Installation of Condensate Recovery System and Float Trap

A Case Study

Background

Micro, small and medium enterprises, jointly called as MSMEs, plays an important role in the Indian economy. There are around 26 million micro, small and medium enterprises units in the country, which provides employment to over 60 million people. Together, the MSME sector contributes over 45% of industrial production and over 40% of exports. The role of MSME sector is set to grow in the economic profile of the country. However, the sector has some inherent issues. The sector is one of the major consumers of energy. The sector consumed an estimated 50.5 million tonne of oil equivalent in 2012. The annual expected growth of energy consumption is about 6 percent annually. It is estimated that 15-20% percent of energy consumed by the sector could be saved. But, due to the small size and traditional nature of business holding and management, it becomes difficult for MSME units to adopt energy efficiency measures, without external supports.

Under this background, the Bureau of Energy efficiency along with Ministry of MSME and cluster level associations, initiated a project titled "National Program on Energy Efficiency and Technology Up-gradation in SMEs". Five MSME clusters were identified all over India for executing intervention measures. Pali Textile cluster was one among them. The project here in Pali, is supported by the Rajasthan Textile and Hand Processors Association.

The Cluster

The Pali textile cluster is one of the biggest MSME clusters in India having over 250 member industries. The units in the cluster are mainly located in two Industrial Areas namely Industrial Area Phase I & Phase II and Mandia Road Industrial Area. The units are classified into two segments mainly: 1) Hand Process Units 2) Power Process Units.

The BEE-SME project aimed to initially implement energy efficient technologies in selected units in the cluster. These units will act as demonstration units for long term and sustainable penetration of energy efficient technologies in the entire cluster. Inspire Network for Environment was selected as the implementing agency for the program.

The Process

The typical flow of the textile process starts with the De-sizing and Mercerizing of raw material. Subsequently, the fabric is fed into the Kier Boiler where scouring operations takes place, then the fabric undergoes bleaching followed by Air Drying (Adan). The next step is colouring of the fabric using jigger or jet dyeing method. This is followed by the finishing process where the material fabric undergoes pre-shrinking in a zero-zero machine. Although, this is a typical layout, other process improvement methods are used, as per requirement, by different units.

The Fabric is now ready for dispatch. The entire processing of fabric in a Textile Processing unit requires steam as the major input. For continuous supply of steam, a boiler or a thermic fluid heater is used. The baseline energy audit revealed that boiler is the major energy guzzler in a typical textile processing units.

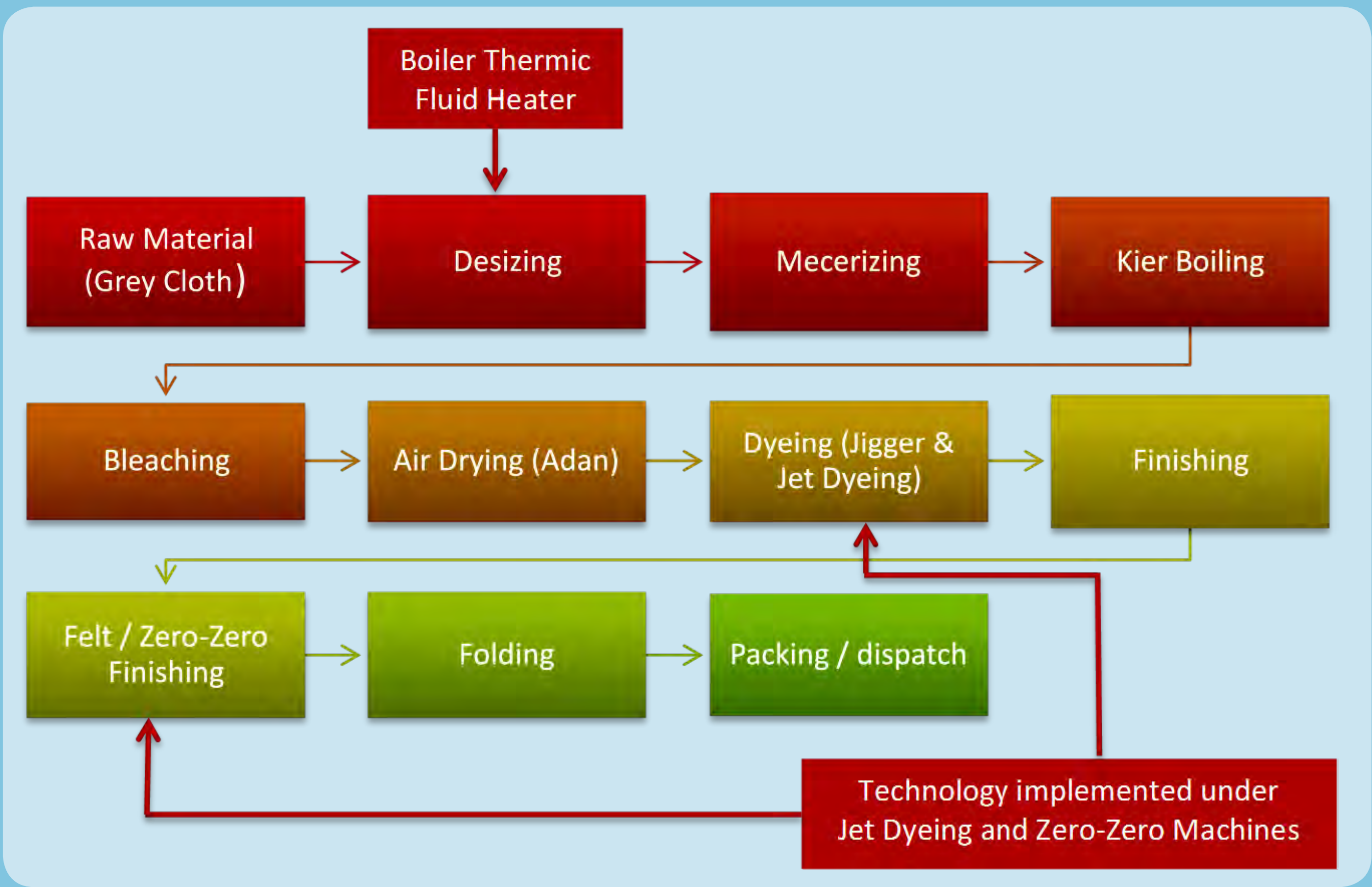


Fig: Process Flow of a Typical Textile Unit

Steam Operated Machines in a Textile Processing Plant – Baseline Scenario

Steam at a working pressure of 4-5 kg/cm2 is used in the textile processing units in a number of machines. For e.g. zero-zero machines are used for finishing operations wherein the fabric is rotated in circular rubber drum with blanket of steam rotating around it. Similarly, jet dyeing machines are used for pressurized dyeing (colouring) process, used mainly for polyester based fabric. A significant amount of steam is lost during the heating operation of the jet dyeing process, as the portion of the latent heat is transferred to the equipment line resulting in condensate formation. Also, a significant amount of steam is transformed to condensate during the cooling cycle of the jet dyeing process. In addition to these, heat available in exit water generated during the process is wasted during the water recycling process. Not wasting, but rather recovering and reusing as much of this sensible heat as possible through installation of condensate recovery system.

Also in typical units, no traps or thermodynamics traps are used in these pressurized steam machines. Thermodynamic traps work on the difference in dynamic response to velocity change in the flow of compressible and incompressible fluids. As steam enters, static pressure above the disk forces the disk against the valve seat. The static pressure over a large area overcomes the high inlet pressure of the steam. As the steam starts to condense, the pressure against the disk lessens and the trap cycles. This essentially makes a TD trap a "time cycle" device: it will open even if there is only steam present, this can cause premature wear. If non-condensable gas is trapped on top of the disc, it can cause the trap to be locked shut. In the current process, it was observed that the TD traps are not being able to remove condensate properly.

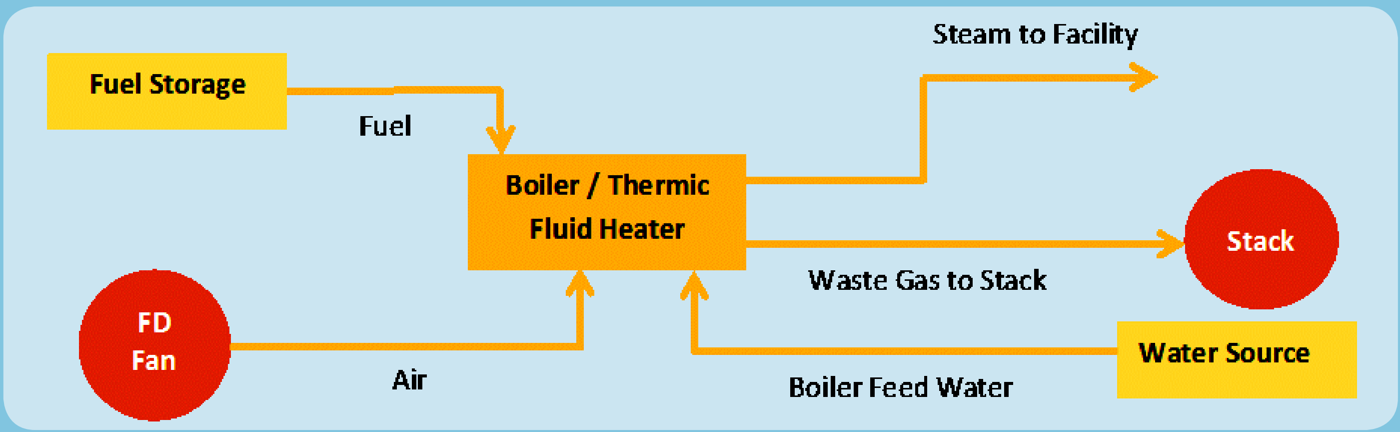


Fig: Typical Steam Process Flow without condensate recovery

Energy Efficient Technology

Predominately two technologies were implemented in the pressurized steam machines like the jet dyeing and the zero- zero machines, under the BEE-SME program i.e., Condensate recovery machine and the pneumatically operated float-traps.

EE Technology 1: Condensate Recovery Machine

In order to recover heat lost through condensate, it is proposed to install a condensate recovery system in the jet dyeing machines. Condensate recovery is a process to reuse the water and sensible heat contained in the discharged condensate. Recovering condensate instead of throwing it away can lead to significant savings of energy, chemical treatment and make-up water. Condensate can be reused in many different ways, for example:

- As heated feed water, by sending hot condensate back to the boiler's deaerator
- As pre-heat, for any applicable heating system
- As steam, by reusing flash steam
- As hot water, for cleaning equipment or other cleaning applications

Working Principle

The system includes a positive displacement condensate pump which can recover (suck) hot condensate and flash steam from the steam pipeline and feed the same into the boiler feed water tank. The pump may also be equipped with an in-built receiver for condensate which eliminates the need for a separate storage tank. The installation of the system will allow 100% recovery of condensate formed during the jet dyeing and the zero-zero process. The technology can be suitably modified for mechanical or sensor based control.

Benefits of the condensate recovery system are:

- Reduced fuel cost
- Lower water related expenses

EE Technology 2: Installation of Pneumatically Operated Float Traps

As per the study conducted in the unit, it is suggested to install pneumatically operated float traps in steam unit of jet dyeing machine in place of TD traps. These float traps will be able to filter out condensate in the machine exit and allow steam to pass through the line. The amount of steam being discharged along with the condensate can be saved in the process.

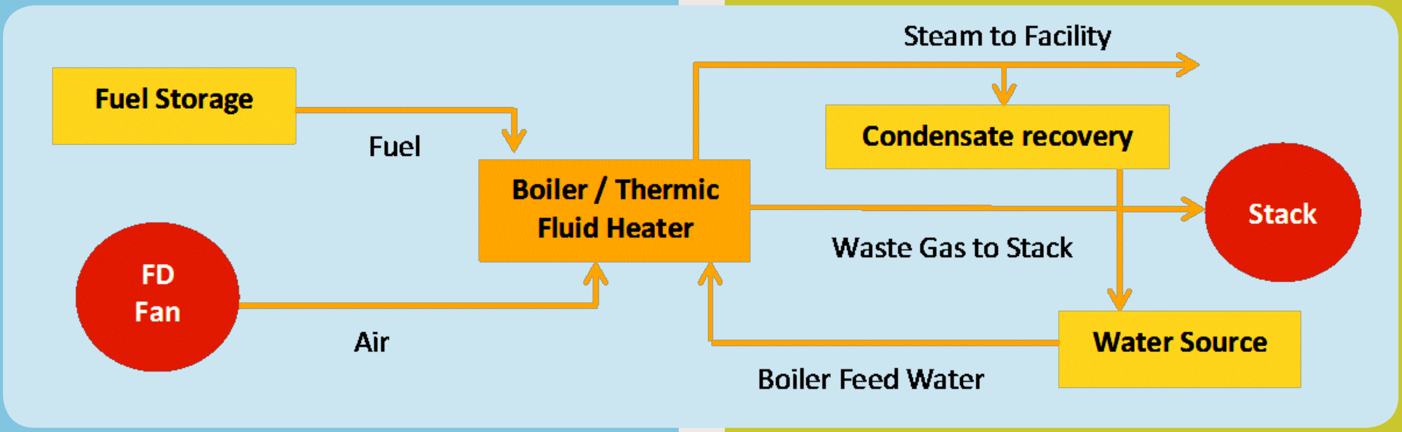
The installation of the float-traps in the steam utilizing units will lead to following benefits:

- Higher capacity turndown trap
- Complete Space Optimization – Area required for installation is less
- No welding required
- No Inline leakages
- Lesser Radiation losses
- Reduced transportation costs

Working Principle

Steam generated by a boiler contains heat energy which is used to heat the product. When steam loses it energy by heating the product, condensate is formed. Also, a part of energy contained by steam is lost through radiation losses from pipes and fittings. After losing this heat, steam gets converted into condensate. If this condensate is not drained immediately as soon as it forms, it can reduce the operating efficiency of the system by slowing the heat transfer to the process. Presence of condensate in a steam system can also cause physical damage due to water hammer or corrosion.

A Steam trap is an automatic drain valve which distinguishes between steam and condensate. A steam trap holds back steam & discharges condensate under varying pressures or loads. The steam traps should have good capacity to vent out air and other non-condensable gases quickly while holding back the live steam.



Typical Steam Flow Process with condensate recovery

Cost Benefit Analysis

Cost benefit analysis for installation of a condensate recovery system in a typical unit is tabulated below:

Cost Economic Analysis of proposed condensate recovery system in a jet dyeing machine			
SN	**Particular**	**Unit**	**Value**
1	No. of Jet Dyeing Machine	no	2
2	Steam Consumption of Jet Dyeing M/c per hr	kg/hr	250
3	No.of Batches per day	no	5
4	Condensate recovery potential (considering heating cycle of 45 mins)	kg/day	1875
5	operating days	days	330
6	Sensible heat @ 4kg/cm^2	kcal/kg	144
7	Sensible heat @ 0.5 kg/cm^2	kcal/kg	111
8	Latent heat @ 0.5 kg/cm^2	kcal/kg	532
9	Flash steam quantity saved	kg/day	116
10	Savings with flash stem (A)	Rs	38381
11	Balance condensate stem	kg/day	1759
12	Temperature of condensate	°C	95
13	Make up water temperature	°C	35
14	Gain in enthalpy	kcal/d	105522
15	GCV of fuel	kCal/kg	8200
16	Cost of fuel	Rs/kg	7.5
17	Savings with condensate stem	Rs	79624
18	Total quantity of RO water generated per day	Ltr/day	1875
19	Cost of RO water per liter	Rs	0.3
20	Savings from Ro water per year (B)	Rs	185625
21	Total Saving (A+B)	Rs	303630
22	Cost of condensate recovery system	Rs	500000
23	Simple pay back	months	20
24	Fuel saving	kg/hr	87
25	Energy saving	%	16.67
26	Annual energy saving	toe	36.08
27	Annual GHG emission reduction	tCO_2/yr	41.02

*Cost of fuel has been taken as Rs 7.5/kg

** Emission factor of coke taken as 113.67 tCO2/TJ

Cost benefit analysis for installation of a float trap in a typical unit is tabulated below:

Cost Economic Analysis of proposed flot trap in a jet dying machine			
SN	**Parameter**	**Unit**	**Value**
1	Bypass Valve size	mm	25
2	Percentage opening of bypass valve	%	20
3	Orifice size of opened valve	mm	5
4	Operating pressure	kg/cm^2	4
5	Steam leakage per batch per jet dyeing machine (considering 45 min heating cycle/jet dyeing	kg/batch/jet dyeing m/c	30
6	No. of batches	no.	5
7	Total steam leakage /day/ jet dyeing	kg/day/jet dyeing m/c	150
8	No. of jet dyeing machine	no.	5
9	Quantity of steam saved	kg/day	750
10	Energy saved	%	27
11	Quantity of fuel saved daily	kg/day	131
12	Annual fuel saving	kg/yr	43148
13	Annual cost saving	Rs/yr	323606
14	Investment	Rs	275000
15	Pay back	months	10
16	Annual Energy Savings	toe	35.60
17	Annual GHG emission reduction	tCO_2/yr	40.46

* Cost of fuel taken as Rs 7.5/kg

** Emission factor of coal taken as 113.67 tCO2/TJ

Implementation at a Glimpse

Jet dyeing with condensate recovery system at Manoj Dyeing

Float trap at Shree Rajaram Mills

Float trap installed at Simandhar Fabtex

Float trap installed at Rajaram Mills

Implementation References

Condensate Recovery System and float Traps has been successfully implemented in the following units in Pali:

- M/s Rajaram Mills Pvt. Ltd.
- M/s Simandhar Fab Tex Pvt. Ltd.
- M/s Manoj Dyeing

The benefits achieved by the plants have been summarized in the table below:

Simandhar Fab Tex Pvt. Ltd.

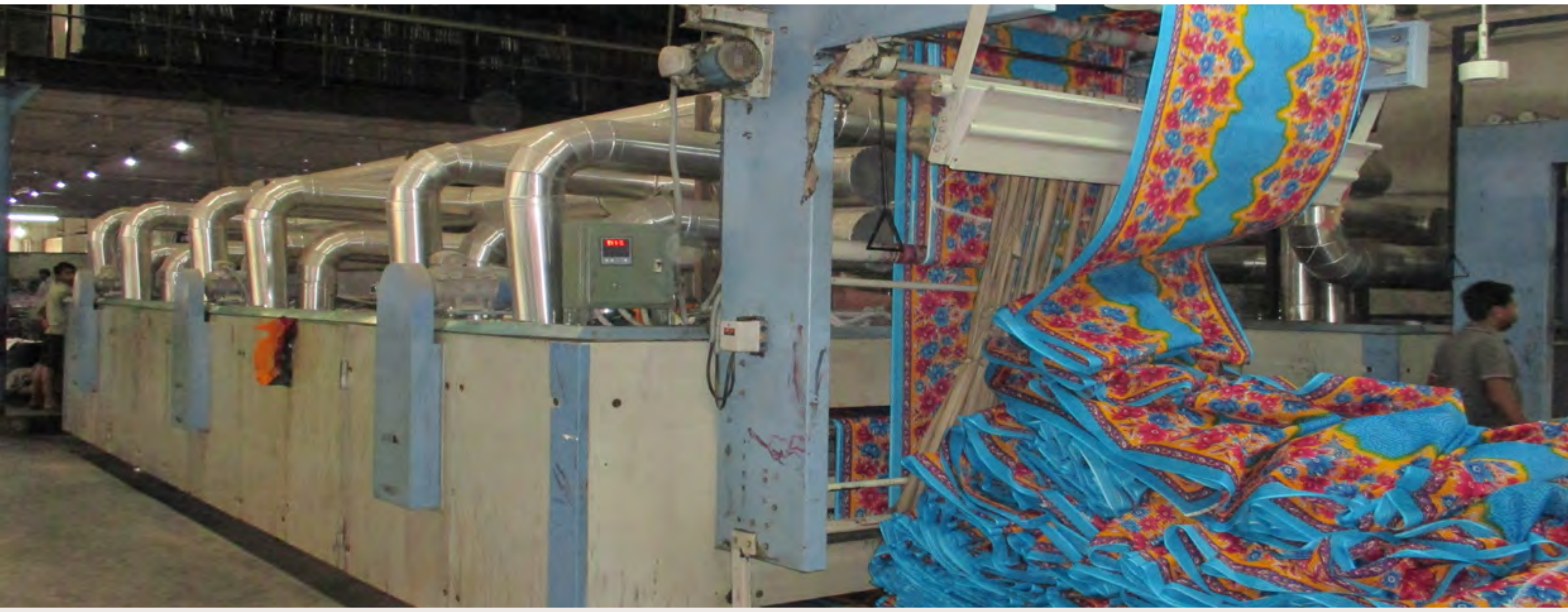
Energy Efficient Technology implemented	Investment (INR Lakhs)	Simple Payback period (months)	Percentage Savings in specific energy consumption from baseline (%)	Annual Energy Savings (TOE)	Annual CO_2 emission reduction (tCO_2/year)
Float Trap in Zero-Zero Machine	1.97	11	4.25	24.06	114.48

Shri Rajaram Mills

Energy Efficient Technology implemented	Investment (INR Lakhs)	Simple Payback period (months)	Percentage Savings in specific energy consumption from baseline (%)	Annual Energy Savings (TOE)	Annual CO_2 emission reduction (tCO_2/year)
Condensate Recovery System (CRS) in Jet Dyeing Machine	1.22	5	15.33	3.20	15.24
Condensate Recovery System (CRS) in Zero-Zero Machine	1.22	2	12.00	8.02	38.18
Float Trap in Jet Dyeing Machine	0.75	3	25.00	35.38	168.40
Float Trap in Zero-Zero Machine	2.78	16	10.00	22.60	107.74

Manoj Dyeing

Energy Efficient Technology implemented	Investment (INR Lakhs)	Simple Payback period (months)	Percentage Savings in specific energy consumption from baseline (%)	Annual Energy Savings (TOE)	Annual CO_2 emission reduction (tCO_2/year)
Condensate Recovery System (CRS) in Jet Dyeing Machine	3.05	6	37.33	6.68	31.78



for more information

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