

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****REVIEW PAPER ON PERFORMANCE ENHANCEMENT OF DAIRY INDUSTRY BY
ENERGY CONSERVATION ANALYSIS****Mr. Jadhav V. V*, Mr. Chougule G. A, Prof. Yadav R. H**

ME Heat Power Engineering Student. J. J. M. C. O. E. Jaysingpur Maharashtra, India.

ME Heat Power Engineering Student. J. J. M. C. O. E. Jaysingpur Maharashtra, India.

Professor, J. J. M. C. O. E. Jaysingpur Maharashtra, India.

ABSTRACT

Energy is critical component of dairy industry. Dairy industry depends on fossil fuels for energy supply. It is known fact that our fossil fuel reserves are finite and we should utilize these resources judiciously. Energy conservation is only route that can get better mileage out of the available resources. The need is to evolve an appropriate strategy for energy conservation to achieve economical and environmental benefits. Energy conservation in dairies is not the suppression of demand for energy use, but efficient use of energy and steep rejection of energy wastage. Energy Conservation in dairy plant means to develop a methodology to achieve energy saving to reduce energy costs in processing system. Energy is one of the fourth pillars for production of dairy products in addition to land, labour and capital. In dairy industry, processing of milk and milk products require considerable amount of energy in the forms of the heat and electricity. A major amount of electrical energy is used for running auxiliary equipments while heat energy is used for heat treatments of milk and milk products in the plant. The cost related to this energy consumption is entitled as overhead cost. One often overlooked, but major overhead is energy costs. Dairy producers are looking the ways to reduce these overheads. Energy Conservation will help to reduce the energy costs which will reduce the processing costs. It leads to develop capable processing system with optimum energy consumption in dairies which will result into the performance enhancement of dairy plant.

KEYWORDS— Energy Conservation, Dairy Industry, Milk Processing.

INTRODUCTION

Dairy industry is included in one of the major food industries in India. The Indian dairy sector contributes a large share of the agricultural gross domestic product (GDP). The Indian dairy industry is poised for dramatic growth in the coming decades. The population growth, urbanization, income growth, and changes in food habits that fuelled the increase in milk consumption and are expected to continue in coming years. Hence milk dairy plants have better prospects available for enhancing performance and productivity. Energy conservation will play major role in this. Energy is an indispensable component of industrial product, employment, economic growth, environment and comfort. The gap between supply and demand of energy can be bridged with the help of energy conservation. The energy conservation is cost effective approach with a short payback period and modest investment. There is a good scope of energy conservation in dairy industry as it is one of the fastest growing industries.

The dairy sector covers activities related to the treatment of milk for alimentary use and milk derived products and by-products. The primary function of dairy plant is to process the milk with the objective of extending its saleable life. This objective is typically achieved by heat treatment to ensure that milk is safe for human consumption and has an extended life maintaining quality. This primary function is supported by preparing a variety of dairy products in a semi-dehydrated or dehydrated form which can be stored. This requires significant amount of energy. The sources of energy in dairy processing plants are generally electricity and thermal energy from fossil fuels including coal, oil, natural gas and LPG. This energy need to be consumed efficiently. Dairy industries use energy for heating and

pasteurization, cooling and refrigeration, air conditioning, pumping, and operating auxiliary equipments. Dairies producing other milk products along with packaged milk require additional energy for churning, pressing, separation, concentration, evaporation and drying. The typical process layout of dairy plant represented below in figure 1.

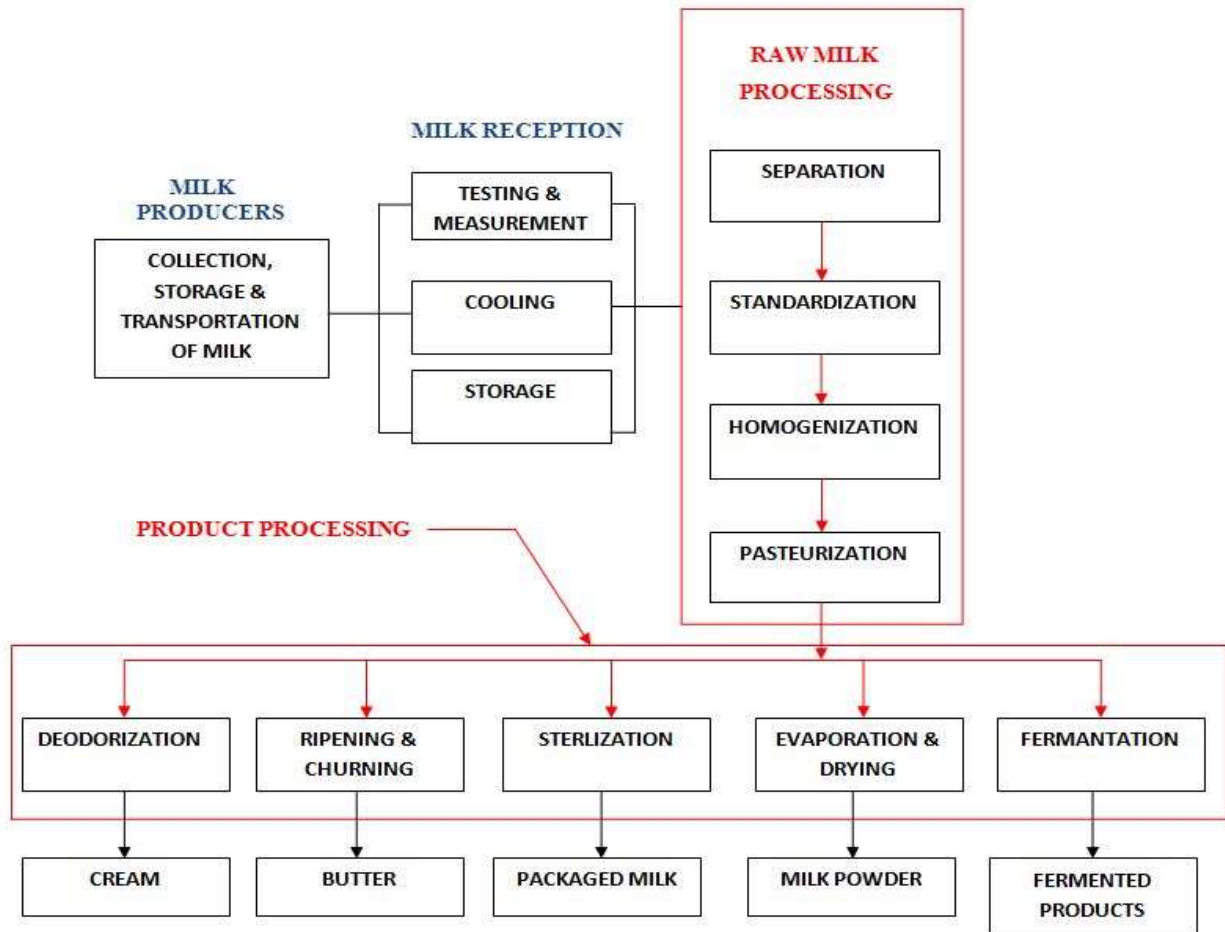


FIGURE: 1

LITERATURE REVIEW

Various researchers have worked on energy conservation analysis and management practices in dairy industries. These studies are motivated by the fact that energy conservation and efficiency improvement in the dairy industries requires special attention since the sector has been suffering from a chronic energy supply shortage, lack of capital investment for new capacity addition and modification; also environmental problems.

T.Hima Bindu, et al.^[1], has done SWOT analysis of Dairy Industry. Authors have mentioned about various initiatives taken by Government of India for development of Dairy Industry like NDDB. Availability of raw milk, technically skilled labours, technological infrastructure, large number of dairy plants, large number of farmers and very large number of animals these are the strengths of the Indian Dairy Industry. Majority of producers are unaware about scientific dairy farming, clean milk production, Absence of comprehensive and reliable milk production data; these can be listed as weaknesses. While dairy industry has great investment opportunities for standardization and upgrading dairy products in the main metropolitan cities. Low productivity of animals and elastic demand of dairy products are the main threats to Dairy industry.

Modi A., Prajapat R. ^[2], have done a case study in Indore Dudh Sangh, Indore. Authors have performed detailed energy audit of pasteurization process to find out sources of energy losses and wastages and emphasized on finding energy saving opportunities in pasteurization process of dairy plant. They have suggested improvised design for pasteurization process with the help of plate type heat exchanger. This has helped the organization to bring down energy consumption from 50818kw to 41319.52kw per day (almost by 18.69%) and cost from Rs. 0.556/litre to Rs. 0.456/litre. Authors also have calculated the payback period of 3 months for new design.

Mr. Umashankar Prasad, Mr. Satyashree Ghodke ^[3], have discussed the problems related to high energy consumption in the milk processing plant and suggested alternative for their active reduction with different approaches to Energy Management applied to a milk processing plant. According to them, this can be achieved by focusing on utilization of the outgoing waste process heat and atmospheric heat depending upon regulatory context, product type and resource cost. Authors have suggested new set-up which has helped to reduce energy cost per liter to Rs. 0.494 from Rs. 0.560/ liter. In this alternative it is suggested to utilize the energy wasted in the form of heat carried by the heated milk going into the chiller unit. The suggested alternative plans to use this heat and the same is used to preheat the milk coming from the supply and hence reduce the heating load required for the purpose of milk processing. This can be done by using a plate type heat exchanger.

Gurumurthy et al. ^[4], has suggested certain energy conservative measures in the field of refrigeration and thermal energy conservation in dairy industries. According to author two major areas for energy conservation in dairies are (i) Fuel Fired Equipments (Boiler) & (ii) Refrigeration System. The energy saving devices considered in this research work are waste heat recovery systems, economizers, cogeneration systems, vapour absorption system. Author has suggested modified design for vapour absorption system and economizer which saves about 1% of fuel for every 60°C raise in temperature. By using this design, it is possible to save around 4% to 5% of fuel. The approximate cost required to install suggested vapour absorption system by utilizing the waste heat is Rs. 20 lacs. This cost can be recovered by saving the electric bill within a period of 3 years and 3 months which can be considered as its payback period.

M. Janzekovic et al. ^[5], have performed research in Slovenian Dairy and came up with the suggestion of replacement of existing Alfa Laval Pasteur 31 for milk pasteurization in the dairy by new Fischer Pasteur 43. This new equipment suggested by author has 20 seconds of maintaining time of pasteurization which has helped to reduce pasteurization temperature from 78°C to 76°C. It also resulted into improvement in effect of pasteurization from 32.25% to 100%. This new equipment has 4 years of payback period with 22.79% of IRR thus resulting in improved profitability of the pasteurization process. They also have suggested new CIP system (clean in place) which assures 43% savings in water, 11.5% savings in washing agents (caustic solution, acid). Due to smaller need for energy (gas, electricity) the energy costs were reduced by 19%. The new CIP energy saving system suggested by author has an influence on the costs of the dairy business activities and the reduction of environment burdening.

Deepak D Desai et al. ^[6], has highlighted the use of Solar Energy in Dairy Industries for energy conservation in their research. Various solar energy operated techniques have been put forth to carry out various operations in dairy. These techniques can be used for cooling purpose, for water heating, for steam generation, for solar drying, for pumping dairy fluid, for lighting and for electric fencing. Most of the milk processing operations are operating on grid electric supply hence to overcome problem of peak load penalty, the part load can be shared by solar based systems. Authors have suggested use of solar PV cells for solar cooling purpose while solar water heating system can save around 200-250 litres of furnace oil per day by heating boiler feed water. Use of solar heating for steam generation can save 4774.2 litres of furnace oil per annum while use of solar dryer reduces the load on air heaters resulted into cost and energy saving.

Paria Sefeedpari ^[7], has carried out the study in 35 industrial dairy farms in Tehran province of Iran in order to improvising energy efficiency of dairy plants through assessment and optimization of energy consumption. This is done by using non-parametric method of Data Envelopment Analysis (DEA) approach. According to the author, electricity shares approximately 36% of total input required in dairy hence special attention must be paid on this area. In this study, author has suggested to adopt new methodologies and supervising systems including energy auditing

resulting in the increase of farmers' knowledge about dairy production system and encouraging them to minimize their energy use. He has recommended the use of energy audit tool improve energy efficiency.

Mehulkumar J Panchal *et al.* ^[8], has highlighted the need and importance and of Energy Conservation and Energy Audit in industrial sector with the help of case study in M/s Zydus Infrastructure Pvt. Ltd. Authors noted that results of energy conservation and energy audit point out possibilities of energy saving, by simple housekeeping measures as well as improved techniques, better instrumentation and more efficient machinery.

Mr. Harpreet Kaur, Mrs. Kamaldeep Kaur ^[9], have underlined the importance of energy conservation. Energy supply is now not considered a commodity but a service. In view of authors, India's strong economic performance of recent years requires continuing effort from the newly formed Government to widen the ambit of economic reform. Authors further mention that though the Government has given higher priority for the power development projects, the Indian power sector is struggling with formidable difficulties of meeting the heavy demands of electricity due to higher amount of power losses and energy thefts. Energy conservation is the only route that can get better mileage out of the available resources.

CONCLUSION

Following conclusions can be drawn from the literature review carried above

- Most of the researchers have focused on pasteurization process for energy savings.
- Experimentally it is shown that modified plate type Heat Exchangers for raw milk pasteurization process reduces the energy consumption.
- It has been shown experimentally that heat carried by heated milk going into chiller unit can be utilized for preheating of raw milk coming from supply. It reduces the heating load requirement.
- Boilers and refrigeration systems are two major energy consuming areas in dairy. Waste heat recovery systems, cogeneration systems can be used to minimize energy consumption.
- Experimentally it has been proved that modified designs of vapour absorption system and economizer saves 4 to 5% of fuel.
- Focusing on Clean in Place (CIP) system can be also useful for reducing energy consumption
- Employing solar energy equipments in dairies for boiler feed water heating, steam generation, lighting can play vital role in energy cost saving.
- All these concluding remarks shows that there is a good scope of energy conservation in dairy industry as it is one of the fastest growing industries.

REFERENCES

- [1] T. Hima Bindu, Dr. S. E. V. Subrahmanyam, Dr. M. S. Bhat, "SWOT Analysis of Dairy Industry in India", International Journal of Scientific Research, Volume: 3 Issue: 1 January 2014, ISSN No 2277 – 8179, pp. 249-251.
- [2] Modi. A., Prajapat R., "Pasteurization Process Energy Optimization For A Milk Dairy Plant By Energy Audit Approach", International Journal Of Scientific & Technology Research (IJSTR), ISSN 2277-8616, Volume 3, Issue 6, June 2014, pp. 181-188.
- [3] Mr. Uma Shankar Prasad, Mr. Satyashree Ghodke, "Energy Management In Milk Processing Plant", International Journal of Humanities, Engineering, and Pharmaceutical Sciences (IJHEPS), ISSN 2249-2569, The Spark Edition/ IJHEPS January 2013, pp. 49-51.
- [4] Gurumurthy Vijayan Iyer, Nikos E.Mastorakis, "Energy Conservation Measures In Dairy Industries", Proceedings of the 4th WSEAS International Conference on Fluid Mechanics and Aerodynamics, Elounda, Greece, August 21-23, 2006 pp. 435-444.
- [5] M. Janzekovic, B. Mursec, P. Vindis, F. Cus, "Energy Saving in Milk Processing", Journal of Achievements in Materials and Manufacturing Engineering (JAMME), Volume 33, Issue 2, April 2009, pp. 197-203.
- [6] Deepak D Desai, J.B. Raol, Sunil Patel, Istiyak Chauhan, "Application of Solar Energy for Sustainable Dairy Development", European Journal of Sustainable Development (2013), 2, 4, ISSN: 2239-5938, Pp. 131-140.
- [7] Paria Sefeedpari, "Assessment and Optimization of Energy Consumption in Dairy Farm: Energy Efficiency", Iranica Journal of Energy & Environment (IJEE), ISSN 2079-2115, March 2012, pp. 213-224.

- [8] Mehulkumar J Panchal, Dr. Ved Vyas Dwivedi, Rajendra Aparnathi, “The Case study of Energy Conservation & Audit in Industry Sector”, International Journal Of Engineering And Computer Science ISSN:2319-7242, Volume 3, Issue 4, April, 2014, pp. 5298-5303.
- [9] Mr.Harpreet Kaur, Mrs. Kamaldeep Kaur, “Energy Conservation: An effective Way of Energy Utilization”, International Journal of Management in Education (IJMIE), ISSN: 2249-0558, May 2012, Volume 2, Issue 5, pp. 623-637.