

ENERGY & FUEL SAVINGS BY ADAPTING STEAM TRAP MAINTENANCE IN TEXTILE PROCESSING INDUSTRIES

- Experiences from User Group Tirupur-

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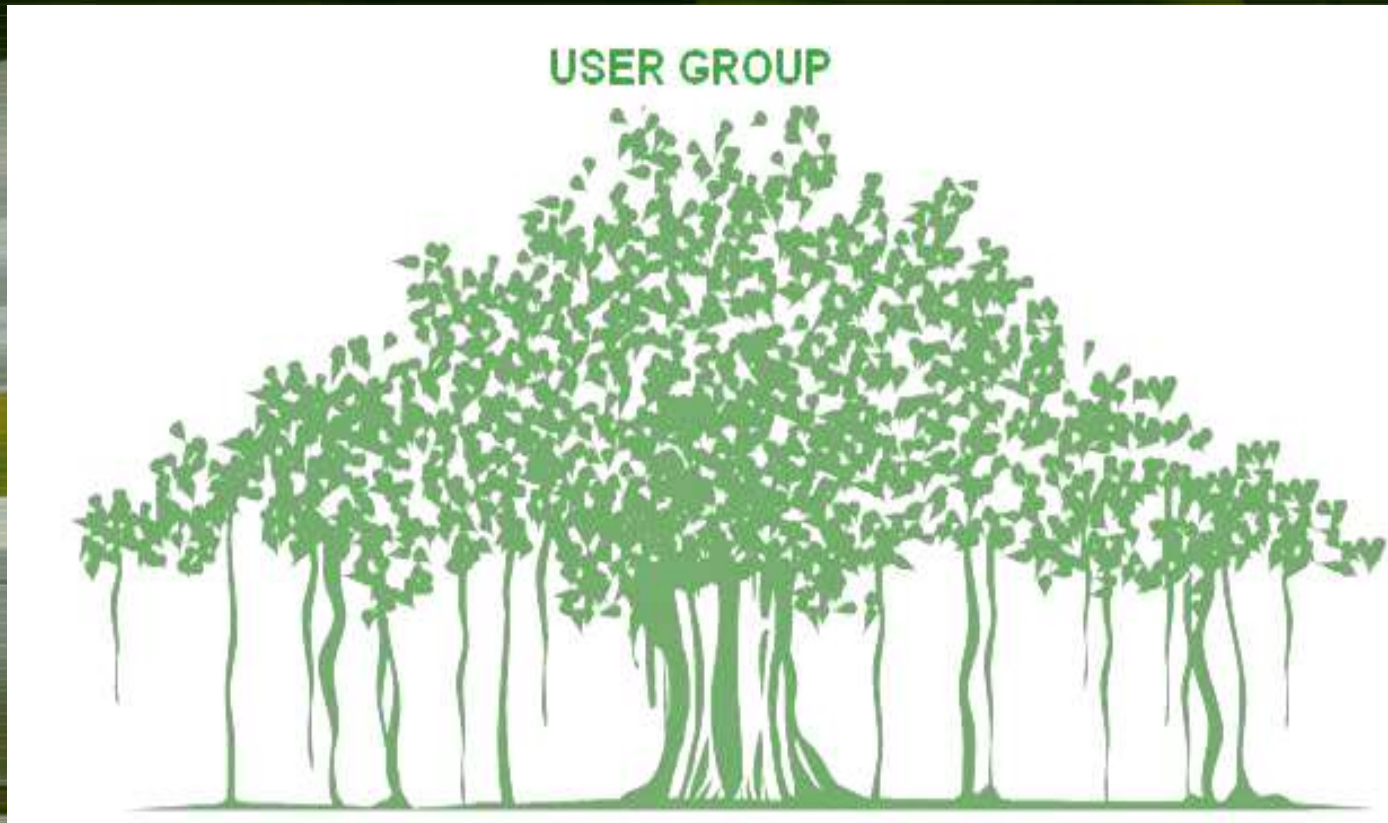
Conquest Quality Systems Services Private
Limited

TIRUPUR



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ENERGY MANAGEMENT IN TEXTILE PROCESSING INDUSTRY



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“User Group” is a well known methodology where companies with **comparable processes collectively discuss** problems and identify solutions. Comparable industrial **processes are optimised** by means of adjustments initiated by the **exchange of experiences and gaining knowledge** on new technologies.



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The Project was supported by :



Ideas, Methodology & Technical
Inputs by:



Co-ordinated by:



Facilitation by:



User Group



- Learning through Discussions.
- Developing base information and evaluating the individual company's position.
- Implementing learned experiences.
- To attain successful results, Monitoring the implemented actions.
- Reporting it to the top management for further positive supports in energy management.
- Sharing of learned & observed findings.

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THE PARTICIPANTS...

1. Kalphaga - Sri Palani Murugan Enterprises - Sipcot Perundurai
2. Mahan Tex - Sipcot Perundurai
3. Poppy's Art - Tirupur
4. Precot Meridian - Sipcot Perundurai
5. RBR Garments - Tirupur
6. Renaissance - Tirupur
7. Shakthi Knitting - Tirupur
8. Shri Bhavani Textile Processors – Gobichettipalayam
9. Tube Knit Fashions Limited - Tirupur
10. Victus Dyeing - Tirupur

With a combined capacity
of 64 Tonnes of Steam



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THE DYNAMICS...



Voluntary participation

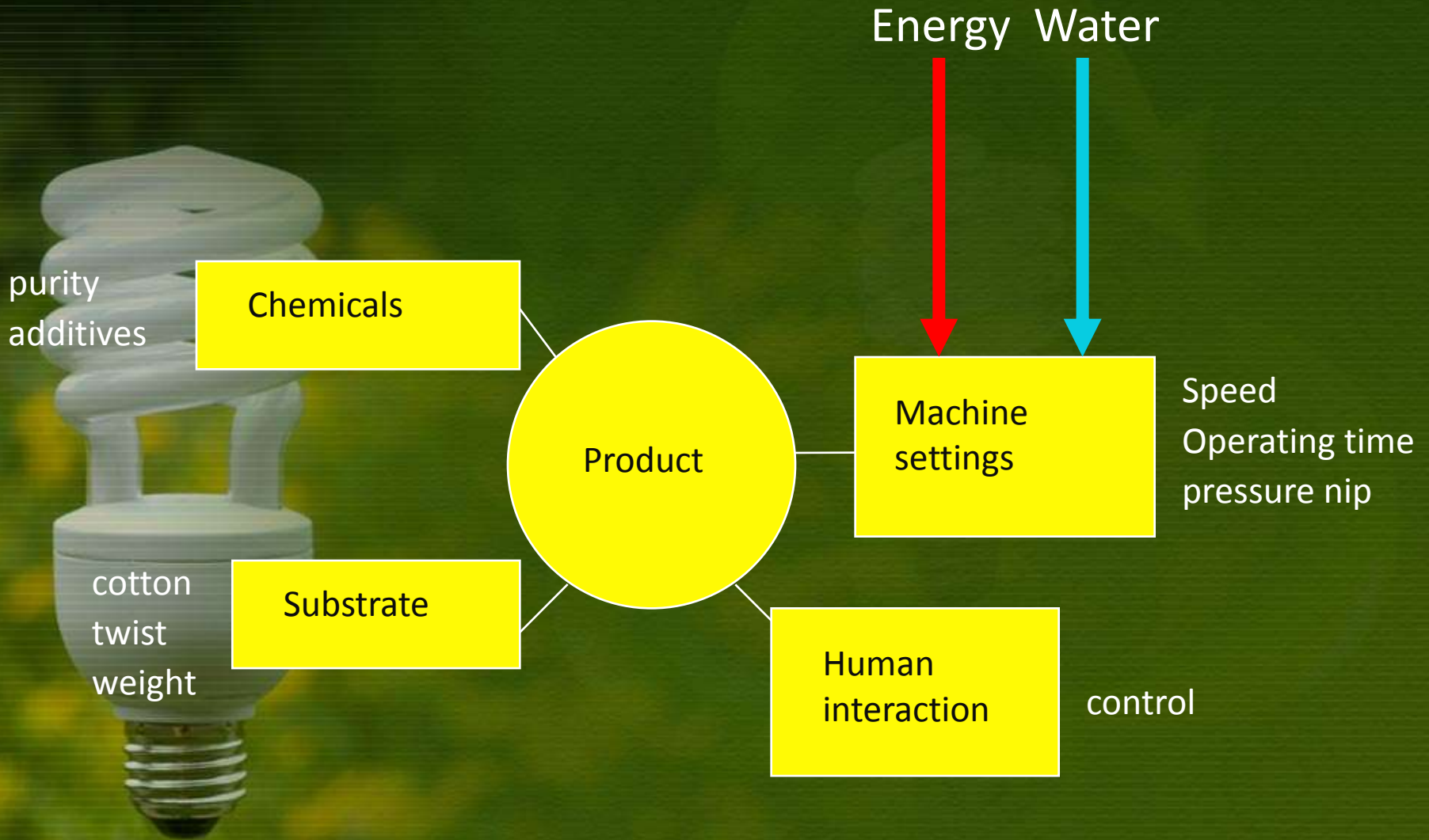
Ready To Learn

Open Discussions

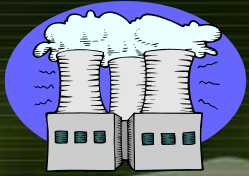
Agree to Disagree

Exploratory

Textile fabrics process



Possible process parameters



Consumption:

- water
- electricity
- wood
- steam



Machine settings:

- temperature
- fabric speed
- squeeze pressure
- tension



Fabric parameters:

- fabric weight
- width
- bow and skewness
- colour
- shrinkage



Chemicals:

- purity
- quality dyes

Energy

- In a textile process, steam energy is playing vital role to impart colour to the fabric.



Energy Modes:

- Wood
- Natural gas
- Furnace oil
- Electricity
- Steam
- Thermal oil
- Compressed air

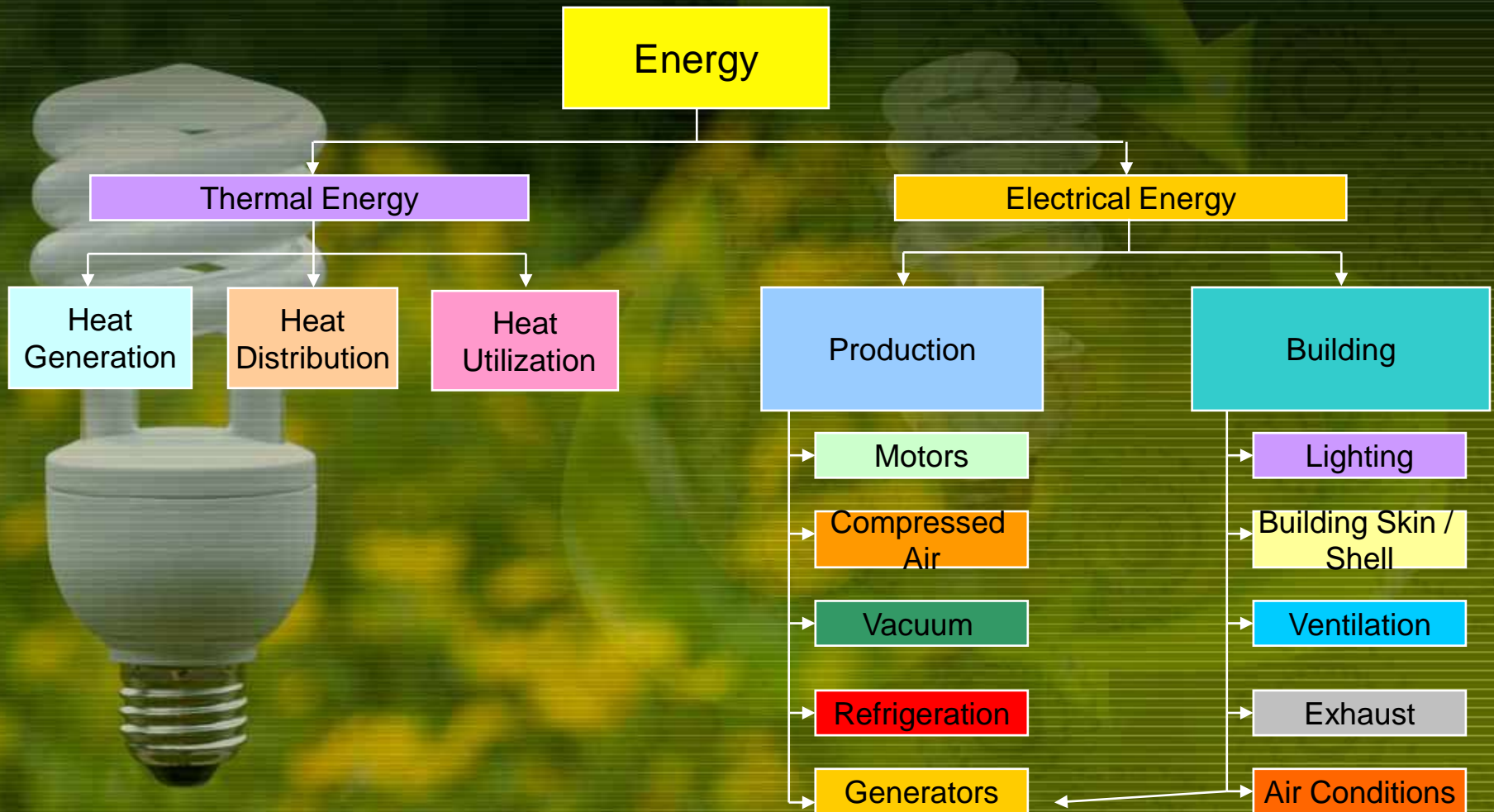
Application:

- Boiler
- Motors (fans)
- Air conditioning
- Compressors
- Lighting

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THE FOCUS...



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❖ The project the team focused on available energy conservation opportunities from,

I. Recovering heat from Flue gas

II. Improving boiler efficiency & evaluation of the energy losses,

III. Insulation of feed water tank, Pipe lines,

IV. Condensate recovery,

V. Maintenance of heat exchanger,

VI. Maintenance of steam traps etc.



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Ground Zero !

BESS = Benchmarking
and Energy
Management Schemes
in SME's

www.bess-project.info/

“Horizontal Measure
List”



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ENERGY MANAGEMENT IN TEXTILE PROCESSING INDUSTRY BESS – MANUAL ...

3.6 Horizontal measure list

PRODUCTION PROCESSES

Thermal energy

Heat generation

Low-cost / short term opportunities	
Energy Saving Opportunity	Action to Check
1. Reduce excess combustion air to minimum	1. CO ₂ /O ₂ measurement
2. Maximise completeness of combustion	2. Soot/CO measurement
3. Maintain boiler cleanliness (soot/scale)	3. Monitor for rise in flue gas temperature
4. Repair (replace) boiler insulation	4. Periodic inspection of boiler insulation condition.
5. Insulate feedwater tank - cover tank	5. Check possible feedwater temperature losses
6. Insulate condensate return lines	6. Check possible heat loss from condensate return lines.
7. Optimise quality of make-up water and feedwater	7. Monitor quality of make-up water and feedwater: hardness, acidity, O ₂ .
8. Minimise blowdown	8a. Monitor concentration of dissolved solids in boiler water. 8b. Improve blowdown controls
9. Maintain nozzles, grates, fuel supply pressure/temperature at manufacturers' specifications	9a. Ensure specifications are available and in use. 9b. Regular check and resetting/maintenance.
10. Maximise combustion air temperature	10. Draw air from highest point in boilerhouse.
11. Reduce steam pressure where it exceeds system/process requirements.	11. Check system/process needs; adjust controls.
12. Use duct for intake of warmer combustion air	12. Install duct from combustion air intake to higher parts of room.
13. Install an automated gas leakage detector.	-
14. Repair leaks in steam pipework.	-
Higher cost / longer term opportunities	
Energy Saving Opportunity	Action to Check
1. For rapidly varying demand, convert one or more boilers to live accumulator (buffer tank).	1. Monitor/evaluate demand change patterns.
2. Alter controls to "High-Low-Off" or "modulating-Low-Off"	2. Monitor/evaluate demand change patterns.
3. Install flash steam heat recovery	3. Consider in large capacity situations with high (continuous/frequent) blowdown. 4a. Provide adequate heat input to meet demand. 4b. Minimise fuel/pollution. 4c. Protect personnel/equipment.
4. Improve combustion controls.	5a. Economiser 5b. Air heater (recuperator)?
5. Waste heat recovery	6. Consider in large capacity situations with high (continuous/frequent) blowdown.
6. Install boiler blowdown heat recovery.	7. Couple process units that have significantly different heat requirements (i.e. low-pressure steam leaving a high-pressure steam consuming production process can be used for a process requiring low-pressure steam).
7. Use process integration	

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BESS – MANUAL ...

Heat Distribution

Low-cost / short term opportunities	
Energy Saving Opportunity	Action to Check
1. Repair/replace faulty insulation	1. Pipework insulation – especially around valves.
2. Repair inefficient steam traps/drains, valve spindles etc.	2. Regular checks for leaks throughout the system.
3. Insert valves to isolate "periodic-use" items in system.	3. Check system for periodic (a.g. seasonal, nightly) items (e.g. space heaters).
4. Remove/isolate "dead-legs" and redundant pipework.	4. Check for dead-legs and redundant piping.
Higher cost / longer term opportunities	
Energy Saving Opportunity	Action to Check
1. Replace steam traps/drains with more efficient designs.	1. Monitor efficiency of, and heat losses from existing traps.
2. Replace or increase insulation	2. Check existing insulation: estimate heat losses in system.
3. Maximise condensate returns.	3. Measure "discarded" heat from condensate.
4. Redesign system to minimise pipe runs.	-
5. Generation pressure reduction.	-

Heat Utilisation a) process

Energy Saving Opportunity	Action to Check
1. Plant insulation	-
2. Local burner efficiency	-
3. Maximise heat transfer rate	-
4. Improve controls (e.g. thermostats)	-
5. Consider alternative energy source	-
6. Ensure plant at high load factor	-
7. Eliminate uneconomic "hot standby" periods	-
8. Recycle waste heat to process	-
9. Recover heat, for use elsewhere	-
10. Train all staff to operate manual controls and to watch for energy saving opportunities.	-

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ENERGY MANAGEMENT IN TEXTILE PROCESSING INDUSTRY BESS – MANUAL ...

Heat Utilisation b) space heating

Low-cost / short term opportunities	
Energy Saving Opportunity	Action to Check
1. Use heat only when area is occupied	-
2. Set thermostats to minimum for comfort	-
3. Minimise loss of hot air	-
4. Clean and effective heaters	-
5. Maintain pipe insulation in unheated areas	-
6. Check condensate traps	-
7. Vent air from hot water systems	-
8. Time switches	-
9. Manual controls where appropriate	-
Higher cost / longer term opportunities	
Energy Saving Opportunity	Action to Check
1. Install more/more efficient thermostats	-
2. Use motorised valves to divide building into different zones	-
3. Air curtains	-
4. Change energy source	-
5. Change heating system – where:	
<u>Insulation</u> <u>Ventilation</u> <u>Use</u>	
Good High Radiant Heat	
Poor Low Convective Heat	
6. Improve building insulation	-

Electrical Energy

Motors

Energy Saving Opportunity	Action to Check
1. Try to ensure that motor capacity is not more than 25% in excess of full load.	-
2. Install motor controllers (voltage, power factor and fixed speed controllers).	-
3. Build in "soft-start" facilities.	-
4. Install variable speed drives	-
5. Install high efficiency motors	-

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THE OPTIONS... LEARNED FROM BESS....

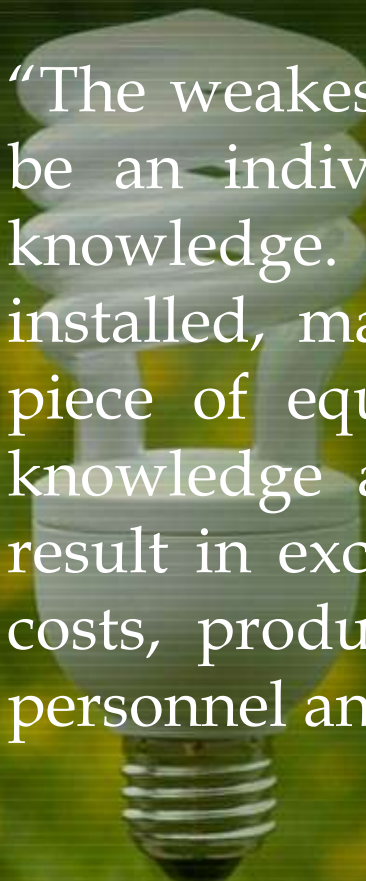
High Cost Long Term

Low Cost Short Term



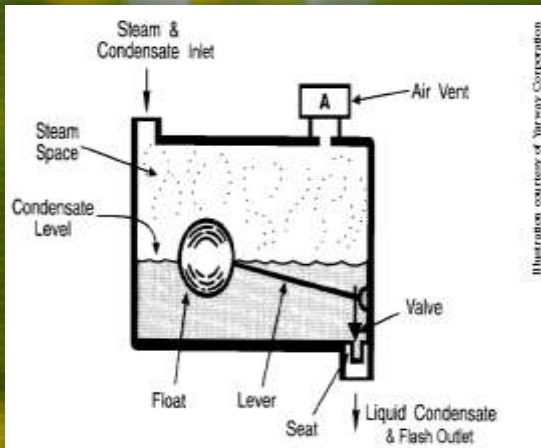
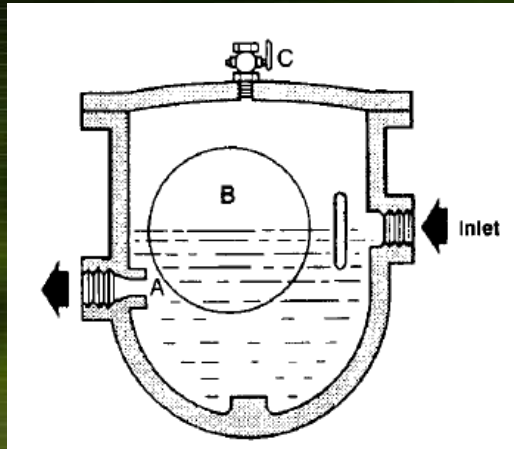
STEAM TRAP

"Lack of Steam Trap Knowledge Is the Weakest Link", By Thomas K. Lago, PM Engineer Magazine, July 1, 2002.



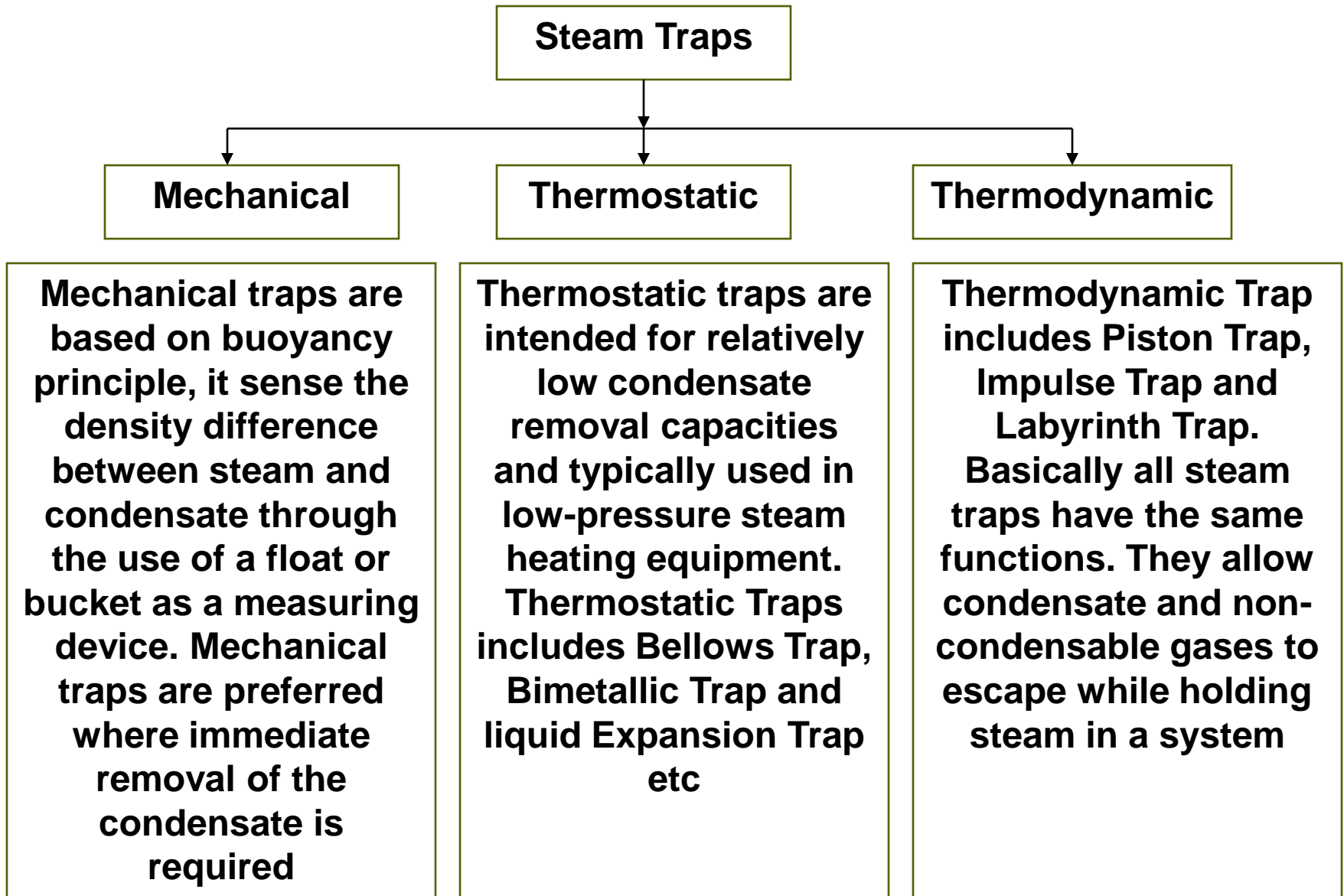
“The weakest link when it comes to steam systems may not be an individual component, but a fundamental lack of knowledge. For example, a steam trap, when properly installed, may be the most beneficial but least understood piece of equipment in the system. However, the lack of knowledge about steam traps and how they function can result in excessive energy loss, compounded environmental costs, productivity problems, and yes, safety concerns for personnel and property”.

STEAM TRAP



- Steam is used as a heating medium through its latent heat. That means that the vapor is condensed as it gives up its heat content.
- In order to have continuous steam heat, one must continuously remove the condensate formed.
- A steam trap is nothing but a separation device; steam trap continuously removes the condensate formed inside the system.
- Proper condensate removal is essential for efficient plant and process operation.
- There are various types of steam traps available, No single type of trap is suitable for all applications.

Steam Trap Classification



STEAM TRAP

The required action of steam traps are given below;



- Steam trap must vent air and other gases from piping and equipment.
- It should prevent the flow of steam into the condensate piping system.
- Steam trap must allow only condensate into the condensate piping system.

What could happen if Trap fails?



- If condensate is allowed to collect in the pipe line, it reduces the flow capacity of steam lines and can lead to “**water hammer,**” with potentially destructive and dangerous results.
- Change in the heating cycle timings.
- Losses of energy

The Fact!



- The fact to understand is that all *new steam devices leak a certain percentage of steam even when newly installed into a steam system.* The most important factor is identifying the percentage or quantity of steam leakage.


Steam Trap leaking test standard

- Steam trap leak testing standards formed in the early 1980's by ANSI/ASME. The ASME Code PTC 39.1 is described by ASME as follows:

- This Code covers devices used in removing condensate and non-condensable gases from steam systems. It covers devices used for intermittent or continuous removal of fluids such as steam traps, orifices and valves. The purpose of this Code is to specify and define the practice of conducting tests of condensate removal devices to determine: (a) Condensate discharge capacity, for specified conditions of saturated and sub cooled condensate and back pressure. (b) Steam loss, under specified conditions.



"Any steam management system should include steam trap monitoring as a basic tool to reduce waste, costs, and environmental liability. Whether this is conducted manually or automatically will depend on the size of the site, the number of traps, the number of personnel, and the urgency of repair." - Spirax-Sarco



“In steam systems that have not been maintained for 3-5 years, between 15 to 30% the installed steam traps may have failed-results steam leaks. Experts claim that leakage in a steam trap may results in increasing in the operational costs. Further experts estimate that in a plant with no active steam trap testing and repair program, 50% of the traps are blowing steam. With monthly inspection and prompt repair, this figure can be reduced to fewer than 3%”.

Maintenance Schedule for Steam Traps

Recommended time schedule for testing steam traps



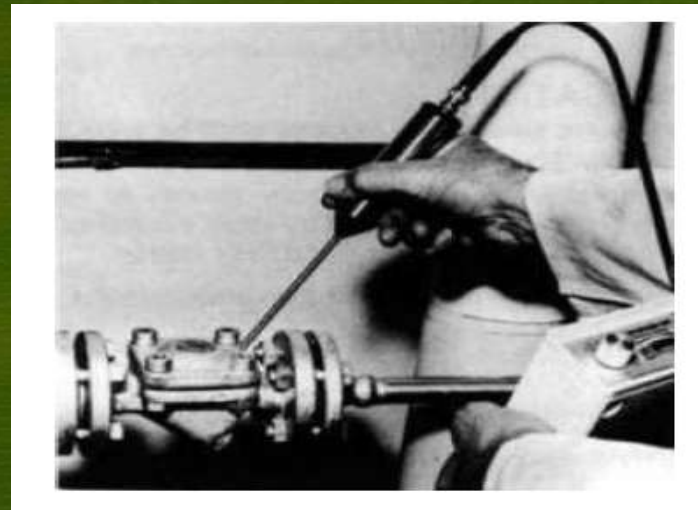
- Process steam traps Every 3 months
- High pressure (150 psig) steam traps Every 6 months
- Low to medium pressure (30-150 psig) steam traps Every 6 months
- Building heating steam traps Twice a heating season.

Common Trap Failures

BT	Blow Thru	Trap has failed in an open mode with maximum steam loss. Trap should be repaired or replaced.
LK	Leaking	Trap has failed in a partially open mode with a steam loss of approximately 25% of maximum. Trap should be repaired or replaced.
RC	Rapid Cycling	Disc trap going into failure mode.
PL	Plugged	Trap has failed in a closed position and is backing up condensate. Trap should be repaired or replaced.
FL	Flooded	Trap is assumed to be undersized and unable to handle the condensate load. Trap should be replaced with proper size.
OS	Out of Service	The steam supply line is off and the trap is not in service.

Testing Steam Trap Functionality

- ***Visual Inspection***
- ***Temperature Measurement*** – Sense upstream and downstream temperatures with contact pyrometers or infrared detectors.
- ***Ultrasonic Detection*** – Ultra sonic sound devices.



What we have adapted

- We adapted the method of measuring the pressure at the inlet & outlets of trap through temperature measurements.
- And Masoneilan Formula
- Using Infra red Thermometer



Photo courtesy of Raytek Corporation

The equation used to calculate the stipulated savings from loss through a trap that has failed: (Masoneilan Formula) *Ref: UNFCCC - AM0017/Version 02*

$$L_{t,y} = FT_{t,y} \times FS_{t,y} \times CV_{t,y} \times h_{t,y} \times \{(P_{in,t} - P_{out,t}) \times (P_{in,t} + P_{out,t})\}^{1/2}$$

where; $L_{t,y}$ = Is the loss of steam due to the steam trap t during the period y in Kg of steam.

$FT_{t,y}$ = Is the failure type factor of steam trap t during the period y.

$FS_{t,y}$ = Is the service factor of steam trap t during the period y.

$h_{t,y}$ = Are the hours of steam trap t is operating during the period in y in hours.

$P_{in,t}$ = Is the pressure of the steam at the inlet of steam trap t in psia.

$P_{out,t}$ = Is the pressure of the condensate at the outlet of steam trap t in psia.

Condition: The equation is only valid for outlet pressures $P_{out,t} \geq (P_{in,t}/2)$; Hence if this condition is not satisfied; use $\{P_{in,t}/2\}$ in the formula.).

Factors Used for the Calculation

Based on type of failure & type of trap

Type of Failure	FT
Blow thru -----	1
Leaking -----	0.25
Rapid cycling -----	0.2

Application	Capacity	Safety factor S	Service Factor FS
Process steam traps		1.75	0.9
Drip & tracer steam traps		3	1.4
Steam flow (No condensate)	Very large		2.1

$$CV = 22.1 \times D^2$$

Where,

CV = Is the Flow Co-efficient.

D = Is the diameter of the Orifice of the steam trap in Inches.

Trap Survey parameters Sheet

STEAM TRAP EVALUATION SURVEY : USER GROUP - TIRUPUR

Department Name								
Steam Trap Type	Total number of traps				Survey Carried out by			
Float					Date			
Thermo dynamic					Time			
Bucket					Evaluated By			
Other					Approved By			
<i>Sl no/ Trap Number</i>	<i>Steam Trap</i>	<i>Location</i>	<i>Size (Inch)</i>	<i>Temperature - In</i>	<i>Temperature - Out</i>	<i>Pressure - In(Psi)</i>	<i>Pressure - Out (Psi)</i>	<i>Status of the Trap: Leaking, Blowing, Clogged</i>
1								
2								

Model Trap Survey Sheet

Steam Trap Evaluation Survey

SI no	Condition of Trap	Operation Perid	Orifice Size	Pressure (Psia)		<i>P_{out} ≥ (P_{in}/2); Hence if this condition is not satisfied; use (P_{in}/2) in the formula.</i>		$\frac{\{(P_{in,t}-P_{out,t}) \times (P_{in,t}+P_{out,t})\}^{1/2}}$	Failure Type Factor FT	Safety Factor	Service Factor	Flow Coefficient CV	Number of Traps Failed in he specified condition	Estimated Steam savings per Year in Kg per trap	Estimated Steam Savings Kg/ Hr	Total Savings
	Blow thru/Leaking/Rapid Cycling/Plugged	Hrs/Yr	Inch	P _{in}	P _{out}	P _{in} -P _{out}	P _{in} +P _{out}	Pressure calculation	SF Enter value: Process Steam Traps - 1.75 Drip & Tracer - 3 Steam flow (No condensate) - Very large FT Enter value: Blow thru - 1 Leaking - 0.25 Rapid Cycling - 0.2		FS Enter value: Process Steam Traps - 0.9 Drip & Tracer - 1.4 Steam flow (No condensate) - 2.1	CV = 22.1 X (Orifices size in inches) ²		$L_{st} = FT \times FS \times CV \times h \times \{(P_{in}-P_{out}) \times (P_{in}+P_{out})\}^{1/2}$ (Masonilan Formula) Ref: UNFCCC - AM0017/Version 02	W	L _{st}
1	Blow Thru	6000	0.118	22	13	9	35	17.74823935	1	1.75	0.9	0.3077204	1	29492.07468	4.915345781	29492.07468
2	Leaking					0	0	0				0		0	#DIV/0!	0

Savings from Trap Maintenance....

SL NO	COMPANY NAME	TOTAL NUMBER OF TRAPS	SURVEY CARRIED OUT FOR	STEAM TRAP DETAILS			FAULTY TRAPS DETAILS				SAVINGS DETAILS		
				TD	FLOAT	BUCKET	NO OF LEAKING TRAPS	NO OF BLOWING TRAPS	RAPID CYCLING	CLOGGED	STEAM SAVINGS IN TONNES	STEAM COST in INR PER TONNE	COST SAVINGS THRO MAINTENANCE
1	A	-	-	-	-	-	-	-	-	-	-	-	-
2	B	32	32	8	19	5	0	0	0	0	0	0	0.0
3	C	29	29	27	2	0	2	3	0	0	78.14	900	70322.0
4	D	-	-	-	-	-	-	-	-	-	-	-	-
5	E	3	3	3	3	0	0	0	0	0	199.69	900	179720.0
6	F	0	0	0	0	0	0	0	0	0	113.77	800	91012.5
7	G	0	0	0	0	0	0	0	0	0	-	-	-
8	H	32	32	6	26	0	4	0	0	0	627.11	900	564403.00
9	I	71	71	56	13	2	20	0	0	4	982	800	785484.0
10	J	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-	-NA-
		TOTAL NUMBER OF TRAPS	SURVEY CARRIED OUT FOR	TD	FLOAT	BUCKET	NO OF LEAKING TRAPS	NO OF BLOWING TRAPS	RAPID CYCLING	CLOGGED	STEAM SAVINGS IN TONNES	STEAM COST in INR PER TONNE	COST SAVINGS THRO MAINTENANCE
	TOTAL	286	264	128	128	8	38	6	4	4	2000.71	4300	1690941.5

Total Fuel savings of about 670 Tonnes

Total Cost savings of about 17 Lacs

Page 1

- THE USER GROUP PROJECT'S TOTAL ENERGY SAVINGS COMBINED SAVINGS FROM TRAP MAINTENANCE, INSULATION OF FEED WATER TANK, INSULATION OF CONDENSATE PIPE & STEAM PIPES IS



1500 Tonnes of Fuel Savings

42 Lacs of Savings per annum

SAVINGS DETAILS		
<i>FUEL SAVINGS IN KGS</i>	<i>FUEL COST in INR PER TONNE</i>	<i>TOTAL COST SAVINGS INR</i>
1500987.34		4141551.26

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THE LEARNINGS...

Fuel Savings leading to money savings,
Leading to...



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THE LEARNINGS...

Reduction in CO₂ Emissions

1720 Tonnes !!!



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