
EXPERIMENT 15 ELECTRICAL LOAD ESTIMATION OF A DAIRY PLANT

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15.1 INTRODUCTION

Electricity is an essential utility required in a dairy plant for the running of electrical motors in performing various unit operations like pumping/compressing fluids, agitation of fluids, conveying materials from one place to other in mechanical and pneumatic conveyors, and other comforts provisions like fans, lights, heaters, coolers etc. Normally electrical power is supplied by state electricity board through step down transformer of 6.6 or 11 or 33 KV to 440 Volts. In some cases dairies have their own power generation through turbine or Diesel Generating sets.

The cost of electrical power makes a major part of operational cost. Its main consumption centre in dairy plant happens to be refrigeration plant where almost 35 to 45 % electrical power is consumed. Other major uses of electrical power are butter churn, homogenizer, powder plant, lighting and ceiling fan load. They do have significant load and needs careful considerations for optimizing the electrical load.

Like other utilities, the extent of electrical load varies with the process schedule. The load pattern in a dairy plant may not be uniform and vary depending upon the operations' schedule as shown in the Fig.1. Proper estimation helps in deciding capacities of cables and other distribution devices for ensure smooth plant operation. The information about the requirement of electricity is helpful in proper selection of the related equipment and would be significant in optimizing cost of utilities.

15.2 OBJECTIVES

- 1 identification of electricity consuming and generating centres /processes; and
- 1 load estimation of electricity for various processes /products & dairy plant.

15.3 EXPERIMENT

i. Principle

Electricity is generated in electricity plant and utilized in milk chilling, pasteurization, cold store and deep fridges

- a. Electricity requirement for motors = KWH
= S Rating of motor, KW operational hours

If the rating of motor is given in HP then $KW = HP \times 0.746$

Load can also be calculated by taking current reading in ampere, supply voltage in volts and power factor, then

Load = KWH = $1.73 \text{ Ampere Volts power factor running hour} / 1000$

ii. Requirements

- i) Plant Equipment: A dairy plant in operational condition having provision for generation &/or supply of electrical power.
- ii) Instrument requirement: Ampere meter, voltmeter, multi tester, energy meter and other accessories like graph paper, scale, pencil, eraser, electricity table

iii. Procedure

- i) Prepare a process diagram for each of products being manufactured in dairy and identify the various unit operations involved.
- ii) Observe the power requirement of these operations and duration of operation.
- iii) Plot these hours on X-axis for each unit operations.
- iv) Sum up electricity requirement of each operation on hourly basis.
- vi) Plot the requirement of each operations and overall dairy's requirement on Y-Axis.
- vii) The graph will show requirement of electricity on hourly basis for the whole day. Mark the average, peak and lowest consumption rate/hour.
- viii) Arrive at conclusion to optimize the generation/supply of electrical power.

iv. Observations

Observe the followings and record:

Process	Equipment	Electricity Rating	Operation Period
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1. Milk reception
 - a. Conveyor
 - b. Can washer

- c. Milk pumps
 - d. Chilling periods
 - 2. Milk pasteurization
 - a. Milk pump
 - b. Pasteurization periods
 - c. Homogenizer
 - d. Cream separator
 - e. Agitators
 - 3. Milk Product manufacturing & packing
 - a. Equipment1
 - b. Equipment2
 - c. Equipment3
 - d. Running hours
 - 4. Cold store particulars
 - a. Power rating
 - b. Running hours
 - 5. Refrigeration section
 - a. Compressor motor
 - b. Chilled water pumps motor
 - c. Condenser pump motor
 - d. Running hours of each of above
 - 6. Steam Boiler
 - a. Fuel pump motor
 - b. Water pumps motor
 - c. Electrical heater
 - d. Running hours of each of above
 - 7. Air Compressor
 - a. Air compressor motors
 - b. Running hour
 - 8. Milk packing section
 - a. Power rating of each machine
 - b. Crate conveyor power load rating
 - c. Crate washer power rating
 - d. Running hours of each machine
- v. **Results:** Requirement of electricity in the dairy is as follows:
- a. Average hourly electricity consumption in dairy:

15.4 PRECAUTIONS

1. Proper balancing of all three phases is required for best performance of power distribution/transmission system.
2. Reschedule operations if present operation pattern is presenting very high peaks during some.
3. Power factor should be more than 0.9. In case of lower power factor, provide power capacitors.