RESEARCH ARTICLE OPEN ACCESS

Impact of Condensate Recovery on Boiler Fuel Consumption in Textile Sector

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ABSTRACT
Energy is one of the main cost factors in the textile industry. Especially in times of high energy price volatility, improving energy-efficiency should be a primary concern for textile plants. There are various energy-efficiency improving opportunities that exist in every textile plant, many of which are cost-effective. Energy consciousness and environmental awareness have transformed condensate from an inexpensive byproduct of steam distribution to a valuable resource that can substantially reduce operating costs. The flash steam generated can contain up to half of the total energy of the condensate, hence flash steam recovery is also an essential part of an energy efficient system. This paper provides information on the steam consumption and recovery technologies and measures applicable to the textile industry. The paper includes case studies from various textile plants in sachin GIDC (Gujarat) and also provides the range of saving under varying conditions.
Keywords: *Condensate recovery, Flash steam, Steam consumption, Textile industry*

I. INTRODUCTION

One of the textile manufacturing clusters in India is located in Sachin GIDC (Gujarat). The products primarily comprise synthetic saris & dress materials and cotton dress materials. There are about 56 textile processing units in the cluster. Of the 56 units in the cluster, around 70% are integrated units with facilities for both dyeing and printing, while the remaining units have only dyeing facilities.

The textile industry, in general, is not considered an energy intensive industry. However, the textile industry comprises a large number of plants which together consume a significant amount of energy. The share of total manufacturing energy consumed by the textile industry in a particular country depends upon the structure of the manufacturing sector in that country. The textile industry uses large quantities of both electricity and fuels. The share of electricity and fuels within the total final energy use of any textile sector depends on the production of the textile industry. For instance, in spun yarn spinning, electricity is the dominant energy source, whereas in dyeing and printing the major energy source is fuels.

Fuel is one of the main cost factors in the textile industry. Especially in times of high energy price volatility, improving energy-efficiency should be a primary concern for textile plants. There are various energy-efficiency opportunities that exist in every textile plant, many of which are cost-effective. Energy consciousness and environmental awareness have transformed condensate from an inexpensive byproduct of steam distribution to a valuable resource that can substantially reduce operating costs. The flash steam generated can contain up to half of the total energy of the condensate, hence flash steam recovery is an essential part of an energy efficient system.

II. TEXTILE PROCESSES

It involves a generalized flow diagram depicting the various textile processes that are involved in converting raw materials in to a finished product [1]. All of these processes do not occur at a single facility, although there are some vertically integrated plants that have several steps of the process all in one plant. There are also several niche areas and specialized products that have developed in the textile industry which may entail the use of special processing steps that are not shown in fig 2.1

The primary raw materials used in textile manufacture are grey cloth, polyester yarn, and various chemicals like soaps, caustics, and dyeing and bleaching agents. Grey cloth usually contains many colored impurities like minerals, waxes, proteins, and so on, which are removed by scouring, bleaching and shrinking. The fabric is then dyed and printed to get the finished products. Scouring is usually carried out in ‘soflina’ Machines, while bleaching and shrinking are carried out in drum washers. Dyeing is mainly carried out in jet dyeing machines and jigger machines. Printing is usually carried out by mechanized screen printing processes, i.e. flatbed printing or rotary printing. After printing, the fabric is passed through looping machines, hydro extractors and ‘Stenter’ machines that dry the fabric enable the colours to set properly and restore the fabric’s width

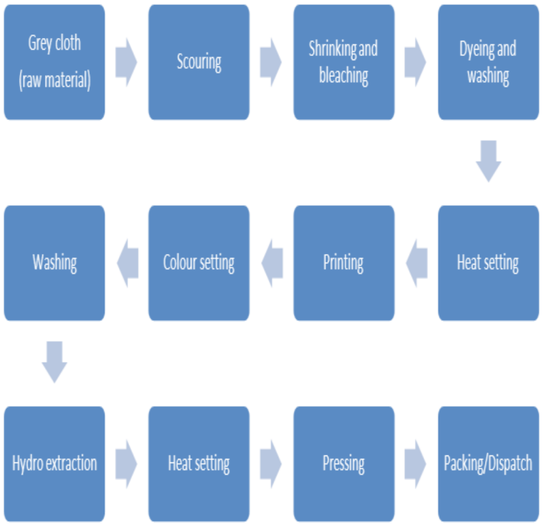

Figure 2.1 Textile processes

III. STEAM CONSUMPTION IN TEXTILE SECTOR

The textile units use both electricity and thermal energy in their processes. Electricity is primarily drawn from the grid, and used to operate pumps, fans, drives and for lighting. Thermal energy is mainly obtained from lignite coal, imported coal and natural gas which are readily available. Coal and lignite are primarily used as fuel in boilers for steam generation, and NG is used in machinery like Stander machines (for heat setting) and loop machines.
The steam required for different processes in textile industry is given in Table 3.1 below

Table 3.1 % of steam requirements in each process

Machine	Process	Steam required (%)
Washing drum	Scouring/Bleaching	13-16
Soflina	Bleaching	6-8
Jet machine	Dyeing	34-42
Jigger	Dyeing	6-8
Ironing machine	Drying	4-6
Loop machine	Drying	6-8

Breakdown of steam in textile industry is shown below. The percentage of steam consumption in each process depends upon the type of industry and number of equipments. The significant proportion of steam is used by jet machine, around 34 to 42%.

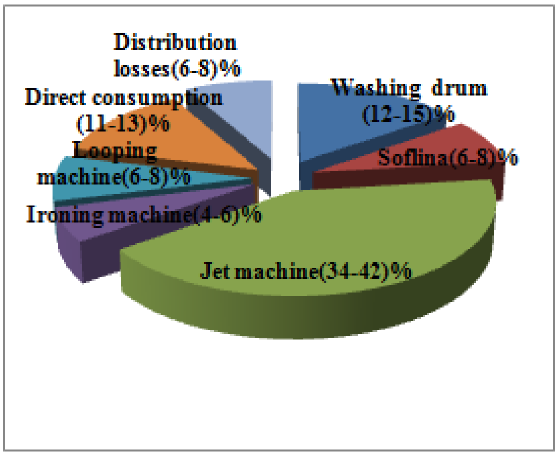

Figure 3.1 Breakdown of steam in textile industry

IV. ENERGY-EFFICIENCY IMPROVEMENT OPPORTUNITIES IN THE TEXTILE SECTOR

This analysis of energy-efficiency improvement opportunities in the textile industry includes both opportunities for retrofit/process optimization as well as the partial replacement of the current machinery with state-of-the-art new technology. The methods mainly consist of recovery of heat from condensate. To improve boiler feed water temperature by recovering flash steam and condensate from jet dyeing machines.

4.1 condensate recovery

The primary points of focus when considering collection of condensate and return to the steam system is the fuel consumption. In plant fuel consumption is decrease by about 1% for every 6°C rise in the boiler feed-water temperature. Return of condensate also reduces water cost; water treatment cost and reduces the pollution load.

4.2 flash steam recovery

Condensate is discharged through traps from a higher to a lower pressure. As a result of this drop in pressure, some of the condensate will then re-evaporate into 'flash steam. The flash steam generated can contain up to half of the total energy of the condensate, hence flash steam recovery is an essential part of an energy efficient system.

% flash steam=(SH-SL)/H*100 (1)

Where SH = Sensible heat in the condensate at the higher pressure before discharge, SL = Sensible heat in the condensate at the lower pressure to which discharge takes place and H = Latent heat in the steam at the lower pressure to which the condensate has been discharged.

Presently the condensate from jet dyeing machines is drained locally; thereby catering to huge enthalpy loss. Condensate from jet machine is recovered only. These is because of recovery of condensate from other machine is not beneficial. The amount of condensate and flash steam produced in each industry is given in table

Table 4.1 Amount of condensate formed

Name of industry	Total steam consumption (kg/day)	Amount of condensate formed (kg/day)	Amount of flash steam recovered (kg/day)
Vipul	63319	37312	2101
Vaishali	55104	36247	2043
Shikhar	63200	14368	810
Sachin	54144	33444	1865
Rivaa	89010	36764	2691
Sankalp	23080	8333	470
Tejoday	48464	39609	2233
Manila	48980	25553	1441
Rainbw	53140	38787	2187
Vaibav	19527	10004	564

From the audit conducted in 10 textile processing unit it is observed that nearly 5.9% of total fuel consumption is wasted through condensate drainage. ie, nearly a 7.1 T fuel is wasted per day. But this is the case of 10 industries, considering whole industry in the apparel park surat, nearly 40 T of coal is wasted per day, which is equivalent to a price value of 16 lac rupees.

Table 4.2 Total fuel saving in each industry

Name of industry	Fuel consumptions (kg/day)	Total fuel saving (kg/day	Monetary saving (Rs/Annum)
Vipul	15000	1188.48	1247901
Vaishali	16000	1154.86	1212613
Shikhar	18000	457.80	480698
Sachin	9000	737.87	1106820
Rivaa	14000	889.14	1333714
Sankalp	9000	185.44	278827
Tejoday	12000	883.47	1325170
Manila	8500	569.98	854979
Rainbw	12000	865.15	1297727
Vaibav	7500	223.13	334699

As per the study conducted, the textile industry in sachin GIDC has been consumed about 121 T of coal per day for steam generation. Through condensate and flash steam recovery, the potential reduction in fossil fuel consumption reduces and also raise the temperature of feed water to 80-90^0. The impact of heat recovery on boiler fuel consumption in textile plant is shown fig 4.1.

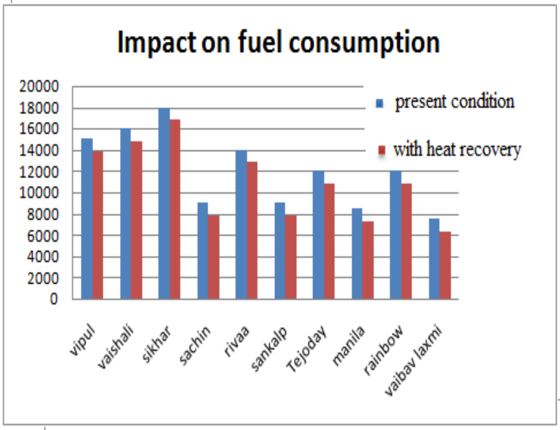

Figure 4.1 Impact on fuel consumption

Based on detailed studies carried in industries, some of the boilers were found to be inefficient and the efficiencies were found to be range of 50 to 60%. The following technological gaps were identified for low efficiency [3]: The boilers are of single pass or two pass flue gas path system leading to low heat transfer and high flue gas losses. High heat losses from the gate and surface due to damaged insulation and opening of the charging doors, No control on fuel firing, Partial combustion leading to un-burnt carbon. With heat recovery the efficiency of boiler increases to 2 to 6%

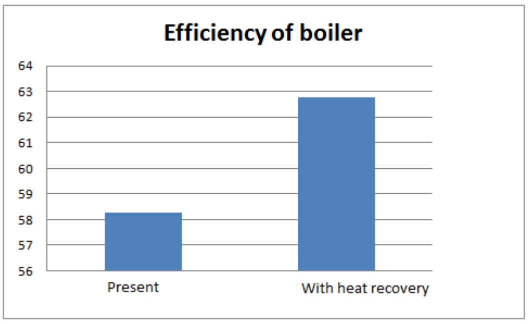

Figure 4.2 Boiler efficiency

V. IMPLEMENTATION OF FLASH STEAM SEPARATOR WITH CONDENSATE RECOVERY PUMP

Flash steam recovery not only reduces economic losses from the system, but it also reduces the steam flow in condensate return systems. The condensate flow out of the flash tank will have much less flash steam. If the discharge is pumped and the pressure is maintained greater than the flash vessel pressure, no flash steam will result in the condensate discharge piping. To manage this type of system, a flow meter should be installed in the flash steam exit. This steam flow should be monitored and recorded with respect to appropriate variables. The primary concern is to identify failed steam traps blowing through. The steam will be passed through to the flash steam outlet.[4]

During working the hot condensate from jet machine is collected in a flash vessel, where flash steam is seperated and feeded directly to feed water tank. And remaning condensate is collected in tank. From condensate tank it is feeded to feed water tank by a pump.

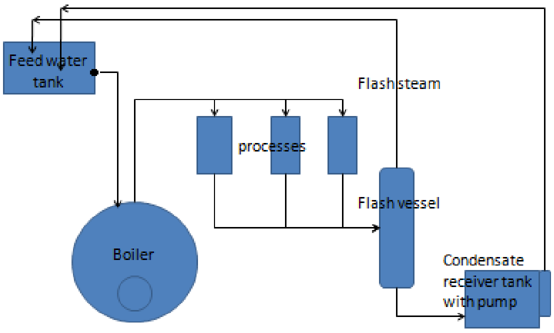

Figure 5.1 Boiler with heat recovery system

VI. CONCLUSION

The techniques and technologies of heat recovery from condensate are analyzed. Experiences prove that in most cases heat recovery requires low investment and has a low payback of normally less than 1 year. By reusing the condensate, feed water temperature increases to 90^0. Reuse of condensate as feed water significantly increases boiler efficiency. By turning to heat recovery, significant cost savings can be achieved.

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