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Minimization of Energy Consumption in Jabalpur Dugdh Sangh by Optimization Approach

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ABSTRACT

To fulfil this objective we are auditing Jabalpur Dugdh Sangh (JDS), a Dairy plant, under Co-operative union of M.P. State Co-operative Dairy Federation Ltd. (MPCDF), Bhopal; located at Imliya Jabalpur is engaged in production of various milk products such as liquid Milk, Shree-Khand, Ghee and Lassi in brand name of 'SANCHI' with presents capacity of 22,000 liters per day. The plant - installed capacity is 1 Lakh litres per day. Electricity and Coal are the major input sources to the plant. Electricity is mainly used for operating various electrical machines such as Air Compressors, Vapour Compressor, Pumps, Fans, etc and Coal is used for Energy input in 2 Nos. of Horizontal Boilers. Refrigeration section consumed major share of electrical Energy and connected load of plant is about 230 HP i.e. 50% of the total load. Major emphasis of this thesis is to reduce the energy consumption by energy auditing and utilize the waste heat of the process which otherwise goes to the atmosphere and to control the pollution depending upon regulatory context. By help of energy audit technique a most economical method is suggested for the lowest possible investment and energy expenditure and minimum performance variation.

Keywords: *Problems, Challenges, Pasteurization Process, Heat exchanger, Energy Optimization, Energy audit.*

INTRODUCTION

Electricity and Coal are the major input sources to the plant. Electricity is mainly used for operating various electrical machines such as Air Compressors, Vapour Compressor, Pumps, Fans, etc and Coal is used for Energy input in 2 Nos. of Horizontal Boilers. Refrigeration section consumed major share of electrical Energy and connected load of plant is about 230 HP i.e. 50% of the total load. Energy audit of Jabalpur Dugdh Sangh (JDS) with an objective to estimate the energy consumption level for different equipment and to suggest suitable cost effective measures to reduce electricity as well as coal bill. Jabalpur Dugdh Sangh (JDS) is the first dairy department of Madhya Pradesh taking initiate such type of energy audit in their unit. The Plant is presently operating in under utilization due to that specific energy consumption has been increased. Therefore, Energy audit helps the management of JDS to assess the energy loss occurring due to underutilization of plant and to implement suitable energy conservation measures to recover the energy loss. In this regard, an energy audit

conduct for feasibility of operating the plant at the present operating condition to suggest suitable cost effective energy savings measures to reduce electricity and coal bill of plant. A Preliminary Energy Survey was initially conducted on month of March 15 The thrust areas of energy conservation identified during the Audit are:-

- A Refrigeration System
- Coal fired Boilers
- Air Compressors

All these areas are critically analyzed to recommend suitable Energy saving measures for reducing Energy & Coal bill of plant and are discussed in subsequent chapters.

II. ABOUT JABALPUR DUGDH SANG

- Located at village Imliya, Jabalpur.
- Engaged in production of Milk, Ghee, Shreekhand & Lassi of "SANCHI" brand.
- Major processes involved in production are Chilling, Pasteurization, Homogenizing, Ghee making and storage.
- The plant operates in single and two shift basis depending on the demand.
- Presently average milk processed per day is about 22,000 litre.
- The present contracted Maximum demand with MPSEB is 200 KVA, whereas the actual maximum demand is about 183 KVA.
- The connected Electrical load of plant is 760 HP.
- Average Power factor is maintained between 0.92 to 0.95.
- The average electricity bill is Rs.40 Lakhs per annum whereas fuel bill is 15 Lakhs amounting to total bill of

Rs.55 Lakhs per annum.

- Thrust areas of Energy & Coal consumption are refrigeration system, Boilers, Air compressor.

III. LITERATURE REVIEW

The competition and quality aspect limited the profitability of the milk dairy plant. The milk dairy processes are fast growing business but high energy cost is a serious problem. In the current scenario to understand the problems related to high energy consumption of the milk processing and to suggest methods for their active reduction with the help of different approaches needed proper management of the all processes used in the plant. Major emphasis of the paper is to utilize the waste heat of the process which otherwise goes to the atmosphere and to control the pollution depending upon regulatory context. The major considerations are the product type and resource cost. By help of energy audit technique a most economical method is suggested for preservation of milk, with the lowest possible investment and energy expenditure and minimum performance variation. World energy consumption is increasing day-by-day and it indicates the nation growth pattern also. The Dairy industry is going to grow in the future and has bright prospects; hence this is an industry which has a huge scope [2]. It's requires process heating, refrigeration cooling and electricity loads. The different type of wastes are developed in milk process of dairy plant such as water waste, steam waste, electrical energy waste etc [21]. The different methods can be used for energy saving in milk dairy plant [18]. The bigger problem in milk plant in pasteurization process high energy cost, as it consumes high electrical energy for complete process [13]. Milk Pasteurized process is an essential process for dairy plant that contributes a large amount of energy mainly consisting of electricity and

other fuels [16]. Losses of energy in pasteurization process are more in compare to other processes. The optimization of pasteurization process is also essential to reduce the milk processes performance variations and associated other losses like quality and preservation cost [17]. The Pasteurized Milk is now an essential process and its optimization by energy audit approach to minimize energy consumption will open a new way of loss reduction. The improvements in pasteurization process by achieving better efficiency and associated product quality developed a confidence in milk dairy industry. The competition and quality aspect limited the profitability of the milk dairy plant. The milk dairy processes are fast growing business but high energy cost is a serious problem. In the current scenario to understand the problems related to high energy consumption of the milk processing and to suggest methods for their active reduction with the help of different approaches needed proper management of the all processes used in the plant. Major emphasis of the paper is to utilize the waste heat of the process which otherwise goes to the atmosphere and to control the pollution depending upon regulatory context. The major considerations are the product type and resource cost. By help of energy audit technique a most economical method is suggested for preservation of milk, with the lowest possible investment and energy expenditure and minimum performance variation.

IV. ENERGY AUDIT OBJECTIVE AND METHODOLOGY

Energy Audit is a systematic search and conservation opportunities as well as systematic approach to measure energy consumption level of the equipments / plant in a limited time frame by a team of energy experts.

Objectives

The major objectives of conducting Energy Audit at Jabalpur Dugdh Sangh (JDS) are

- Reduce electricity bill of the company up to 5 to 8%.
- Reduce Coal bill up to 10%.
- Reduce Specific Energy consumption.
- Adopt modern practices/technologies for improving energy efficiency.
- Increase the profitability of the company.

Methodology

Methodology There is no tailor made proposed methodology, as the energy audit role changes with the organization type [10]. The aim of representing the methodology for milk dairy plant is to control the wastage and losses of the complete manufacturing cycle. The first step of methodology is the identification of main work center or functions of the dairy plant. The different types of energy used and equipment are listed for detail energy audit. The energy audit is conducted on selected function's selected equipment only [12]. The data of energy consumption and energy related data are collected [13]. An audit team consisting of qualified and experienced electrical and mechanical engineers. However, it may be mentioned that each team was accompanied by an expert. The energy audit identifies the dairy plant areas where wastage of any type of energy found. To developed improved model of manufacturing system the audit approach determined the critical areas and energy wastage and the advanced manufacturing techniques improved them [3].

A. Preliminary Energy Survey

- (i) Searching for energy savings possibilities by visual inspection.
- (ii) Identifying leakage in compressed air line and Visual inspection of the insulation provided.
- (iii) Understanding the process of different sections of the plant.
- (iv) Inspecting illumination level of working areas.
- (v) Identify status of energy meters installed at the individual sections and main substation.

B. Data Collection

- (i) Month wise energy consumption & Maximum Demand data was collected from MPSEB energy bill for last 3 years (2012-13), (2013-14), and (2014-15) up to March 2015 to review the energy consumption level of JDS.
- (ii) Data was also collected from individual sections /substation to understand the present process & energy scenario at the workshop.
- (iii) Designed data are also collected for individual equipment & process.

C. Measurement of Operating Parameters

Measurements were taken for individual motors of pumps, homogenizers, Compressors with the instruments available with me & available instruments at JDS to measure various electrical parameters such as V, I, KW, KVA, power factor. Temperature measurements were done at boiler, Pasteurizer, condenser, ice bank tank to check the actual operating parameter in the present working conditions.

Following instruments were used for measurements during field's studies of energy Audit:-

Opt fuel – fuel gas analyzer

Temperature and CO%, O₂ of Flue Gas of Boilers.

Digital temperature indicator

For measuring the temperature of the boilers, pasteurizer, chillers, condenser, air, & vapour Compressor

Digital anemometer

For measuring speed of air flow in fan.

ph & TDS meter

For analysis of feed water and blow down water for coal fired boilers

Hygrometer

For measuring relative humidity and temperature during study of refrigeration system.

Load manager – KRYKARD ALM-3

For complete electrical Energy management (V, I, kW, kVA, kVAR, P.F., etc.) during the study of transformer, electrical motors, distribution system.

Clamp on multimeter

For measurement of V, I, kW, KVA, P.F. etc.

LUX meter

For measuring the illumination level.

Digital tachometer

For measuring speed of shafts, motors.

D. Data Analysis

- Data analysis done after the field visit includes:
- Findings the energy saving options.
- Analysis & review of past energy consumption data recorded from MPEB bills.
- Analysis of the measured data taken on line from individual equipment like pumps, boilers, Vapor compressor, Air compressor etc.
- Quantification of energy efficiency & associated losses in the equipment.
- Techno-Economic benefits calculations for the cost effective recommendations.
- Analysis of the Coal samples.
- Proximate & Ultimate analysis and determination of GCV.
- Analysis of Coal sizing and firing methods for effective combustion.
- Analysis to provide recommendation to reduce coal wastages at various stages i.e. Coal storage, handling & firing.

Draft Report Submission

Data thus collected from site (both designed & measured) are taken for subsequent analysis and a draft report was submitted in November 2015 containing measured & designed data of electrical and thermal equipment along with recommendations for reducing energy consumptions.

V. RESULT & DISCUSSION

Energy Management and Implementation plan are provided in this Chapter for effective energy management & smoother implementation in Jabalpur Dugdh Sangh for energy saving measures provided for different areas /equipment discussed in this report.

Energy Management Plan

Energy Management plan is an action plan for energy conservations, energy monitoring, target setting and reviewing the action taken on plan for carrying out above areas of work . It is suggested to form a in – house Energy Conservation Cell by deputing the following offices in the plant as below:-

In –House Energy Conservation Cell

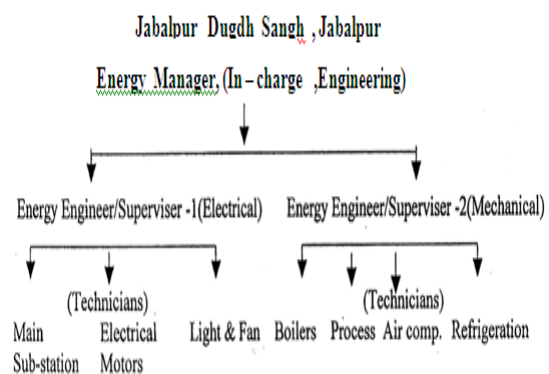


Figure 1: Energy Manager (In-charge, Engineering)

The proposed Energy Conservation Cell is to be constituted by deploying In-Charge (Engineering) as Energy Manager, two Sr. Engineers/ Supervisors as Energy Engineer and Electrician /Technicians as Energy Technician for different sections/areas shown in the above chart. Apart from their routine job, the Energy Manager should prepare action plan and fix up targets/norms for Energy consumptions and implement slowly the Energy saving measures with low/zero capital investment . The Energy Manager should report daily/monthly to **General Manager of plant** regarding the **status of** Energy consumption at different section/equipment, Specific Energy consumption of plant, target of annual energy consumption and should be responsible for implementing the Energy conservation measured in plant. Though the members of team has the specified responsibilities to act along with their

routine job, the role of Energy Manager is very much important.

The Role of Energy Manager

Report to the General Manager of plant

- Provided the top management with accurate, complete and up to the day information about electrical /thermal energy consumption in the plant.
- Get day to day production / job report from different sections.
- Get the Energy consumption report from Energy engineers on daily / monthly basis from different sections.
- Get status report of Energy meters installed at different sections.
- Analysis the Energy consumptions Vs Production & estimate specific energy consumption figures.
- Set Target / Norms of Energy Consumption / unit production output.
- Display posters/ Board of Energy consumptions at different working for awareness of employees and organize energy conservation awareness programme.
- *Sample for display board for awareness in plant*
- Unit saved is Unit Generated
- Save energy for better Profitability
- Stop leakages of Hot Water, Air & Steam

Examine under utilization and over loading of equipment.

Estimate ‘Optimization Potential ‘on different locations to enable the management to focus on its Energies on areas having maximum potential for saving.

Workout strategies to realize energy savings based on Energy Audit Report & provide new ideas to Energy Engineers action for implementation.

The Role of Energy Engineers /Supervisors
Energy Engineers /Supervisors will report directly to the Energy Manager.

Get day to day Energy Meter reading of different sections, production data from Energy Technicians and prepare daily report on Energy consumption. Calculate specific energy consumption figures and submit to the Energy Manager.

Supervise directly implementation of Energy conservation measures, implement action taken on report.

Prepare status report of Energy meters, Equipment, Instruments.

Prepare load report of different equipment.

The Role of Energy Technician

- Collect daily Energy meter readings from site and submit it to the concerned Energy Engineers.
- Execute the implementation of Energy savings options in the workshop.
- Inspect under loading/overloading/ idling or equipments and submit the load report to Energy Engineers.
- Examine status of Energy meters, Instruments and Equipments and submit status report to the Energy Engineers.
- Identify leakages, Energy loss at equipments and immediately report to Energy Engineers to take action.