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Energy conservation in textiles industries

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INTRODUCTION

Energy means any form of energy derived from fossil fuels, nuclear substances, Hydro-electricity and from renewable sources. Energy is one of the most important ingredients in any industrial activity.

Its conservation is the reduction of quantity of energy used. Conservation of energy supports the eco friendly lifestyle by providing energy, which saves the money and at the same time, saves the earth. Global Energy crisis, as well as high cost of fuels enforces to conserve energy to maximum extent. The textile industry is one of the major energy consuming industries but retains a record of the lowest efficiency in energy utilization. About 34% of energy is consumed in spinning, 23 % in weaving, 38% in chemical processing and another 5% for miscellaneous purposes.Consumption pattern of electrical power dominates in spinning/weaving, while thermal energy is mainly used for chemical processes. It is known that thermal energy in textile mill is largely consumed in two operations, in heating of water and drying of water. Fuel consumption in textile mills is almost directly proportional to amount of water consumed. Reduction in consumption of water will save energy. Conservation of energy can be affected through process and machine modification, proper chemical recipes, and new technologies. The possibilities of utilizing new energy resources like solar energy, wind power, tidal power, nuclear energy, etc. are to be explored. 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.

United States Department of Energy (2004) :

In spun yarn spinning, electricity is the dominant energy source, whereas in wet-processing the major energy source is fuel. Manufacturing census data from 2002 in the U.S. showed that 61% of the final energy used in the U.S. textile industry was fuel energy and 39% was electricity.

The U.S. textile industry is also ranked the 5th largest steam consumer amongst 16 major industrial sectors studied in the U.S. The same study showed that around 36% of the energy input

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to the textile industry is lost onsite (e.g. in boilers, motor system, distribution, etc.)

Types of Energy Used in the Textile Industry :

1. Electricity - as a common power source for machinery, cooling and temperature control systems, lighting, office equipments
2. Oil
3. Liquified petroleum gas - for boilers which generate steam
4. Coal (Ozturk, 2004)

Source of Energy Used in Production Process for Each Specialized Technical Field :

The major operations and sources of energy use involved in the production process of each specialized technical field, as a necessary component of over all production of apparel goods, are illustrated in the Table 1.

Table 1 : Over all production of apparel goods

Product form/machine types	Processes	Energy requirement (GJ/tonne output)
Desize unit	Desizing	1.0 - 3.5
Kier	Scouring/bleaching	6.0 - 7.5
J-box	Scouring	6.5 - 10.0
Open width range	Scouring/bleaching	3.0 - 7.0
Jig/winch	Scouring	5.0 - 7.0
Jig/winch	Bleaching	3.0 - 6.5
Jig	Dyeing	1.5 - 7.0
Winch	Dyeing	6.0 - 17.0
Jet	Dyeing	3.5 - 16.0
Beam	Dyeing	7.5 - 12.5
Pad/batch	Dyeing	1.5 - 4.5
Continuous/thermosol	Dyeing	7.0 - 20.0
Rotary Screen	Printing	2.5 - 8.5
Steam cylinders	Drying	2.5 - 4.5
Stenter	Drying	2.5 - 7.5
Stenter	Heat setting	4.0 - 9.0
Package/yarn	Preparation/dyeing (cotton)	5.0 - 18.0
Package/yarn	Preparation/dyeing (Polyester)	9.0 - 12.5
Continuous hank	Scouring	3.0-5.0
Hank	Dyeing	10.0-16.0
Hank	Drying	4.5-6.5

Focus Areas for Energy Conservation :

Thermal Energy:

Wet processing of textiles consumes a very high proportion of thermal energy mainly for the evaporation of moisture from textiles at various stages of wet processing and also for heating of process chemicals. Steam is generated employing boilers by using either coal or furnace oil and lately low sulphur heavy stock oil available from the refineries as fuel having average calorific values of 4200, 6200, 10280 and 10700 Kcal respectively. Thermal energy in the form of steam is supplied to the various equipment's through pipe for this purpose.

Electrical energy:

The wet processing of textiles consumes only a small portion of electrical energy, around 15% of total electrical energy, mainly for running the various processing machinery's.

Promotion of Energy Conservation Technologies :

Energy conservation awareness is relatively easily understood at home, when a program is introduced into a factory to promote it, its thorough implementation tends to be delayed at an early stage. Therefore, for its actual course of implementation, it is desired to devise company-wide coordinated measures similar to QC activities at factories. Also, 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.

Organizational rationalization :

Every engineers and technicians should have specialized technical knowledge, to play a central role in energy conservation efforts, the implementation of an energy conservation program itself should not be left to a handful of specialists or specialized sections. Rather, it is desirable to address the task company-wide, for example by setting up an 'Energy Management Committee'.

Improving efficiency of electricity use :

Lighting :

Due to its nature of operations, the share of lighting in electricity use is relatively high. After the switch from tungsten bulbs to fluorescent lamps achieved considerable electricity savings, electricity-saving fluorescent lamps have been developed and marketed for further improvements, including those capable of reducing electricity use by several percent for the same level of illumination.

Electric motor :

The textile industry uses a vast number of relatively small electric motors. Notably, 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. This is also a rationalized feature in terms of energy saving. However, regarding the selection of each motor, emphasis has been placed on mechanical performance, resulting in a motor with an excessive capacity. This leaves considerable room for reexamination from a energy conservation point of view.

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. However, since electric heating only requires a small initial investment as a result of convenience and simplicity in equipment construction, it is still used for small capacity local heating purposes. Therefore, it is desirable to conduct a comparative investigation into alternative heating methods, such as far-infrared radiation heating, high frequency dielectric heating and microwave heating.

- **Improvements in efficient fuel use**
- **Improvement in efficient use of steam**

– **Utilization of heat exchanger**

Rational use of energy in process-specific technologies :

Process-specific techniques relating to energy saving are summarized for each specialized technical field.

Fiber production :

This division has already reached a high level of production rationalization**.** In particular, the following techniques relate to energy saving:

– **Raw material production process-** Energy saving through improvements in the process and reaction conditions.

– **Polymerization process -** Reduction' in polymerization time by means of high efficiency catalysts, polymerization methods, etc.

– **Spinning process -** Promotion of energy saving through combining the POY and DTY methods.

– **Newly built factories -**To avoid high losses in the factories built during the high growth period having production decreased , suitably sized factories should be constructed.

Spinning :

In view of price competition with overseas companies labor saving as well as energy saving is desired. A modern factory requires approximately three times as much electricity as a traditional one, particularly in the air-conditioning plant. Energy saving measures are required fine spinning, as the main operation of the spinning process, consumes a large amount of electricity.

Weaving :

Conventional shuttle looms are based on the weft-insertion method, incorporating a shuttle zooming to and fro with a large inertia mass (approx. 400) and mounted with extra weft, and they also use energy consuming pirns as an integral part of the machine. For this reason, the shuttle less looms' contribution to energy saving cannot be regarded as too high. On the other hand, as a large amount of energy is consumed in sizing, as one of the preparatory operations for weaving, the introduction of foam and solvent sizing operations are being investigated. Furthermore, long fiber fabrics using non sizing filaments have been developed, eliminating the sizing process altogether.

Knitting :

The share of energy cost in the total cost of production is not necessarily high for the knitting process. However, of the main production facilities for this process, knitting machines have also been undergoing a shift towards high speed and large capacity and fine gauge features. The current industry trend is for high value added goods. Therefore a potential tendency for increased energy consumption should be taken into account.

As a result, it is desirable:

– To conduct a comprehensive re-examination of the production schedule

– The implementation of actual energy conservation measures to reduce the share of energy cost in the total production cost.

Dyeing and finishing :

It is very important to advance energy conservation in the dyeing and finishing field, which has a high energy consumption share. The dyeing and finishing process consists of many interwoven unit operations involving heat losses.

Rationalization techniques for dyeing and finishing :

- High speed processing of unit operations
- Elimination or merger of unit operations
- Reduction in processing bath ratio
- Reduction of processing time
- Reduction in temperature rise margin
- Re-examination of drying method
- Shift to solvent processing
- Use of continuous bath

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