because in the same time save:

- Energy to transfer beer from one tank to another.
- CO_2 (Before beer transfer tank is filled with CO_2)
- Energy for beer centrifugation. A typical centrifuge processing 200 Hl/h of beer require 18 kW of electrical energy. This equates to 0,32 MJ/hl. It should be noted that because of the high inertia of the rotating parts, the starting load on centrifuge is high. Furthermore, during slurry discharging an equivalent volume of beer enters the machine and must be brought to rotational speed in a short time. These two factors means that the load on the motor will exceed the running load, and the motors are designed to resist this maximum loads that is around 22.5 kW.

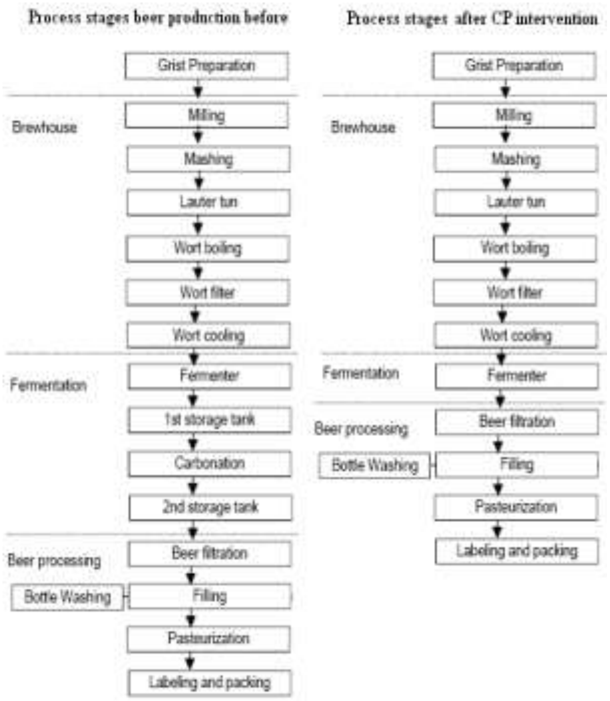

Figure 7 - Beer production diagram before and after intervention

Heat production and heat removal at beer fermentators

Energy liberated during sugar catabolism by yeast is used in the biosynthesis of cellular material and bioproducts, and is also liberated as heat. Heat is calculated from the overall equation of glycolysis [9]:

$$\text{Glucose} + 2P_i + 2ADP \Rightarrow 2\text{Ethanol} + 2CO_2 + 2ATP \quad (1)$$

Free energy of this reaction ΔG_0 is around 157 kJ/mol (Mahler & Cordes) However , this does not take in account the use of ATP generated in further reactions in the cell (2 ATP $\Rightarrow$ 2ADP + $2P_i$) which generated $2 \times 31 = 62$ kJ/mol. Thus, the overall heat production may be calculated as 219 kJ/ mol of glucose fermented (Kunze 1996).

The overall heat output in a typical fermentation (primitive extract of wort is 12^0Balling = 12.6 kg extract/ hl of wort, of which 9.5 kg is fermentable) will be 219 kJ/mol of glucose that is equivalent to 1217 kJ/kg glucose. Fermentation of 1000 hl of wort would yield:

$$1000 \times 9,5 \times 1217 = 11,5 GJ$$

This heat would not be evolved in a uniform manner, but rather reach a peak at a maximum fermentation rate. This peak may be estimated at around 0,22 kg extract/hl/h (Fricker, 1978)

$$1000 \times 0,22 \times 1217 = 0,26 \text{ GJ/Hour}$$

From the other hand the heat which must be removed to achieve cooling of the beer depends upon the temperature range. This is expressed by the equation:

$$Q = M \times C_P \times \Delta t \qquad (2)$$

Where, Q is the heat in kJ; M in kg; C_P is the specific heat in kJ/kg/^{0}C (4,05 kJ/kg/^{0}C); Δt is the temperature change of the beer. So, for cooling 1000 Hl of beer from 15^{0}C to 5^{0}C the heat removed will be:

$$1000 \times 100 \times (15 - 5) \times 4,05 = 4,05 GJ$$

For a cooling process that take place at a peak rate of 1^{0}C/hour the rate of cooling is given by:

$$1000 \times 100 \times 1 \times 4,05 = 405 \text{ MJ/h}$$

4.2.4. Beer packaging

Breweries require significant amounts of energy in the forms of heat and electricity for beer packaging. Energy intensity, or specific energy consumption, reflects the amount of energy required per unit of output or activity. The variation in intensities is partly influenced by the type of product being produced. For example, draught beer has much lower energy requirements than other types of beer since it is not tunnel pasteurized. Intensities will also vary depending on the amount of production.

Table 2 - Energy intensity for packaging lines

Packaging line	Energy Intensity	Notes
Keg	35	Low value as result of high volume of production and no tunnel pasteurization
Bottle	220	High value. Small beer volume. Tunnel pasteurization. Washing bottle machine.
Can	85	Tunnel pasteurization.
PET	150	High value due to blowing machine for PET bottles.

4.3. Comparison of energy values at the facility with reference values

In this paragraph we provide a summary of energy datas before and after CP intervention in the brewery as well as references to technical literature. Energy efficiency is an important way to reduce production costs.

Table 3 - Comparison of energy values before and after CP intervention with reference values

Parameter	Before CP intervention	After CP intervention	Optimal interval
Total energy consumption in MJ/Hl	258.6	231.2	180 - 190
Heat in MJ/Hl	210	188	100 - 150
Electricity in kWh/hl	13.5	12	7 - 12
Percentage of energy on beer production cost	4.2	4%	3 - 4%

Table 4 - Specific electric consumption in kWh/Hl beer produced before and after CP intervention compared to the reference values

Sector	Before CP	After CP	Optimal interval
Packaging	4.59	3.89	1.5 -3.5
Refrigeration	4.48	3.75	3 - 4
Compressed air	1.35	1.31	0.8 – 1.1
Brewhouse	1.08	0.95	0.5 - 1
Lighting	0.81	0.76	0.5 – 0.6
Facility heating	0.65	0.65	< 0.6
Boiler	0.40	0.39	0.4 -0.5
Utilities	0.70	0.41	0.5 – 0.6

Table 5 - Specific thermal energy consumption in MJ/Hl beer produced before and after CP intervention compared to the reference values

Sector	Before CP	After CP	Optimal interval
Brewhouse	136.5	120.0	65 - 100
Packaging	56.7	50.3	20 - 45
Facility heating	4.2	3.5	1 – 1.5
Utilities	6.6	14.2	10 - 15

We suggest that there are still opportunities to reduce energy consumption cost-effectively in the facility in different brewing practices and technologies.

5. CONCLUSIONS

A variety of opportunities exist within breweries to reduce energy consumption while maintaining or enhancing the product quality and productivity of the plant. Improving energy efficiency in a brewery should be approached in several ways.

Breweries use equipment such as motors, pumps and compressors. These require regular maintenance, proper operation and replacement with more efficient models, when necessary.

Process optimization and ensuring the most productive technology is in place are key to realizing energy savings in a plant's operation. Energy monitoring and process control systems play important role in energy management and in reducing energy use.

Average specific energy consumption, formerly well above the 210 MJ/hl started to drop from 2010 due to some CP intervention on the brewery. Inherent inefficiencies of smaller scale operations cause high specific energy use relative to output as European breweries.

Energy consumption is equal to 4% of the production costs of beer, making energy efficiency improvement an important way to reduce costs. The efficient use of energy has become a major factor in the profitability of a brewery. Furthermore, the cost of energy is predicted to increase at an even greater rate in the future in Albania.

In the Brewing Industry, 80% of the energy used is for process heating. Consequently to effect savings in this area, processing methods must be changed while still maintaining product quality. It is pointed out, that most of the electrical consumption in a brewery is used for powering refrigeration plants. The areas of action which will produce immediate results include: condensate return systems, recycling of cooling water, effective control of boiler efficiencies and the latest developments in electrical power consumption. Longer range possibilities directly affecting the process are also considered, including water and heat recovery in pasteurizers, flash pasteurization techniques, heat recovery from brewhouse and reduced wort boiling times.

6. REFERENCES

[1] ISO (International Organisation for Standartisation) (2004a). ISO 14001: 2004. Environmental Management Systems – Requirements with guidance for use. Geneva: ISO. (Accessed on 09-05-2006).

[2] Ganapathy, V. (1994). Understand Steam Generator Performance. Chemical Engineering Progress 90 (12): pp. 42-48.

[3] Hackensellner, T. (2000). Efficient energy Use in the Brewhouse, The Huppman Group, Kitzingen, Germany.

[4] Kidger, P. (2001). Personal communication on CHP and other brewery efficiency measures.

[5] Vollhals, B. (1994). Energy Saving in the Brewhouse. MBAA Tech. Quart. 31: pp. 1-4.

[6] The brewers of Europe. (2002). Guidance Note for estabilishing BAT in the Brewing Industry. October 2002. Brussels. Belgium.

[7] EC (European Commission). (2006). Integrated Pollution Prevention and Control.Reference Document on Best Available Techniques in the Food, Drink and Milk Industries. Seville: EC. http://eippcb.jrc.es/pages/FActivities.htm (accessed on 20-10-2005).

[8] European Brewery Convection. (1999). Manual of Good Practice. Beer Filtration, Stabilization and Sterilization, 156.

[9] European Brewery Convection. (2000). Manual of Good Practice. Fermentation & Maturation, 187.

IZVOD

EFIKASNO KORIŠĆENJE ENERGIJE I RESURSA KROZ OČUVANJE I OPORAVAK U PIVARAMA

Pivare su zgrade relativno velikih razmera i visoko energetski potrošači u industrija. U suštini, proizvodnja piva je podeljena na tri procesa: vrenje, fermentacija i pakovanje. Vrenje piva zahteva veliku potrošnju toplote, naročito za zagrevanje vode troši se trećina (1/3) potrošnje celog postrojenja. Fermentacija sa procesom sazrevanja troši veliku energiju za hlađenje rashladnog sistema. Ovaj proces troši 60 do 70% od celokupnog kapaciteta hlađenja. U procesu pakovanja, takođe, troši se mnogo toplotne energije (pare). U principu, potrošnja pare u procesu pakovanja je 70 do 80% u odnosu na potrošnju pare u procesu vrenja.

Efikasno korišćenje energije sastoji se u konzervaciji i oporavku. Očuvanje energije, kroz smanjenje količine zagađenja, kreiran je u proizvodnji ili korišćenju energije (npr., CO_2, NO_k, SO_2, pepela,itd).

Od drugih mera zaštite za smanjenje energetskih potreba, rukovanje i tretman otpadom igraju važan faktor u smanjivanju operativnih troškova u proizvodnji.

Postoji nekoliko metoda za dobijanje energija koje se mogu koristiti u pivarama za smanjenje potrošnje energije; međutim, većina ovih metoda za dobijanje energija su skupi i treba posmatrati samo one koji dovode do smanjenja potrošnje energije. Oporavak isparenja kondenzata predstavlja veliku uštedu u potrošnji energije za pivare. Korišćenje energije tokom transformacije CO_2 i NH_3 iz tečnosti u gasovitom obliku kompresorskim kulama je, takođe, dobro poznat postupak.

Ključne reči: *energija, konzervacija, oporavak, sinergija, toplota, para, energija za hlađenje.*

Originalni naučni rad

Primljeno za publikovanje: 06. 01. 2014.

Prihvaćeno za publikovanje: 14. 04. 2014.