Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 1, Number 9; October, 2014 pp. 124-127

http://www.krishisanskriti.org/jbaer.html

Budget Constrained Energy Conservation – An Experience with a Textile Industry

Ramesh Suresh[1], Sudhan Rajkumar Natrajan[2], Harish Kumar Navaroj[3]

[1,2,3]*Undergraduate Student,, Department of Mechanical Engineering*
Kumaraguru College of Technology, Coimbatore, Tamil Nadu, INDIA

Abstract: **Conservation and efficient use of energy in industry has for a long time been a priority of the government on India. In anticipation of enactment of federal legislation on energy management for industry, the state of Government of Tamil Nadu, Kerala and other Southern States, made energy audits mandatory for large-scale energy consuming industries. So among industrial consumers, the aspect of energy conservation is gaining due importance of the realization that "Energy Saved is Energy Produced and that too at Economical Cost". This paper shares the experience of the authors on energy conservation projects carried out in a textile industry situated in Tamil nadu state. Economic and efficient measures of energy conservation have been followed subject to budget constraint and the effects of such measures were realized through reduction in energy cost with the added advantage of environmental safety.**

1. INTRODUCTION

Today, energy and environment are two areas that have sought the greatest attention at the international level. With the issue of the global environment, becoming as important as never before, energy particularly its conservation in industries, has become the main target for all parts of the world that has to be achieved as soon as possible. Textile industries are found to be energy-intensive [4% energy cost in total input cost[compared to other industries like chemical, food, computer manufacturing, etc.. and hence extensive research has been focused on such industries in the past to reduce the energy cost and the total input cost.

In post-independence india, the industrial sector has reached to a level of consuming 50% of total commercial energy available in the country. Indian manufacturing industries like fertilizer, cement, sugar, textile, aluminium, paper, etc.. are found to be highly energy-intensive and their energy efficiency is well below that of industrialized countries. Research on Indian industrial sector indicates that around 25% of the total energy consumed by the industrial sector can be saved through energy conservation means.

In this paper, the energy conservation experience of the authors with a textile industry is presented. The selection, and particular, of a textile industry has been considered because of 1) the higher magnitude of electrical energy used in such industries and 2) the large number of textile industries in this country.

Since there is constraint on the investment budget for energy conservation measures imposed by the management of the textile considered, projects conserving only electrical energy have been identified and the implemented since the electricity cost in the total energy cost of the textile industry is found to be around 65%. All other energy conservation measures are reserved for next stage of implementation at a higher budget level.

2. STUDY OF EXISTING CONDITIONS

2.1 Industry considered

One of the privately owned medium size spinning and sewing thread industry in Tamil Nadu, producing 15 tons of yarn and 10 tons of sewing thread/day, is the site for which energy conservation measures were carried out during the financial year 2012-2013.

2.2 Electrical demand

This textile industry has four separate low-tension services, receiving electricity from the state electricity board (SEB) under tariff iii B. the permitted maximum demand is around 420KW.

2.3 Consumption

Energy consumption: 10,080 kWh/day

2.4 Elecrticity tariff

The textile industry is situated in a non-metropolitan locality and LT Tariff iii B is applicable at the following rates:
Energy (kWh) charges: Rs. 7/kWh

2.5 Machineries/equpments inventory

The mill engineer's report indicates the availability of the following machineries and equipments:

Blow rooms- 1
Ring frames- 18
Cone and cheese winding machines- 3
Sewing thread machines

Cards, preparatory machines, draw frames, combers, lap formers, etc.

Diesel generators: 1*500 KVA.

3. ENERGY AUDITING

The Board of Directors of the Textile industry decided to go Energy Conservation measures due to the following reasons:

- The industry has served for more than a decade.
- The rise in cost of energy input due to periodic tariff revision by the SEB and also the frequent diesel price rise in every year.
- The Board of the industry is considering the option of going for Renewable Energy Sources in the near future for economic reasons and also to avail the Government's incentives ,and
- The repeated instructions from the Electricity board, Electrical Inspectorate and state pollution control Board to go in for in for Energy Conservation.

3.1 The Energy Conservation Team (EC Team)

The Energy Conservation Team (EC Team) consist of i) A Associated Professor in Mechanical Engineering with heat transfer as area of specification ii) A Certified energy auditor with 7 years of Experience iii) A Post graduate students in M.E Energy engineering with Electrical and electronics engineering background in UG.

3.2 Service Agreement

The EC team was responsible for conducting a detail energy audit with the support of Mill Engineer and the Mill Maintenance personnel. At the end of the Audit, a detailed report on the Machineries/Equipment inventory, existing conditions, possibility of energy conservation, plan for implementation, implementation cost and carrying out the plan period, and rate of return, was given to the management for its approval. Based on the decision of the board and the Budget sanctioned, the EC team carried out its responsibility.

3.3 Time Span

For this Textile industry's Energy Conservation Project, the EC team took 3 months for conducting the detailed Energy Audit; the Board took two weeks for its approval and budget sanction, and again the EC team took another three months for the implementation.

3.4 Criteria set by EC Team for Energy Auditing

The EC team set the criteria for energy auditing as

i) Cross-checking the Machineries/Equipments inventory produced by the industry,
ii) Analyzing the Monthly Electricity Bills from the commencement of the industry
iii) Study of load growth, Loading pattern and Demand control
iv) Analysis of distribution system, cables, routing of wires and cables
v) Checking of indoor and outdoor lighting,
vi) Determining Motor efficiency, Air conditioning, systems, etc.
vii) Ways of improving internal giants from Equipments.

3.5 Audit Outcome

The EC team identified the following areas (projects) through which energy conservation could be achieved:

i) Electrical services and distribution system,
ii) Individual machinery power factor analysis
iii) Insulation and Distribution losses
iv) Lightning
v) Motors and Drives performance analysis
vi) Equipment and process Modification
vii) Operation and Maintenance
viii) Cogeneration and Energy Management System.

For each project i) the annual energy savings, ii)Project future energy cost and annual cost savings iii) project capital or first cost, iv) payback period, return on investment, and v) priorities to project based on investment merit, were provided to the management for its approval and capital authorization. The Board permitted to implement those energy conservation projects related to electrical demand and energy cost as the first phase subject to a budget of Rs.6000 with a condition that the savings through such projects should offset the implementation cost over a short period of time.

4. ELECTRICAL ENERGY CONSERVATION

Based on the Board's approval, the EC team decided to go for the following electrical energy conservation projects:

4.1 Power Factor improvement

Findings: The average power factor of the industry varies between 0.85 and 0.93 since its commencement for the all four services, which was well above the requirement of the SEB. The instantaneous power factor for the individual motor was poor because of variable load conditions. So, at the average power factor, the load in the KW was 420 KW. 350 KVAR

Capacitors were already installed to improve the power factor to 0.89 (average), which was not sufficient to reduce the energy input of the industry to a great extent, because some of the capacitors failed to draw the current.

Recommendations: The EC team decided to identify the failure capacitors and replacing that existing capacitors with the new capacitors according to the actual KVAR requirement of the individual machines. This can be done to maintain the power factor to an average value value of 0.99.

The best locations for the capacitors were identified as i)at the stabilizer side itself to compensate the base load and ii) at the load supply side as per the KW capacity, so that only when the load is on, the capacitor will be on. The new capacitors of 280 KVAR were installed to improve the power factor to 0.99.

4.2 Improving power quality

Findings: For every machine, the voltage and current Total harmonic distortion should be in the range of 4 and 11% respectively. But some of the machines have THD is in the range of 14%.

Recommendations: The EC team has to maintain the voltage stabilizer to limit the individual motor's unbalanced current carry around +/-10%. So Efficiency and life span of the machine gets improved up to 2% and 10 years.

4.3 By energy efficient motors

Replacing standard efficiency motors with premium or high efficiency motors is a valuable energy conservation program. Total energy required to operate the motor is equal to the mechanical load on the motor and the mechanical and electrical losses in the motor.

Findings: There were 30 induction motors of capacities each ranging from 13 KW to 15 KW for driving the ring frames. By load test, their full load efficiency was found to be found around 86% and an average energy consumption of 12 kWh/hour/Motor. The energy consumption of these motors alone are formed a major portion of 45% in the total electrical energy requirement of the industry.

Recommendations: It is recommended to go for energy efficient motors of capacity 13KW with 91% efficiency, uniformly for all the frames.

4.4 Through lighting

Findings: The Lighting installation consisted of 90 electronic ballast fluorescent lamp each rated at 50 watts.

Recommendations: The EC team will be install a twin tube CFL each rated 85 W with voltage control system for the lighting in the industry, which made use of one autotransformer for every lighting control zones, and finally connected to a central control panel. The voltage control system has reduced energy consumption in two ways: firstly, following start-up, the supply voltage was reduced to monitor the daylight level in the industry, the supply voltage was reduced up by up to a further 5%.

5. BENEFITS OVERVIEW

Since the conservation measures carried out were budget constrained, a higher magnitude of saving in energy and cost could not be expected. After the implementation of the conservation projects, a total saving in electricity consumption of 49,536 kW/annum has been achieved. The electricity charges/annum was brought down to a value of 1,163,749 from Rs.1,510,554 with the saving of Rs.3,46,805. Such a saving was found to be 18.23% on the annual electricity charges and 11.85% on the total energy cost of the textile industry.

The total investment for the energy conservation projects and saving in electricity cost per annum were found to be Rs.2,90,000 and Rs.3,46,805 respectively.

Apart from the economical benefits, environmental benefits are also achieved through the present EC projects. The Carbon dioxide, Sulphur dioxide and Nitrous oxide emissions, in India, from Fossil-fuel generation of electricity per kWh are found to be 0.22 Kg, 6.80 gm and 2.63 gm, respectively. The reduction in these emissions due to the present energy conservation measures is calculated. An appreciable reduction in all the pollutants are noticed which helps not only in safeguarding the environment and but also gets benefits from reduced environment penalty cost.

The following tables show the energy saving details in all the service connection separately:

I. Service Connection-I

Sc no: 886
Operation Hours/days: 18
Energy savings 3.63% of 84 KW: 1.7 Units
Units cost: Rs 7/Units

S.No	Energy savings in **kWh@0.85** Load factor/Month	EB Bill saving in Rs/Month	EB Bill saving in Rs/Year
1	796 units	5572	66898

II. **Service Connection-II**

Sc no: 955
Total demand: 84 Kw
Operating hours/ day: 18

Energy saving3.63% of 84Kw: 2.5 Units
Unit cost: Rs 7/Units

S.no	**Energy savings in kWh@0.85 Load factor/Month**	**EB Bill saving in Rs/Month**	**EB Bill saving in Rs/Year**
1	1151 units	8057	96,678

III. Service Connection-III
Sc no: **1029**
Total demand: **84** Kw
Operating hours/ day: **18**
Energy saving3.63% of 84Kw: **3.1** Units
Unit cost: Rs 7/Units

S.no	**Energy savings in kWh@0.85 Load factor/Month**	**EB Bill saving in Rs/Month**	**EB Bill saving in Rs/Year**
1	1400 units	9802	1,17,625

IV. **Service Connection-IV**
Sc no: **1202**
Total demand: 70 Kw
Operating hours/ day: 18
Energy saving3.63% of 70Kw: 1.4 Units
Unit cost: Rs 7/Units

S.no	**Energy savings in kWh@0.85 Load factor/Month**	**EB Bill saving in Rs/Month**	**EB Bill saving in Rs/Year**
1	781 units	5467	65,604

6. CONCLUSION

In this paper, the energy conservation experiences of the authors with a textile industry were presented. Since there was there was constraint imposed by the Management of the textile industry on the investment budget for the energy conservation measures, project conservation only electrical energy have been considered and the saving of 18.23% on the electricity cost. An attraction benefit has been achieved along with the annual reduction of Tons of NO_x through energy conservation measures encouraged the industry and made them to grand permission to proceed with the next phase of energy conservation at a higher budget capacity.

REFERENCES

[1] List and number all bibliographical references in 9- point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example [2-4], [2, 5], and [1].

[2] S. Rahman and A. de castro, “Environmental impacts of electricity generation: A global perspective,” *IEEE Trans. Energy Conservation*, vol.10, no. 2, pp. 307_314, June 1995.

[3] J.B.Gaskell, “How green is your plant?” *IEEE Power Engineering Journal*, vol. 13, no 2, pp. 49-57, Apr.1999.

[4] A. Z. Khan, “Electrical energy conservation and its applications to a sheet glass industry,” *IEEE Trans. Energy Conservation*, pp. 666-671, sept. 1996.

[5] IEEE Bronze Book on Recommended Practice for Energy Conservation and Cost Effective Planning in Industrial Facilities. *New York: IEEE*, 1993.

[6] C. Palanichamy et al., “Refresher course on recent trends in maintenance of industrial electrical equipments and energy conservation,” in *TCE proc*., Feb. 23-24, 1991.