Energy conservation audit and approaches for energy saving in textile process house - Part 1

Mr. Tanaji Kadam
The Bombay Textile Research Association, L B S Marg, Ghatkopar (W), Mumbai 400086

Abstract

The need for energy conservation has become of prime importance due to the fast growth of the textile processing industry resulting in substantial energy consumption. The Stricter environmental regulations, the demand for sustainable production, various compliances by the reputed global brands, the need for carbon footprint reduction etc are the driving forces to the energy conservation activities in a textile process. This paper is an attempt to demonstrate how the textile process house can develop an energy audit system, and simply implement energy-saving techniques. The shop floor engineers and process technicians who make daily decisions will primarily benefit from this paper. In part 1, identification and a small introductive description of the energy-consuming processes are done.

Keywords

Energy conservation, Textile processing, Recycling, steam, process water, electricity, air, energy audit

Citation

Mr. Tanaji Kadam- "Energy conservation audit and approaches for energy saving in textile process house - Part 1 ", *BTRA Scan* - Vol. LIII No.1 Jan. 2024, Page no. 1 to 4

1.0 Introduction:

Energy is one of the most important inputs in any industrial activity and process. In a typical textile process house, in the total operational cost, about 30-40% is the cost due to energy. Also, the global Energy crisis, their limited sources and the higher cost of fuels, is forcing textile processing mills to focus and look at more activities and actionables to conserve energy to the possible and maximum extent. The textile industry retains a record of the lowest efficiency in energy utilization and is one of the major energy-consuming industries. Power consumption is the major aspect in spinningand weaving processes, while thermal energy or steam energy is a major aspect oftextile wet processing. It is known that thermal energy in textile mills is largely consumed in two operations, in heating of water and drying of water. Fuel consumption in textile mills is depending upon the amount of water consumed or used in the process. Hence if consumption of water can be reduced, it will also save energy. Conservation of energy can be affected through process modification, machine modification, proper chemical recipes, new technologies and most important i.e. recycling.

*Corresponding author,
E-mail: tsd@btraindia.com

The possibilities of utilizing new energy resources like solar energy, wind power, tidal power, nuclear energy, etc. are to be explored yet in a big way. However, the initial cost of production will increase in step with the cost of oil, which is still hindering the textile industry from using such sources as an industry is still doubtful in terms of cost incurred.

The need for energy conservation has assumed prime importance due to the rapid growth of the textile processing industry resulting in substantial energy consumption [1]. Due to stricter environmental regulations, the demand for sustainable production, various compliances by the reputed global brands, the need for carbon footprint reduction etc are the driving forces to the energy conservation activities in a textile process.

To promote energy conservation practices in the Textile processing industry, we are trying to raise awareness of this important activity and also trying to explain how sustainable energy conservation can be achieved through the systematic practical approach. This paper is a small attempt to demonstrate how the textile process house can develop an energy audit system, and simply implement energy-saving techniques. The shop floor engineers and process technicians who make daily decisions will primarily benefit from this paper. As the depth and length of the subject are large. Such a large amount of information can not be accommodated in one single paper. Hence, a series of papers will be published on this subject. For reader's information; The Bombay Textile Research Association is actively involved in the energy conservation audits for the textile industry. The mill can take advantage of this BTRA activity.

In this part 1, we will be discussing the description and identification of major energy-consuming processes in a textile process house, various utility usage and potential saving possibilities. In coming part 2, the energy audit framework will be described and in part 3, we will be discussing on the typical energy-saving measures implementable in textile process houses and their monetary benefits and payback periods for the investment.

2.0 Description and identification of various processes in the Textile process house

The fabric received for wet processing is in grey form or rough form and it contains natural and added impurities in the process of its manufacturing. The Wet fabric processing is done to improve serviceability and its appearance (shade and finish) in many operations like pre-treatment, dyeing, printing and finishing.

The spinning and weaving manufacturing activities involve mainly dry operations and consume very little water and chemicals. whereas, textile wet processing requires a lot of water, steam, air, power and chemicals. Also, these operations produce significant polluted waste and further, the waste treatment wants again energy. The typical process sequence followed for knitted and woven fabric in textile process houses is given below in Fig 1 and Fig 2 respectively.

The various processes used for textile processing are briefly described below. In the next section, the process-wise summary of utility or energy requirements is given

i) Singeing – This process is carried out to burn out the protruding fibres from the fabric surface by passing the fabric directly on the flame at high speed.

ii) Desizing – In this process, sizing ingredients are removed by the traditional or enzymatic desizing process. After desizing the fabric can absorb the chemicals and water easily. The drained process water/wash water is of 60-90°C.

iii) Scouring –The scouring process is carried out to remove impurities like waxes, oils, and fatty acids both naturally present or added during manufacturing. This process is carried out at 90-120°C in alkaline conditions in atmospheric to sometimes high pressure also. The drained process water many times is of 60-90°C.

iv) Bleaching :- The purpose of this process is to make a fabric white by removing naturally present tint in it. Chemicals like hydrogen peroxide, sodium hypochlorite etc are used as bleaching agents. This process generally is combined with the scouring process.Here also, the drain water is of 60-90°C.

v) Mercerising:- This process is a treatment of cotton fabric with high concentration alkali (caustic soda) to swell the fabric and fix the dimensions of the fabric with the increase in tensile strength and lustre and dye uptake. Here, wash liquor or excess diluted sodium hydroxide is normally recovered and reused either for the scouring process or mercerization process.

vi) Dyeing:- To achieve the desired shade the dyeing is done. There are many dyeing techniques depending on dye type, fabric type and Accordingly the dyeing temperature and energy consumption is varied. The main two types of dyeing can be considered as batch technique and continuous type dyeing technique.

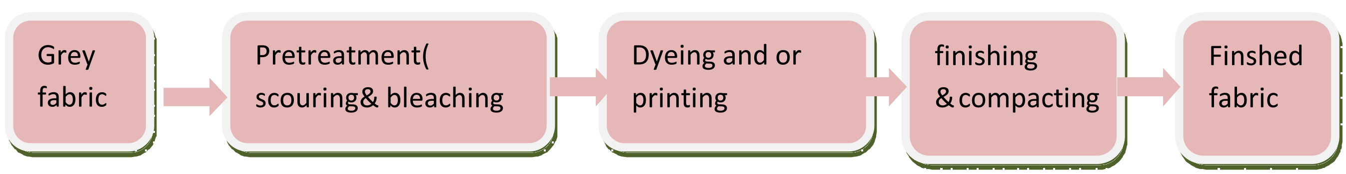

Fig 1 Process flow sheet for knits fabric

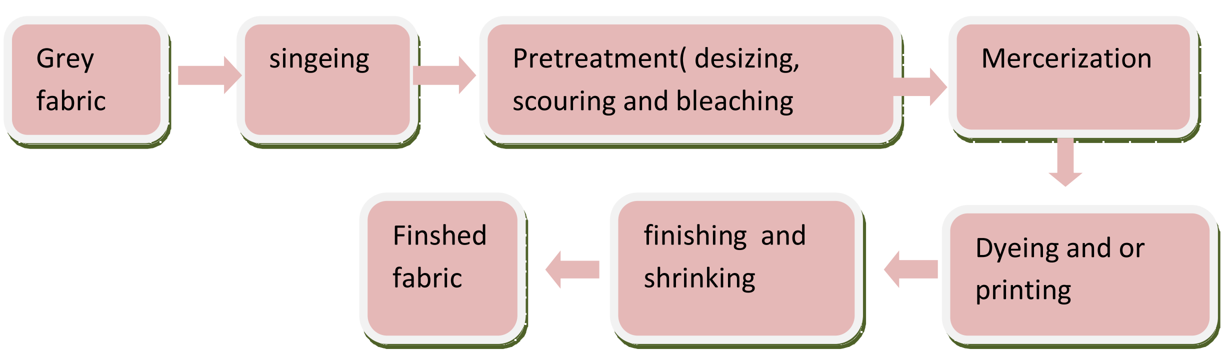

Fig 2 Process flow sheet for woven fabric

vii) Printing :- Printing is a process by which coloured patterns are produced or printed in the fabric. Unlike dyeing, it is usually carried out in a specific area to achieve a planned design. After colour application, the fabric is dried, steamed, cured and washed as per the dye type used in it.

viii) Finishing:- This is done on the stenter machine. This is performed to improve the fabric's appearance, texture and performance. Softness, lustre durability, and functional effects like water repellent, fire retardant, antimicrobial etc are increased or imparted. Sometimes to achieve the effect by mechanical methods, machines like sanfirisation, calendaring, peaching, sueding and brushing are used.

ix) Drying :-This process can be done at any stage of the production to remove the moisture from the fabric. The drying methods mainly used are contact drying i.e. cylinder drying and hot air drying.

3.0 Various processes, their utility consumption pattern and potential areas of energy saving

For the above-mentioned various processes, the utility consumption or requirement is summarized. This table also provides the possibility of the utility saving opportunity.

4.0 Benchmarking

To understand current level of performance and compare the baseline energy conservation trends we need benchmarking

Table 1 :- Processwise utility requirement and potential saving possibility

Process	Energy requirement					Eenergy saving opportunities
	Air	water	Steam	Electricity	Gas	
Singeing	✓	✓		✓	✓	Gas consumption
Desize padding	✓	✓	✓	✓		Steam consumption
Desize washing	✓	✓	✓	✓		Steam consumption
Scouring and bleaching	✓	✓	✓	✓		Steam consumption
Mercerisation	✓	✓	✓	✓		Steam consumption
Contact drying	✓	✓	✓	✓		Steam consumption
Hot air drying	✓		Thermic fluid	✓		Hot air/Fuel consumption
dyeing	✓	✓	✓	✓		Steam consumption
Printing	✓	✓	✓	✓		
Print fixation	✓		✓	✓		
washing	✓	✓	✓	✓		Steam consumption
Stenter finishing	✓	✓	Thermic fluid	✓	✓	Hot air/Fuel consumption
Mechanical finishing	✓			✓		

standards process-wise and then product mix type-wise. The Target benchmark for steam consumption may be taken as given in below table 2.

Table 2 Showing Target steam consumption process wise /machine wise

Machine/ Process	Target Steam consumption kg/ kg of material	Steam pressure Kg/cm2
Fabric Processing		
Desize washing on Jigger (M:L= 1: 2)	< 1.1	3 - 4
Desize Washing on continuous washer	< 1	3 - 4
Scouring and washing – Jigger (M:L = 1:2)	< 1	3 - 4
Peroxide bleaching and washing - Jigger	< 1	3 - 4
Continuous bleaching range	< 3	3 - 4
Mercerization	< 2	3 - 4
Vertical Drying range (VDR)	< 1.25	3 - 4
Jigger dyeing including washing – vat dyes/Sulphur dyes/reactive dyes (M:L= 1:2)	< 1.5	3 - 4
Beam dyeing including washing – Polyester dyeing	< 4	4 -5
Continuous pad steam dyeing range	< 4	4 - 5
Jet dyeing / Soft flow dyeing		
Jet dyeing – U type @ M:L= 1:4 polyester dyeing and washing	< 3.5	4 -5
Jet Dyeing - Long tube @ M:L= 1: 6 polyester dyeing and washing	< 4	4 -5
Jet dyeing – polyester complete pretreatment, dyeing/ full white and washing M:L= 1:5	< 5	4 -5
Soft flow dyeing -cellulosic (complete process of pretreatment, dyeing and washing) M:L= 1:6	< 5	4-5
Soft flow dyeing -cellulosic (complete process of pretreatment, full white washing) M:L= 1:6	< 3	4 -5
Printing		
Print paste preparation	< 0.2	1 – 1.5
Loop Ager for reactive printing /discharge printing	< 1.5	3 - 4
Loop Ager for disperse printing	< 2.5	3 –4
Soaper with dryer	< 4	4 - 6

Note :-The above tabulated benchmarking figures are based on the " norms for Chemical processing " developed by BTRA Mumbai[2]

5.0 Conclusion

The energy conservation audit is an important tool and methodology for reducing the carbon footprint of textile process houses. Before proceeding to energy conservation auditing one should understand the various processes in the textile wet processing industry and its utility requirements.

Once the process mapping is done concerningthe utility consumption then the auditing work becomes easy and subsequently the energyconservation opportunities can be seen with respect to benchmark utility consumption patterns.

References

1. Energy Audit Manual for Textile Industry published by PCRA Feb 2012, Pv
2. Norms for chemical processing published by BTRA Mumbai, April 2021, p 17