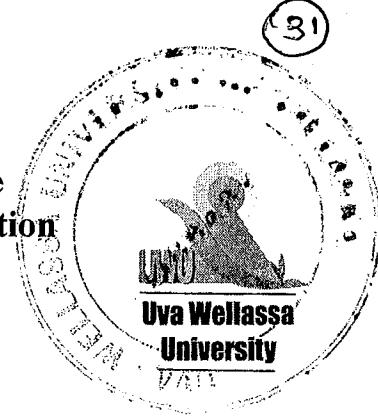


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**Uva Wellassa University**  
**Faculty of Animal Science & Export Agriculture**  
**BSc in Palm and Latex Technology and Value Addition**



**End Semester Examination March/ April 2013**  
**Year IV Semester I**

**Energy Management in Tea Processing (TEA 431-3)**

**Instructions**

Answer all questions

No. of questions : Five (05)  
No. of pages : Three (03)  
Time : Three (03) hours  
Total marks allocated : 40%

**Index No:** .....

1. Share of energy consumption in the withering process of a typical tea factory is in the range of 45% to 50%. In this contest more attention has to be paid for withering process to minimize the energy waste. A study has been carried out in a Tea factory at Ratnapura area and the following details have been observed during the survey.

Number of withering troughs in operation	-	12
Rated power of the motors	-	10 kW
Operating power of the motors	-	8 kW
Average withering time	-	16 hrs
Full speed of the motor	-	960 rpm
Operating days per month	-	25

A test has been carried out to evaluate the effectiveness of use of variable speed drives in withering fan motors and it has been noticed that it is possible to operate the motors at the following speed without effecting the withering process.

960 rpm at 6 hours  
700 rpm at 5 hours and  
500 rpm at 5 hours.

- a. What is the load factor of this motor?
- b. What is the monthly electricity consumption of a trough?
- c. What is the estimated electricity saving with introduction of variable speed drives?
- d. "The electricity consumption in withering troughs can be reduced by improving the leaves standards". Discuss the above statement.

(Note – the power of a motor is proportional to the cube of the speed. ( $P \propto n^3$ ))

2. Energy management activities were carried out with a national focus with a target of achieving a 20% reduction in the energy consumption level of 2010 by 2020. Sri Lanka Sustainable Energy Authority serves as the focal point of implementation of such activities and more emphasis is given to establish "Energy Management System" in end user sectors.
  - a. What are the governing laws available for energy management activities in Sri Lanka now?
  - b. An International standard named "ISO 50001" was introduced in 2011 with objectives of establishing continual improving framework in energy management. What are the key elements of this standard?
  - c. Describe those elements taking a tea factory as an example.
3. A tea factory is operating at maximum demand of 140 kVA with 0.8 power factor. All inclusive demand charge for this particular factory is 970 Rs./kVA.
  - a. Identify and explain 03 measures that can be introduced to reduce the maximum demand in a tea factory.
  - b. What is the maximum active power of this particular factory?
  - c. Factory management has decided to introduce a capacitor bank of 60 kVAr to this factory with the objective of reducing maximum demand. What would be the expected maximum demand reduction just after fixing the capacitor bank?
  - d. What is the simple payback period if the specific cost of the capacitor is 3500.00 Rs./kVAr.

4. Firewood is used as a source of thermal energy in most of the tea factories in Sri Lanka now. The average specific firewood consumption in tea production is 1.0 kg of firewood /kg of made tea (Firewood at 20% moisture). There are two major technologies viz. conventional air heater and hot water generator that are been used in tea sector for generation hot air for tea drying.
  - a. List down two advantages and two disadvantages with respect to the above two technologies.
  - b. What is the 3T principle of combustion? Explain this taking a wood fired boiler as an example.
  - c. Write down five energy conservation measures that can be implemented in a wood fired hot water generator.
  
5. The potential of renewable energy resources (Wind, solar, biomass etc.) in Sri Lanka is considerably high. But most of the activities are mainly depending on the imported fossil fuels in the country. The major source of electricity generation in the country is fossil fuel and the share of fossil fuel in electricity generation is in the range of 65% to 70% and it has gone up to 86% during last drought period. It has been estimated that the fossil fuel resources are continuously depleting and it will get completely depleted within next 50 to 100 years time and the cost of fuel will increase drastically in future. In this context it is very essential to have alternative solutions for tea manufacturing process.

Identify three alternative solutions instead of using fossil fuel (Either direct or indirect) in tea manufacturing process and describe them.

