INSTALLATION OF AUTOMATION AND CONTROL SYSTEM IN BOILER

(*For Surat Textile Cluster*)

Cluster Brief:

Surat, known as the synthetic capital of India, is house to about 400 textile processing units, involved in processing of synthetic sarees and dress materials. The textile processing units can be broadly classified into 'Dyeing' units and 'Printing' units. Most of the units have the facilities of both dyeing and printing. The sarees and dress materials produced in Surat cluster are not only marketed in India but also exported to various countries. The textile processing units in Surat, are mainly micro, small and medium enterprises (MSMEs) and are spread over various location like Palsana, Sachin, Pandesara and Surat city industrial areas. The main raw material for the cluster is polyester grey cloth which is sourced from local polyester producers in and around Surat. Majority of the industries located in Surat are wet processing units which requires high amounts of thermal energy in the form of steam and thermic-fluid, leading to a high share of energy cost. The sector is unorganized in nature, mostly using old and inefficient technologies. There is a significant potential to make these units energy efficient and cost competitive, through accelerated adoption of energy efficient technologies in the cluster.

Existing practice:

Textile processing units at Surat are equipped with boilers in the range of 6 TPH to 12 TPH which are typically fired using solid fuel i.e. coal. Most of these boilers are equipped with waste heat recovery system. Although, there are VFDs installed in the FD / ID Fans, the air flow control is manually done in most of the units. Studies suggest that most of the units fail to maintain the correct amount of air in the combustion chamber, required for optimum combustion. This leads to incomplete combustion with a significant percentage of the heat loss through dry flue gas loss. The excess air flow can be determined by the free oxygen percentage in the flue gas which automatically leads to higher excess air percentage. Also, the draft pressure is not monitored and controlled to the desire level. The blow-down control in the boiler is also manual which leads to a lower boiler efficiency. The following table shows the variation in the oxygen percentage in different units with coal as fuel:

Units Name	**Fuel Type**	**GCV**	**Boiler Capacity (TPH)**	**Oxygen Percentage (%)**	**Excess Air (%)**
Annapurna	Coal (lignite)	3100	4	15.1	256%
	Coal (mixed)	4100	5	8.6	69%
Aggarwal	Coal (mixed)	4200	5	9.6	84%
Ravi Exports	Coal (mixed)	4200	4	8.23	64%
Gulshan Prints	Coal (lignite)	3100	8	11.6	123%
Narayan Processors	Coal (imported)	5200	4.5	5.7	37%
	Coal (lignite)	3100	3	15.20	262%
Laxmi Vishnu	Coal (mixed)	3100	6	12.18	138%

The sample flue gas analysis for thermic fluid heaters in the same units are shown below:

Units Name	**Fuel Type**	**GCV**	**Thermopack (U)**	**Oxygen Percentage (%)**	**Excess Air (%)**
Annapurna	Coal (mixed)	4100	3000	10.9	108%
Aggarwal	Coal (mixed)	4100	1000	11.3	116%
Ravi Exports	Coal (mixed)	4100	2000	10.7	104%

Gulshan Prints	Coal (mixed)	4100	2500	10.07	92%
Narayan Processors	Coal (mixed)	4100	2500	10.33	97%
Laxmi Vishnu	Coal (mixed)	4100	1500	11.83	129%

Proposed technology:

Thus significant potential for energy savings exists with excess air control alone. Based on the detailed analysis of the existing boiler, it is proposed to install "Automation and control system in the boiler". The key parameters which requires monitoring and control are as follows:

- ✓ Optimum boiler combustion efficiency through effective monitoring and control of Forced Draft (FD), Induced Draft (ID) and Fuel feeder.
- ✓ Monitoring and synchronizing fuel feeder control with respect to instantaneous steam pressure.
- ✓ Excess Air monitoring and control based on the fuel feeding rate with the help of feedback from the stack oxygen sensor.
- ✓ Furnace draft pressure monitoring and controlling the furnace at slightly negative draft pressure.
- ✓ Automatic boiler blow-down based on TDS level monitoring

Justification of technology selection:

The proposed technology of automation and control system in boiler not only helps to monitor and analyze various boiler parameters but also can improve the efficiency of boiler through effective monitoring and control of air-fuel ratio; controlling furnace draft; maintain optimum fuel feed based on steam pressure in boiler and automatic blow-down. The improvement envisaged through the installation of the system has been summarized in the table below:

Parameter	Current Operation	Ideal Operating Scenario	Effect on Boiler Performance	Post Implementation of ideal scenario
Stack Oxygen %	Oxygen measurement not available	Excess air will be maintained within requirement based on the fuel used for optimized combustion	Higher stack oxygen will result higher heat loss as excess air carrying heat	FD fan and feeder auto control based on steam pressure, which maintains the stack oxygen within standard limits.
Draft Pressure	Not measured online	-0.25 to -0.75 mmWC (Auto control)	Positive draft pressure causes back-fire and more negative draft pressure results in fuel unburnt	Based furnace pressure feedback ID fan auto-controlled which help to maintain the pressure within limits
Unburnt Loss	3.0%	2.5%	Unbalance of draft and excess air resulting in higher unburnts in Bottom and Fly Ash	Optimized draft will provide higher residence time in combustion and Excess air trimmed within band as per load will improve combustion

CO	< 150	< 300 ppm	High excess air resulting in incomplete combustion and higher unburnts	By having synchronized combustion and proper FD and ID balance will yield better combustion
Stack Temp	150-153 deg C	140-143 deg C	Higher stack temperature indicating higher excess air leading to heat loss and fuel loss	Synchronized combustion with result precise A:F ratio due to trimming and balanced draft will lower stack oxygen and temperature both
Steam Pressure	20-22	21-22	Large steam temperature variation lead to deteration of steam quality	Precise control of steam temperature will improve response of boiler and quality of product
Blow Down Control	Manual	Automatic based on TDS and hardness	Due to manual blow-down and dependent on spot check analysis (**2880 ppm**) resulting in loss of heat and quality in steam	Auto Blow down based on TDS will maintain IBD TDS at **3500** ppm

Energy & monitoring saving:

For calculating the energy and monetary benefits, a typical case of boiler of 8 tph capacity has been considered. The benefits envisaged through installation of boiler automation and control system has been summarized in the table below:

Parameter	UoM	As is	To Be
Oxygen level in flue gas	%	13.50	11.00
Excess Air supplied (EA)	%	180	110
Boiler efficiency	%	62.25	66.39
Savings in fuel	%	5.4	
Fuel saving	t/h	0.03	
Annual operating hours	h/y	7320	
Annual fuel saving	t/y	248	
Fuel Price	Rs/t	6108	
Annual monetary savings (thermal)	Rs in lakh/y	15	
Motor Power	kW	22.81	20.45
Power savings	%	10.34	
Power savings	kW	2.36	
Annual power savings	kWh/y	17260	
Power Tariff	Rs/kWh	6.87	
Annual monetary savings (electrical)	Rs in lakh/y	1.19	
Total monetary savings	Rs in lakh/y	16	
Estimated Investment	Rs in lakh	12	
Simple Pay-back	years	0.73	

* extracts of calculation provided

The benefits can be summarized as:

- ✓ 2-5 % reduction in specific fuel consumption
- ✓ 1-3 % reduction in specific power consumption
- ✓ Improvement in boiler indirect efficiency by 2-5%
- ✓ Improvement in boiler blow-down loss
- ✓ Improvement in boiler draft pressure

Replication Potential:

Based on the discussion with associations, units, sample survey and energy audits, it is estimated that the technology has a replication potential of 20% in the cluster. Based on 20% replication, the overall project benefits will be as follows:

Parameter	UoM	Value
Annual thermal energy saving (one unit)	t/y	92
Annual thermal energy saving (one unit)	MJ/y	1850133
Annual electrical energy saving (one unit)	kWh/y	17260
Annual electrical energy saving (one unit)	MJ/y	62136
Annual total energy savings	MJ/y	1912269
Annual coal saving (considering 20% replication)	t/y	5893
Annual electricity saving (considering 20% replication)	kWh/y	1104650
Annual energy saving (considering 20% replication)	MJ/y	12238521 1
Annual CO_2 emission saving (one unit)	tCO_2/yr	16
Annual CO2 emission saving (considering 20% replication)	tCO_2/yr	994
Estimated investment in technology (one unit)	Rs in Lakh	12
Estimated investment in technology considering 20% replication (assuming price down due to demand aggregation)	Rs in Lakh	704
Total Investment	in million USD	1
Total energy savings (in 10 years)	TJ	1224
Annual CO_2 emission saving (in 10 years)	tCO_2/yr	9942