Energy Audit Summary Report
CIT
Audit no. 60 – IRL04
Food Industry

Instituid Teicneolaíochta Chorcaí
Cork Institute of Technology

May 2012

Supported by INTELLIGENT ENERGY EUROPE

This energy audit has been carried out with cofunding of the European Commission (EACI) in the Framework of the EU funded project EINSTEIN-II (ProjectNo. IEE/09/702/SI2.558239)

AUDIT no. 60 – IRL04

1. Data of the auditor

1.1. Contact data of the auditor

Eileen O'Leary, Clean Technology Centre, Cork Institute of Technology, 53 Melbourne Road, Bishopstown, Cork, Ireland; eileen.oleary@ctc-cork.ie Phone: +353 21 4344864.

Chemical engineer and environmental consultant. One visit to site, half-day duration: Summer 2011.

2. Introduction

2.1. Objectives

The company wishes to investigate options to reduce energy costs.

3. Status Quo: processes, distribution, energy supply

3.1. General info on company

Small scale manufacturer of ice-cream, producing approx. 50 tpa. Peak season is June to September.

3.2. Flow sheet for the site

Flowsheet for the thermally relevant processes is as follows.

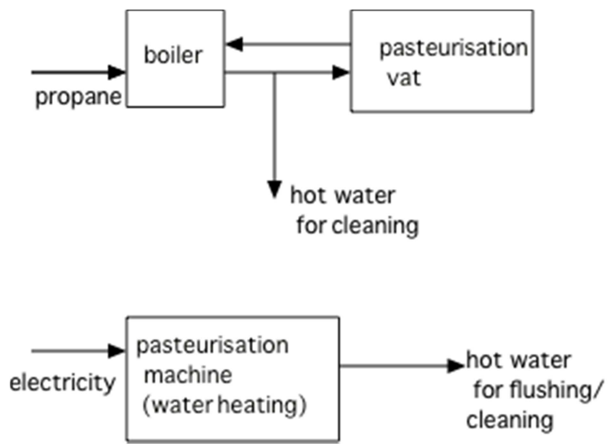

Fig: Flowsheet for the process

3.3. Description of the existing system

Main energy consuming energy processes and buildings

The main energy consuming processes at the site:

- Pasteurisation/cooking vat for sterilising and cooking the custard.
- The aging vat, which is cooled via a glycol fed plate heat exchanger (not considered further).

- Pasteurisation machine for heating water for washing the lines and vessels. Lines and equipment are flushed with 85 ^{o}C water before use and cleaned after use with 65 ^{o}C water.
- Hot water supplied by the boiler for cleaning small equipment in sinks.

Energy Supply

Hot water is supplied for the pasteurisation/cooking vat, and for some of the cleaning, by an 11 year old propane boiler. Propane is supplied in cylinders. There is some supplementary heat provided to the associated storage tank by an electric calorifier, but the amount is unknown. In addition, electrical heating of water takes place twice per day in a pasteurisation machine. This water is used for flushing and washing the lines and vessels, before and after use.

Distribution system, media and temperatures

Hot water at 85 ^{o}C from the boiler is circulated in a closed loop to the pasteurisation/cooking vat. Hot water from the boiler is also directly supplied to taps. Hot water is electrically heated in the pasteurisation machine and supplied directly to the lines and vessels.

Energy Consumption – Present State

Annual data	**Present state**	
	MWh	€
Primary energy consumption (PEC)*	97 elec: 90 gas: 7	€5,000
Primary energy consumption for thermal use (PET)*	10 elec: 3 gas: 7	€1,500
Final energy consumption (FEC)	36 elec: 30 gas: 6	€5,000
Final energy demand thermal (FET)	9 elec: 3 gas: 6	€1,300
	MWh	
Useful supply heat (USH) – boiler	5	
Useful supply heat (USH) – pasteurisation machine	3	
Heat demand (UPH) – total	9.4	

*NB: the MWh value for electricity includes energy consumed to produce the electricity at the point of generation.

The following figure shows the annual distribution of the heat demand according to the different steps of the two heat utilising processes supplied by the boiler: – cooking and cleaning. The additional water for cleaning that is heated electrically is also included.

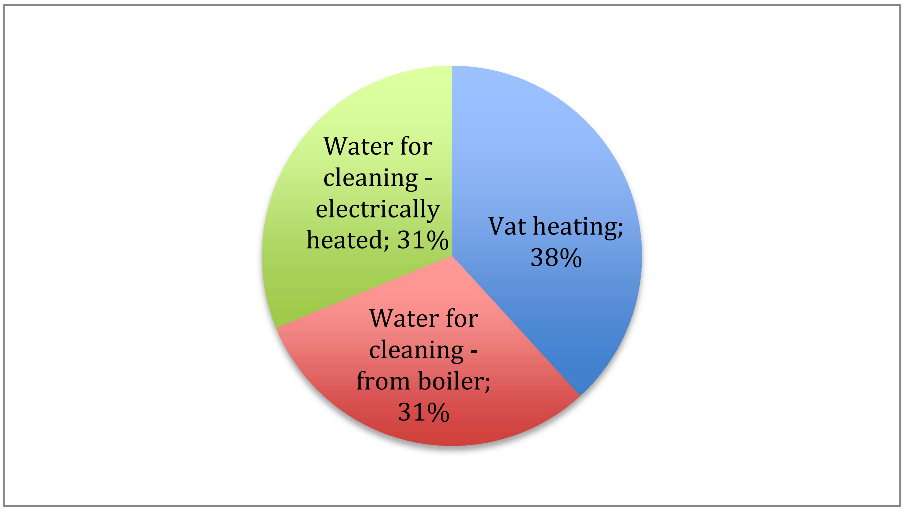

Fig: Useful heat demand (UPH) – by process

The following figure shows the cumulative annual heating demand by temperature for the processes supplied by the boiler.

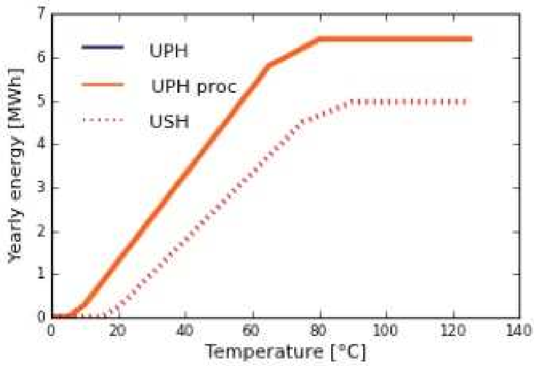

Fig: Heat demand – by temperature: processes supplied by the boiler

The following figure shows the annual heat load demand by operating hours during the year for the processes supplied by the boiler.

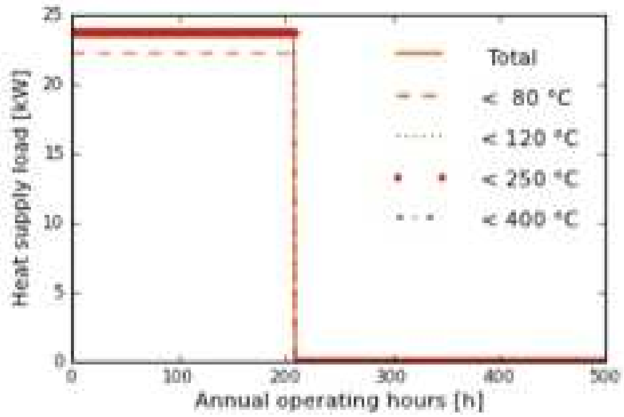

Fig: Cumulative heat demand – by time: processes supplied by the boiler

3.4. General

3.4.1 Assumptions by introduced by the auditor

A list of assumptions made by the auditor is as follows:

- The length of time taken for the pastuerisation vat to be heated to 85 ^{o}C was estimated based on information from the company on processing time and the rating of the boiler.
- Boiler efficiency assumed to be same as published values for the model in question (78%).

3.4.2 Assumptions for missing data introduced by the consistency check

There was no missing data that needed to be introduced by the consistency check:

4. Comparative study

4.1. Proposed alternatives

The following alternatives have been considered:

Option No.	Name	Description	Most relevant data of (new) equipment proposed	MWh and € saved per annum	Approx investment & payback
1	Solar thermal flat plate 10 kW	Use of a flat plate solar thermal collector to supplement water heating.	10 kW flat plate collector	1.9 MWh €270	€8,500; > 20 years
2	Condensing boiler	Replacement of existing 11 year old boiler with a condensing boiler.	25 kW boiler	1.1 MWh €170	€1,000; 6 years

3	Solar thermal evac tube 10 kW	Use of an evacuated tube solar thermal collector to supplement water heating.	10 kW evacuated tube collector	3.4 MWh €470	€8,600; 18 years
4	Solar thermal flat plate evac tube 5 kW	Use of a smaller evacuated tube solar thermal collector to supplement water heating.	5 kW evacuated tube collector	2.4 MWh €330	€3,900; 12 years
5	Solar thermal flat plate evac tube 2 kW	Use of a smaller evacuated tube solar thermal collector to supplement water heating.	2 kW evacuated tube collector	1 MWh €140	€2,000; 11 years
6	Hot water reuse	Storage of hot flushing water for reuse after processing	Insulated storage vessel min 110 litres	1.2 MWh €200	€500; 3 years

5. Selected alternative(s) and conclusions

5.1. Selected alternatives

The selected alternative is hot water reuse. This is where the electrically heated 85 ^{o}C water that is used before processing to flush the vessels and lines, is stored and used for the 65 ^{o}C cleaning after processing. Storage time is of the order of 4 to 6 hours. At the moment this 85 ^{o}C water is dumped after use, with the 65 ^{o}C water being freshly heated.

Why was this alternative selected?

There is a somewhat reasonable payback time on the hot water reuse, approx 3 years. The payback times on the solar thermal collectors are too long to consider purely on commercial terms. The payback on the boiler, while lower, is also unlikely to be considered. The possiblility of future grant application for a new boiler and/or solar collectors could be considered, when such calls for funding are made.

There is scope for the electrical heating of water to be replaced by being heated instead by the existing or new boiler. However, the site is operating using bottle propane gas, which is currently actually more expensive per kWh than electricity.

5.2. Comparative study and conclusions

		Present state	**Alternative**	**Saving**
Total primary energy consumption (1)				
- Total	[MWh]	97	93.3	3.7
- Propane	[MWh]	7	7	0
- Electricity	[MWh]	90	86.3	3.7
CO_2 emissions	[t/a]	18.2	17.5	0.7
Annual energy system cost (2)	[EUR]	€5,000	€4800	€200
Total investment costs	[EUR]	-	€500	-
Payback period (3)	[years]	-	2.8	-

(1) Including primary energy consumption for non-thermal uses

(2) Energy cost (fuel and electricity bills). Operation and maintenance costs and annuity of total investment have not been included.

(3) No grant aid or subsidies taken into account.

5.2.1. Energy and environmental analysis

The proposed hot water reuse would reduce CO_2 emissions by 0.7 tpa. This alternative will reduce electricity consumption by 1.2 MWh per year, reducing energy annual costs by 4%. This corresponds to a PEC reduction of 3.7 MWh/a.

5.2.2. Economic analysis

Installation of a storage tank for hot water reuse should be of the order of €500 or less. Payback would be 3 years or less.

5.2.3. Conclusions and outlook

As the site is a small user of energy, the paybacks for solar thermal or a new condensing boiler are too long to consider implementation. However, annual calls for grant aid applications are usually issued by the Sustainable Energy Authority of Ireland, SEAI. A successful application for such grant aid would reduce the payback times considerably and may make solar thermal or a new condensing boiler more economically viable.

5.2.3.1 Constraints under which the results can be considered valid

The results are considered valid for the following:

- Production days of 175 per year.
- Average fuel prices of €0.13/kWh for day-time electricity and €0.15/kWh for bottled propane.
- Assuming zero grant aid.

5.2.3.2 Areas where a more detailed analysis would be necessary

The following would improve the estimates:

- The schedule could be specified in more detail since peak production coincides with the maximum potential generation through solar collection during summer. This may improve payback somewhat on the solar thermal option.

5.2.3.3 Next steps with the company

The above outcomes will be presented to the company.