ENERGY MANAGEMENT IN TEXTILE INDUSTRY

SARITA SHARMA

Department of fashion Technology, International College for Girls, Jaipur, India
E-mail : ritukarvi@gmail.com

Abstract- Energy is one of the most important ingredients in any industrial activity. The availability is not infinite however. Energy crisis globally, as well as high cost of fuels resulted in more activities to conserve energy to maximum extent. Energy crisis globally, as well as high cost of fuels resulted in more activities to conserve energy to maximum extent. The textile industry is one of the major energy consuming industries and retains a record of the lowest efficiency in energy utilization. About 23% energy is consumed in weaving, 34% in spinning, 38% in chemical processing and another 5% for miscellaneous purposes. In general, energy in the textile industry is mostly used in the form of: electricity, as a common power source for machinery, cooling & temperature control system, lighting, equipment etc.; oil as a full for boilers which generate steam, liquefied petroleum gas, coal. And this has made pathway to conservation of energy which can be affected through process and machinery modifications and implementation of technological advancements relating to process optimization as well as development of newer methods to meet the challenge of substantial energy saving in textile wet processing.

Keywords– Textile *industry, spinning, electricity, wet processing.*

I. INTRODUCTION

The conservation of energy is an essential step we can all take towards overcoming the mounting problems of the worldwide energy crisis and environmental degradation. In particular, developing countries are interested to increase their awareness on the inefficient power generation and energy usage in their countries. However, usually only limited information sources on the rational use of energy are available.

The rational use of energy calls for a broad application of energy conservation technologies in the various industrial sectors where energy is wasted. One of these energy intensive industrial sectors to be considered to improve efficiency through the introduction of modern energy conservation technologies is the textile industry. The textile industry is one of the major energy consuming industries and retains a record of the lowest efficiency in energy utilization. About 23% energy is consumed in weaving, 34% in spinning, 38% in chemical processing and another 5% for miscellaneous purposes.

The need of energy management has assumed paramount importance due to the rapid growth of process industries causing substantial energy consumptions in textile operations. Conservation of energy can be affected through process and machine modification, new technologies and proper chemical recipes. The possibilities of utilizing new energy resources are yet to be explored. These energy resources are solar energy, tidal power, wind power, nuclear energy, etc. But initial cost of production will increase in step with cost of oil, which makes development of such sources doubtful in terms of cost incurred.

II. TYPES OF ENERGY USED IN THE TEXTILE INDUSTRY

In general, energy in the textile industry is mostly used in the forms of: electricity, as a common power source for machinery, cooling and temperature control systems, lighting, office equipment, etc.; oil as a fuel for boilers which generate steam; liquefied petroleum gas; coal; and city gas.

Table 1 Energy Consumption Share of Each Specialized Technical Field in the Textile Industry

Specialized Technical Field	Fuel	Electri-city	Total	Share%
Fiber production	32,551	21,498	54,049	21.0
Spinning	3,224	44,262	47,480	18.4
Twisting	219	1,660	1,879	0.7
Textured-yarn production	120	1,543	1,663	0.6
Weaving	4,467	24,848	29,315	11.4
Knitting	4,059	11,709	15,858	6.1
Dyeing	37,661	28,412	66,073	25.0
Clothing manufacturing	8,240	15,420	23,660	9.2
Others	5,959	12,000	17,959	7.0
Total	96,500	161,442	257,942	100.0

Unit: million Rs.

Note: Calculated from the Tabulated Industrial Statistics (Industry Volume)

Table 2 Types of Energy Sources Used in the Textile Industry

Technical Field	Fiscal Year	Electricity (10^3 KWh)	Kerosene (Kl)	Gas Oil (Kl)	Fuel Oil A(K1)	Fuel Oil B(K1)	Fuel Oil C(K1)	Liquefied Petroleum Gas(t)	Coal (t)	City Gas (10^3 m^3)	Total (10^6 Kcal)
Fiber Production	1986	3,839,760	4,067	10	6,182	16	719,547	712	517,177	134	15,631,924
	1987	889,582	5,587	17	2,221	—	635,941	699	706,402	116	15,854,930
	1988	3.882,074	3,821	14	12,209	--	622,291	727	788,698	134	16,012,279
	1989	3,887,386	2,736	3	28,520	-	544,848	656	838,510	155	15,458,822
	1990	4,066,002	3,571	5	35,503	—	549,098	662	871,265	177	15,358,554
Dyeing	1986	1,325,692	24,250	400	39,770	11,751	816,942	83,678	7,187	40,881	12,103,452
	1987	1,351,241	22,565	406	50,351	11,906	806,477	87,978	30,084	41,835	12,322,468
	1988	1,343,959	21,879	442	97,509	12,323	775,313	95,349	37,846	41,902	12,610,598
	1989	1,397,260	21,470	471	180,880	10,507	708,562	104,125	37,580	45,111	12,706,610
	1990	1,398,127	20,702	614	199,846	10,068	678,942	109,281	32,827	51,293	12,724,916

Note: Calculated from the Annual Report on Textile Statistics. Dyeing represents the dyeing process including finishing, for both woven and knitted materials

III. FOCUS AREAS FOR ENERGY CONSERVATION

1. THERMAL ENERGY

Thermal energy is major for chemical processing while power dominates consumption pattern in spinning/weaving. Thermal energy in textile mills is mainly consumed in two operations. They are heating of water and drying of water.

The following table indicates the department wise percent steam consumption in a composite textile mill

Table-I	
1 Processing	65%
2 Sizing & Size mixing	15%
3 Humidification in weaving and spinning	10%
4 Unaccountable due to engineering, line losses, leaks etc.	10%
Total	100%

Thermal energy in the form of steam is supplied to the various equipments through pipe. The average steam consumption in unit operations and stages of wet processing are seen in the following table.

Table-II

Sr. No	Dyeing process	Steam consumption in Kg / Kg of fabric
1	Dyeing in jigger or winches	3.5
2	Dyeing in H.T.H.P. dyeing machine	5
3	Pad – dry steam dyeing	8
4	Pad - dry cure/thermo sole dyeing	5

2. ELECTRICAL ENERGY

The wet processing of textiles consumes around 15% of the total electrical energy mainly only for running the various processing machineries. Most of the textile mills draw their power requirements from their respective state electricity boards. Sometimes this has an adverse effect resulting in severe power cuts for the industry. Due to this reason, several mills have opted for their own captive generation in spite of higher costs. By taking the advantage of tail race low pressure steam, some mills have tried for turbines. However, their use is limited due to non-availability of low to medium turbines and their maintenance as compared to diesel engines.

IV. ENERGY CONSERVATION IN TEXTILE INDUSTRY

For fuel conservation, some of the measures are mentioned below.

1. Human factor management.
2. Fuel selection.
3. Fuel handling and storage.
4. Fuel combustion.
5. Steam generation.
6. Steam distribution.
7. Steam utilization.
8. Maintenance of machine.
9. Waste heat recovery.
10. Alternate sources of fuel.
11. Renovation / replacement of existing plants.
12. Process modification

Some measures from the dyer's approach are mentioned below.

1. ELECTRICAL ENERGY

The main usage of electrical energy in the textile industry is in the manufacture of yam and cloth, amounting to nearly 3/4th or 4/5th of the total power requirement in a textile mill, where as hardly 15 to 20% of electrical power is consumed for running various machines in textile wet processing.

1. One bath bleaching may enable to save around 70% electrical inputs.
2. Reduced number of ends / turns jiggers may help in saving around 20% electrical inputs.
3. Elimination of curing in printing saves 100% electrical inputs for curing step.
4. Combined drying - cum - curing in resin finishing saves around 35% electrical inputs.
5. Use of high efficiency motors in place of standard motors with proper application will save 2 to 4%.
6. Replacement of under size and over size motors saving depending upon the percentage of loading on the motors.

7. Use of high temperature grease according to insulation class of motors.
8. Investigation of exact burning reason, rewinding as per original technical data. Motors convert electricity into mechanical energy to drive machinery. Throughout this conversion, some energy is lost. Current motors feature improved styles and incorporate the most recent developments in materials technology. The foremost efficient of these motors are termed High Efficiency Motors (HEMs)

Other benefits of HEMs besides energy savings are:

- Higher power factor,
- Longer lifespan and fewer breakdowns,
- Run cooler and less susceptible to voltage and load fluctuations, and
- Produce less waste heat and noise.

2. THERMAL ENERGY:

Apart from electrical energy, the wet processing department of a textile mill requires substantial quantities of thermal energy in the form of steam as a source of heating. The various ways and means by which a substantial portion of huge quantities of thermal energy consumed during the course of textile wet processing can be saved include the following.

1. Since Most Of The Thermal Energy Is Wasted In Removal Of Water, Different Attempts Have Been Made To Reduce The Energy As Follows.

a. Efficient removal of water using heavy squeezing enables 15-20% reduction in energy requirement for drying.
b. Vacuum impregnation squeezes out the air from the cloth 'and provides better dye or chemical impregnation and more uniform application and this process enables 60-65% fuel saving compared to conventional system.
c. Vacuum roll extractor enables 70-75% saving in energy.

2. Some Developments Relating To Increased In Efficiency of Drying and Setting Units.

a. The heating up time on conventional stenter and hot flue driers are 10-20 sec. and 40-60 second respectively but by employing sieve drum drier which reduces the time of heat up to 1-3 second and gives almost 60-70% energy saving.
b. Radio frequency is used for uniform heating throughout the mass of the material which gives 60% saving in energy.
c. Use of heat transfer fluids (thermo pack) like hydro-carbon of enabling temperatures up to 300°C. This process gives 80% savings in energy.

3. Some Developments Relating To Techniques Based On Reduced Liquor- To- Material Ratio In The Operations.

a. Foam application technique gives almost. 50-60% savings in energy for low wet pick-up applications.
b. Use of low M. L. R. jet dyeing machines saves 40-60%fuel.
c. Azeotropic / emulsion based system of processing saves 60-70% fuel considerably because of significantly low water content of the system.

4. Some Developments Relating To Process Developments and Old Process Modifications.

a. Reduction in pressure kier time by kier modification from 6-8 hrs. enables 60-65% energy saving.
b. By using reducing agents like Anthraquinne the scouring time can be reduced to 3-4 hrs from 6-8 hrs. This process enables 40- 50% savings in energy.
c. By solvent scouring process 60-80% energy can be saved.

5. Cold bleaching by activating sodium chloride by hypochlorite use no thermal energy and hence 80-90% energy saving is possible.
6. Hot mercerization enables the combining of scouring and mercerization’s and saves energy around 30-40%.
7. Du –Pont’s two minutes bleaching uses hydrogen peroxide at very high pH value with a special formulation to prevent undue decomposition of peroxide and damage to the fabric. An energy saving around 80-85% is possible with this process.
8. Combined one step hypochlorite bleaching and scouring at R. T. enables almost 100% energy saving.
9. Combined one step desizing, scouring and bleaching by redox system reduces almost 60% energy requirement
10. Use of solar energy for de-sizing and scouring enables almost 40-50% energy saving.
11. Cold pad batch method for reactive dyeing by sodium silicate for fixation of the dyestuff gives 100% energy saving.
12. Low temperature curing of pigment prints by using highly active catalysts like ammonium chloride, ammonium sulphates etc. save 30-40% energy.
13. Use of flash agers for reactive color printed and dried goods. The printed and dried cloth is padded with alkaline solution of high electrolyte content and steamed for about 30-60 minutes. This method saves almost 50% steam
14. Dyeing cum sizing of denim warps enables almost 40% saving in energy.

V. PROMOTION OF ENERGY CONSERVATION TECHNOLOGIES

In order to promote energy saving measures efficiently, it is found to be effective to separately consider general management techniques for "rational use of energy" and process-specific techniques to be developed in each specialized technical field.

VI. ENERGY CONSERVATION MANAGEMENT TECHNOLOGIES ORGANIZATIONAL RATIONALIZATION

Since energy management is relevant to a wide range of departments within a company, it is necessary to enhance the awareness, improve the knowledge and obtain the participation and cooperation of everybody involved in the production process

1.2 IMPROVING EFFICIENCY OF ELECTRICITY USE

(1) Lighting- Due to its nature of operations, the share of lighting in electricity use is relatively high. It is important to re- examine whether the light source is utilized in the most efficient way and take electricity saving measures
(2) Electric motor- The textile industry uses a vast number of relatively small electric motors. while a conventional machine was driven by a single motor with the generated mechanical power transmitted to various parts of the machine in a collective manner, many modern machines utilize multiple motors with a control board controlling the movement of each motor, which is directly coupled to a machine part to drive it independently from others.
(3) Electric heating- In the textile industry, electric heating has largely been replaced by other methods (steam, gas heating, or direct or indirect fired heating) for some time in order to achieve cost reductions

IMPROVEMENTS IN EFFICIENT FUEL USE

(1) Selection of fuel- In selecting fuels, those with good flue gas characteristics in addition to high calorific value and ease of combustion are desired, so that air pollution can be prevented as much as possible.
(2) Selection of boiler- Boilers used in the textile industry have experienced a change from Lancastrian- or Scotch-type tubular or smoke tube to water-tube boilers, As a result, boiler efficiency has improved.

IMPROVEMENT IN EFFICIENT USE OF STEAM

Piping- The amount of steam in the textile industry involved is not so large but the locations where steam is required are widespread so that steam losses due to heat radiation from steam transportation pipes and pressure drops are considerable. For steam transportation over long distances, high pressure and small-diameter rather than low pressure and large-diameter piping is desired.

Steam accumulators -A steam accumulator can be installed midway through the heat transporting pipe, between the boiler and the heat consuming load, in order to store excess steam when the load is light by transforming it to heated water

UTILIZATION OF HEAT EXCHANGER

In each production process of the textile industry, the heating and cooling of gases and liquids as media of heat are frequently required. This is done through heat exchange between different fluids, and in order to avoid contamination or chemical reaction due to their direct contact, heat exchangers are used to carry out indirect heating and cooling.

ENERGY CONSERVATION THROUGH SOFTWARE APPROACH

NITRA has developed a user friendly software that performs energy balance on any machine in a textile mill, stores the info along with information on the particular price and theoretical price of the performed operation along with the gradation of quality obtained

NON-CONVENTIONAL SOURCES OF ENERGY

The different alternative renewable sources of energy are biomass, tidal energy, geothermal energy, solar energy and wind energy. The technology is easy and straightforward to control, with nearly very little maintenance cost. There will not be any drawback of air pollution. It means that nothing is wasted and there is no effluent.

ENERGY AUDIT

An energy audit is a survey, inspection and analysis of energy flows for energy conservation in an industry to reduce the amount of energy input into the system without negatively affecting the output.
Areas of Energy Audit

In the study of Energy audit of the running equipment, we first see the visible abnormal symptoms in the inefficient transfer of energy in the system.

Lighting - sparks, in case of contactor switching, loose joints etc

Heating - in motors, other load equipment coupled to motor Due to Friction, metal-to-metal touch, poor lubrication, misalignment

V. CONCLUSION

Modernization through plant and machinery could be effective in reducing energy consumption. We can conclude

1. There is no panacea for achieving energy conservation in the textile manufacturing industry.

2. With the actual implementation of an energy conservation program, it is important to grasp the current level of energy consumption and its actual conditions in detail, set goals (energy consumption and corresponding cost), and achieve the goals through a company-wide effort as far as possible.
3. In the textile manufacturing industry, it is important to thoroughly understand that, depending on the trend of the market, the company is targeting, consumer requirements for the textile products to be supplied differ, thereby urging the implementation of energy conservation measures which are relevant to the production of the goods that suit the market.
4. Therefore, it is necessary to expect that, when multi-line, small-volume production type high value-added goods are produced, energy consumption may increase rather than decrease with production rationalization, In contrast with mass-production type goods.
5. When differentiated goods are produced, the share of energy costs in the overall production cost should be given importance rather than energy consumption.
6. It is reasonable to consider that ultimately desired energy conservation promoting techniques will depend on the development and practical application of innovative technologies in each specialized technical field.

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