



Uva Wellassa University
Faculty of Animal Science & Export Agriculture
BSc in Tea Technology & Value Addition



End Semester Examination February/March 2012
Year IV Semester I

Energy Management in Tea Processing (TEA 431-3)

Instructions

Answer **all** the questions

No. of questions : **Five (05)**

No. of pages : Five (05)

Time : 03 hours

Total marks allocated: 100%

Index No:

Question 01

Tea industry is one of the biggest industries in Sri Lanka and the annual average electricity consumption in this sector is 300GWh. There are 642 factories in the country and produce tea both for domestic and export market.

A study carried out by Sri Lanka Sustainable Energy Authority reveals that the national average specific electricity consumption is 0.63 kWh/kg of made tea and there are few factories that perform in best condition and the specific electricity consumption in such factories is 0.43 kWh/kg of made tea.

An Energy Audit has been carried out in a typical tea factory in Babulla area and the data and measurements taken during the Audit are given bellow.

Month	Electricity		Firewood for	Firewood for	Production -
	kWh	kVA	Drying - m ³	withering - m ³	Made tea (kg)
January	39640	110	160.9	56	44857
February	37870	110	161.7	26	45276
March	34530	148	282.0	76	78363
April	101355	188	180.4	129	127852
May	74510	184	75.1	98	101020
June	65700	162	192.8	60	77154
July	37375	128	180.4	44	49520
August	37147	88	115.4	33	30520
September	33501	120	131.2	44	35524
October	34840	140	226.3	81	60857
November	53150	115	190.5	67	54314
December	51439	140	175.3	97	65632

Details of the furnace, fuel and the flue gas test results

Details of the furnace:

Make	-	Made by Colombo commercial company (CCC)
Type	-	3 pass fire tube
Fuel feeding	-	Batch feeding

Flue gas test results :

Time	O ₂ Percentage	Flue gas temperature - °C
10.00 am	13.2	193.8
10.15 am	13.1	198.9
10.30 am	13.1	198.7
10.45 am	16.2	169.4
11.00 am	13.3	198.1
11.15 am	12.8	188.7



Details of the fuel:

- Fuel used - Jungle fire wood at 35% moisture
- Size of the fire wood - 3 m in length and firewood are not been splattered

Details of the hot air blower and the ID fan at the furnace:

Description	Rated power - kW	Actual power - kW
Hot air blower (Main fan)	18	7.2
ID (Induced draft) fan	5	3

- I. What is the specific electricity consumption in month of January in terms of kWh/kg of made tea?
- II. The average annual specific electricity consumption of the above factory is 0.82 kWh/kg of made tea and the annual electricity consumption is 601000 kWh. Annual total production is 770800 kg of made tea. If the factory management brings down the specific electricity consumption of this factory to the national average, what is the annual electricity saving potential?
- III. The specific fire wood consumption of this factory is 1.35 kg of fire wood / kg of made tea. What would be the appropriate specific firewood consumption for drying?
- IV. Write down five recommendations with justifications that can be implemented to reduce the existing thermal energy waste in this factory.
- V. It has been recorded that the O₂ percentage in the flue gas at 10.45 am was 16.2 and the average O₂ level is in the range of 12.8 to 13.3. What would be the reason to sudden increase the O₂ level than the average?
- VI. What is the load factor of the hot air blower (main fan) at the furnace?
- VII. What is your recommendation that can be practically implemented to increase the load factor in the above blower?

Question 02

“It can be reduced the electricity consumption in withering troughs by introducing variable speed drives (VSD’s)”. Discuss the above statement.

Question 03

An energy audit has been carried out in Oodoowarre estate recently and the energy balance of the factory is given bellow.

Description	Energy consumption per day - kWh	Percentage energy consumption
Withering	269	23
Rolling	164	14
Shifting and packing	304	26
Drying	245	21
Others	187	16

The shifting and packing section contributes the highest share of energy consumption of the factory. Develop an “Energy Management Programme” for shifting and packing section.



Question 04

An inefficient motor has been changed with new efficient motor in a roller in a tea factory in Ratnapura area and the details of the project as follows.

• Efficiency of the existing motor	-	83% (Eff3 category)
• Capacity of the existing motor	-	7.5 kW
• Efficiency of the new motor	-	88% (Eff2 category)
• Load factor	-	80%
• No of Hours of operation	-	16hrs / day
• No of days operation	-	340 / year
• Investment	-	Rs. 35,000.00

- I. What would be the annual energy saving of this project?
- II. What is the annual monetary savings if the price of an electricity unit is Rs. 13.65?
- III. What is the simple payback period?
- IV. In addition to the efficiency improvement in a motor, what are the other energy management options that can be implemented in a roller room?

Question 05

About 86% of the global activities are depending on the fossil fuel. Fossil fuels are been used as a secondary energy source for many activities. Global warming is one of the issue that has been noticed due to burning of fossil fuel.

- I. What is called "Green house effect" and how does it related to "Global Warming"? Develop a comprehensive discussion paper providing details.
- II. Write down five environmental impacts happen due to "Global Warming" and justify the results with facts.