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Energy Conservation Opportunity in Dairy plant with a practice of energy audit

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Abstract:

It is vital to conserve energy for evolution, growth, and survival as it is a component of day-to-day life as well as increase in demand. India as a nation developing country and require focusing on energy. Energy conservation with proper methodology like energy audit can be proper solution. The paper focuses on the importance of energy conservation by considering the loads of a dairy plant considering the energy consumed by the present loads and recommending energy efficient technology.

Key words: Energy, Dairy

1. INTRODUCTION

1.1. Current Market Overview

Raw milk procured from milk producers' co-op. society (PMPCS) is being transferred to dairy plant through hired vehicles in aluminum/S.S MILK Cans and road milk tankers. As soon as the vehicles to dairy plant, milk cans are un-loaded on chain can conveyor. Milk cans are being conveyed towards milk weighing scale. During transfer, grading of milk is carried out. Only good milk cans will be weighed. Whereas sour milk & curdled milk & curdled milk cans will be taken away from conveyor and weighed separately.

Good milk is weighed on an electronic weight scale & a composite sample of each type of milk i.e. cow as well as buffalo, of each society is drawn. These samples are tested on line in Q.C. Laboratory on code number basis Weighment, sampling & testing are performed automatically through computer network with SAP Application. After weighing of raw milk, it is instantly chilled & stored in raw chilled milk storage tanks. From there, it goes to milk processing section. Milk received through road milk tankers are unloaded after its unloaded after its analysis and transferred to raw milk storage silos.

1.2 Technical Features of Dairy Plant

In milk processing section raw chilled milk is being pasteurized in milk pasteurizer during pasteurization.

Milk is also standardized to required fat & SNF content according to market demand and then stored in milk silos. After quality check at silo level fat, SNF & bacteriological quality, pasteurized milk from silos is being transferred to milk packaging section.

Here, pasteurized standard milk is being packed in polythene pouches on form-fill-seal machine. Pouches such packed are being kept in crates and these crates are stored in cold storage having temp. +4°c till being marketed.

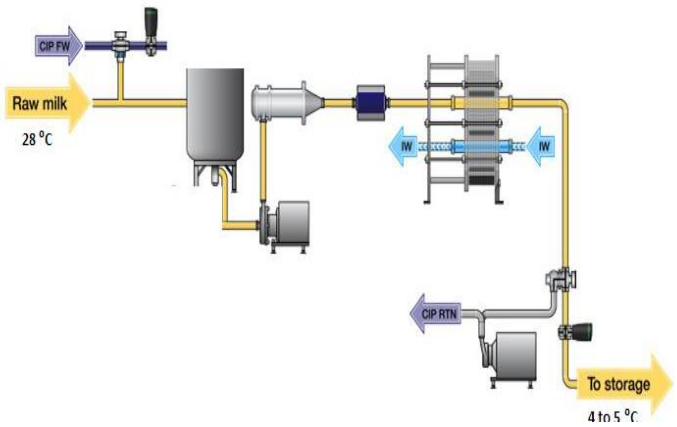


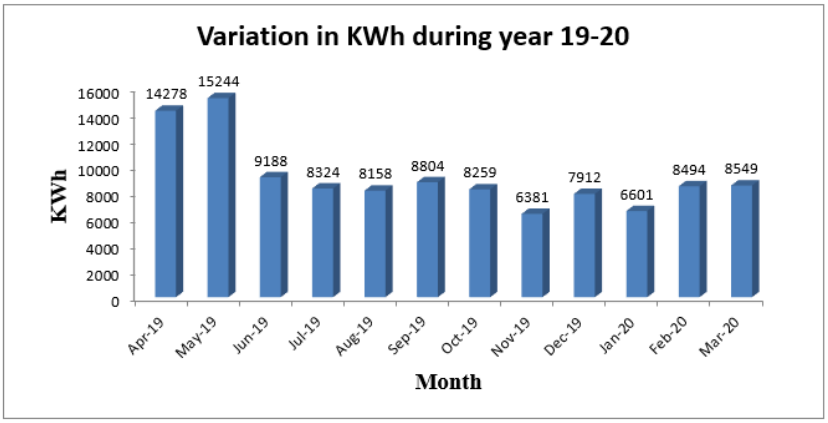
Figure 1 : pasteurized standard milk Process

2. ELECTRICITY BILL ANALYSIS

Month	Kwh	Elect. Bill	Rs./KWH
Apr-19	14278	125860	8.81
May-19	15244	133634	8.77
Jun-19	9188	84135	9.16
Jul-19	8324	76310	9.17
Aug-19	8158	76737	9.41
Sep-19	8804	81890	9.30
Oct-19	8259	78296	9.48
Nov-19	6381	61593	9.65
Dec-19	7912	74080	9.36
Jan-20	6601	62972	9.54
Feb-20	8494	78476	9.24
Mar-20	8549	79335	9.28
Average/Sum	9183	84443	9.26

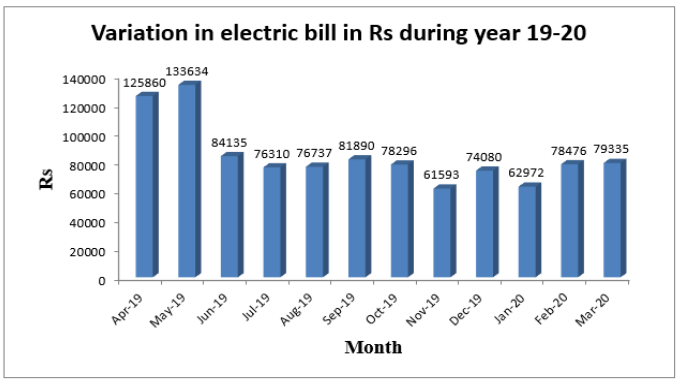
Table 1: Electric Bill Analysis

- **kWh Consumption**



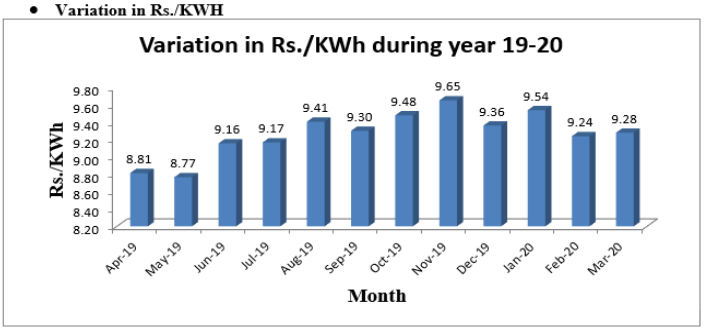
From the above graph it is observed that maximum kWh consumption is observed in month May.-2019 (15244 kWh) and minimum kWh consumption is observed in Nov-2019 (6381 kWh).

- **Electricity bill in Rs.**



From the above graph it is observed that maximum bill is observed in month May.-2019 (133634 Rs) and minimum bill is observed in Nov-2019 (61593 Rs).

- **Variation in Rs./KWH**



From the above graph it is observed that maximum Rs./KWh is observed in month Nov.-2019 (9.65) and minimum Rs./ kWh consumption is observed in May-2019 (8.77).

3. LIGHTING LOAD ANALYSIS

Sr. No.	Details	Volts	Amp.	P.F.	kW	Total
01	Main Lighting	238	3.1	0.72	0.54	2.33
		240	6.2	0.89	1.34	
		240	2.9	0.65	0.45	
	Average/Sum	239	4.06		2.33	2.33

4. ENERGY CONSERVATION THROUGH INSTALLATION OF ECO VENTILATOR IN PLACE OF ELECTRIC EXHAUST FANS

4.1 Energy Saving by Installing Scroll Compressor

The chilling center has 4 Bulk milk Coolers. Each Bulk Milk Cooler is of 5000 Ltr capacity and is supported by 2 compressors. There are total 8 number of compressors. There are 4 reciprocating compressors and 4 scroll rotary compressor. The total time required to run the chilling center is based on two shifts. First one is morning time from 8 to 12 am and another one is evening time from 8 to 12 pm. So, in this way the total working time is 8 hours. All the compressors are located on the terrace. Some of the compressors have bad insulation and are keeping in not so good situation. Some of the condenser fins are also not in so good condition as well which can have effect on its efficiency.

Total six compressors tabulated were in operation during the Energy Audit.

Power consumption of 4 BMC Compressor considered per year = 50,000 kWh

Considering power saving 30 % after installing Scroll Compressor

Power saving of 4 BMC Compressor = 15,000 kWh

Amount that can be saved @ Rs. 8/kWh= Rs. 1,20,000

Approximate Investment = Rs. 2,40,000

· Simple Payback = 24 Months

Hence, it is recommended to replace existing reciprocating compressors with scroll compressors.

4.2 Energy Saving Through Insulation of Compressor pipe

Consider Power Lossdue weak insulation

(0.2% x 84,443 kWh per month) = 169 kWh

· Amount that can be saved @ Rs. 8/kWh per year = Rs. 16,224

Approximate Investment = Rs. 1000

Simple Payback = 1 Month

4.3 By doing Reduction of lighting Voltage to 230 volts by Shifting the Lighting Load to existing Voltage Stabilizer

For lighting 230 volts is the ideal supply and this reduces the power consumption by the lamp. It ultimately improves the life of lamps and reduces the replacement cost. The detailed power saving calculation is given below.

Recent Power Consumption (at avg. 239V) = 2.33 kW

Power Consumption for lighting load keeping voltage 230 V = 2.21 kW

Net Saving in lighting load = 0.12 kW

Units Saved per Year = 345.6 kWh

Considering 8 hrs/day and 360 days per Year operation

Amount saved per year @ Rs. 8/kWh = Rs. 2764.80

4.4 Installation of Solar Power Plant

Proposed 20kW with consideration of minimum contract demand 40 kW with On-Grid Solar System with Technical Information:

Particulars	**Description**
Solar Power Plant	20 kW
Solar Panel in Watt	335 watt
Solar Panel Qty	60 nos.
On-Grid Solar Inverter	20 kW
MC4 Connector	12 Pair
Solar Structure	20 KW

Space required	120 sq meter
Solar Accessories	Fasteners, Cable Tie , Crimping Tool, Earthing Kit, Lighting Arrestor
Price	Rs 9,40,000 (Approximate price including installation)
Saving calculation : 100 unit per day x 8 Rs/ per unit x 365 days	RS. 2,92,000
Simple Payback	3.2 year

5. GENERAL OBSERVATION AND RECOMMENDATION

1. Need to provide pressure gauge to check compression ratio for the regular performance of refrigeration system.
2. Need to replace reciprocating compressor with scroll compressor with a view of Energy saving, Durability and quiet operation.
3. Keep the evaporator surface and condenser tubes clean to avoid fouling problem. It could result from algae growth, sedimentation, scale formation or slime. As this problem increases head pressure, it can lead to increased energy use by the compressor.
4. Clean dirty air passages for Motor Cooling Most times when efficiency drops in this device; it is because of a cooling problem.
5. It is observed that compressor's discharge line temperature is higher. The system may start to fail from worn rings, acid formations, and oil breakdown.
6. A reduction in the delivery pressure by 1 bar in a compressor would reduce the power consumption by 6 – 10 %.

6. Conclusion:

The existing system, existing devices replaced with energy efficient devices. It can be seen that considering all the energy saving opportunities, there will be a huge amount of saving in electricity i.e. 51,978 kWh leads to 4.16 Lakhs of savings in a year. It requires the total investment of 11.80 lakhs with attractive payback of more than 3 years. These are very few basic steps that anyone can follow and conserve energy and thus reduce the bill amount and also contribute to fight against pollution, global warming and promise a better world to live.

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