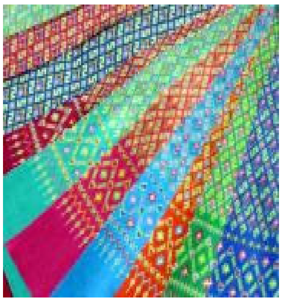
DETAILED PROJECT REPORT
ON
INSTALLATION OF SYSTEM FOR CONTROL OF EXCESS AIR IN BOILER
(PALI TEXTILE CLUSTER)







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Bureau of Energy Efficiency

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INSTALLATION OF SYSTEM FOR CONTROL OF EXCESS AIR IN BOILER

PALI TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Installation of System for Control of Excess Air In Boiler

Textile SME Cluster, Pali, Rajasthan (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PAL/TXT/EAC/05**

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Acknowledgement

We sincerely appreciate the efforts of industry, energy auditors, equipment manufacturers, technology providers, consultants and other experts in the area of energy conservation for joining hands with Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India for preparing the Detailed Project Report (DPR) under BEE SME Program in SMEs clusters. We appreciate the support of suppliers/vendors for providing the adoptable energy efficient equipments/technical details to the SMEs.

We have received very encouraging feedback for the BEE SME Program in various SME Clusters. Therefore, it was decided to bring out the DPR for the benefits of SMEs. We sincerely thank the officials of BEE, Executing Agencies and ISTSL for all the support and cooperation extended for preparation of the DPR. We gracefully acknowledge the diligent efforts and commitments of all those who have contributed in preparation of the DPR.

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List of Abbreviations

- BEE - Bureau of Energy Efficiency
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- FD - Forced Draft
- GHG - Green House Gases
- HP - Horse Power
- IRR - Internal Rate of Return
- MoP - Ministry of Power
- MSME - Micro Small and Medium Enterprises
- NPV - Net Present Value
- ROI - Return On Investment
- SME - Small and Medium Enterprises
- WHR - Waste Heat Recovery
- CERs - Certified Emission Reduction

EXECUTIVE SUMMARY

Pali has evolved as one of the most important production centers in the Textile Dyeing and Finishing sector despite there being nothing favorable for proliferation of a cluster. The place lacks all possible resources, from raw materials to fuels, Dyes & Chemicals and above all water which is the most important for processing of textiles. Today there are over 350 units in Pali alone and the production of all of these combined together crosses 5.5 million meter per day mark.

All the Industries in Pali cluster are in SME sector. These Industries process Manmade Fiber, Natural Fiber and blends. The units mainly process lower value clothes and the quality of fabric used is less than 100gm per RM. Few units have their own brand. Most of the units do job work for traders and the job works are also done process wise. Thus there are different units specializing in a particular process.

The process adopted by the units can be divided into three major classes –

a. Pre treatment

b. Dyeing and Printing

c. Finishing

The majority of units mainly do hand processing and a few (less than 20%) units do power processing. However, the output of the power process units far exceeds those of hand processing units.

Energy forms a major chunk of the processing cost with over 30% weightage in the cost basket. As per the preliminary and detailed energy audit findings, there exists potential of saving over 20% electricity and 30% fuel in the applications in power process industries with over all general pay back period of less than one year. Hand process industries are very less energy intensive, though, there also exists a saving potential of over 20%. The payback period in these industries is higher due to their working schedule and lower utilization of facilities.

The units in Pali cluster use disperse dyes for coloration of Polyester fabric or polyester contained in blends. Heat setting is necessary in these textiles and also finishing after Dyeing – Washing or Printing – Dye Fixation – Washing processes. Stenter is used for the two processes and this is very energy intensive process. Going by connected load and also by the absolute electricity consumption in textile dyeing and processing units, stenter happens to have a share upwards of 50%.

During Energy Audit, none of the boilers except one were found to be equipped with Auto Excess Air Control System. Even, awareness about the Excess Air control System was very low. Installation of proposed technology would save about 98.06 MT RPC per year.

This DPR highlights the details of the study conducted for assessing the potential for installation Automatic excess air control system in boiler, possible Energy saving, and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of Project Implementation.

Total investment required and financial indicators calculated such as monetary saving, IRR, NPV, DSCR and ROI etc for proposed technology is furnished in Table below:

S.No	***Particular***	***Unit***	***Value***
1	Project cost	₹ (in Lakh)	3.0
2	Fuel Saving (RPC)	MT/year	98.06
3	Monetary benefit	₹ (in Lakh)	7.35
4	Debit equity ratio	Ratio	3:1
5	Simple payback period	Months	5
6	NPV	₹ (in Lakh)	24.92
7	IRR	% age	217.50
8	ROI	% age	29.51
9	DSCR	ratio	10.24
10	CO_2 saving	MT	243
11	Process down time	Days	6

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Pali Textile Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy Use and Technology Audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity Building of Stake Holders in Cluster on Energy Efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting of energy efficiency projects in the clusters

Activity 3: Implementation of Energy Efficiency Measures

To implement the technology up gradation projects in clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of Innovative Financing Mechanisms for Implementation of Energy Efficiency Projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1.0 INTRODUCTION

1.1 Brief Introduction about Cluster

Pali is the District Head Quarter of the Pali District situated at a distance of approx. 300 KMs from Jaipur and 70 KMs from Jodhpur. Pali can also be reached from Ahmedabad via Abu Road and has direct train connectivity to Ahmedabad and Mumbai. The nearest airport having commercial flights plying is at Jodhpur. The map depicting Pali district and its distances from various towns is produced below in fig. 1.

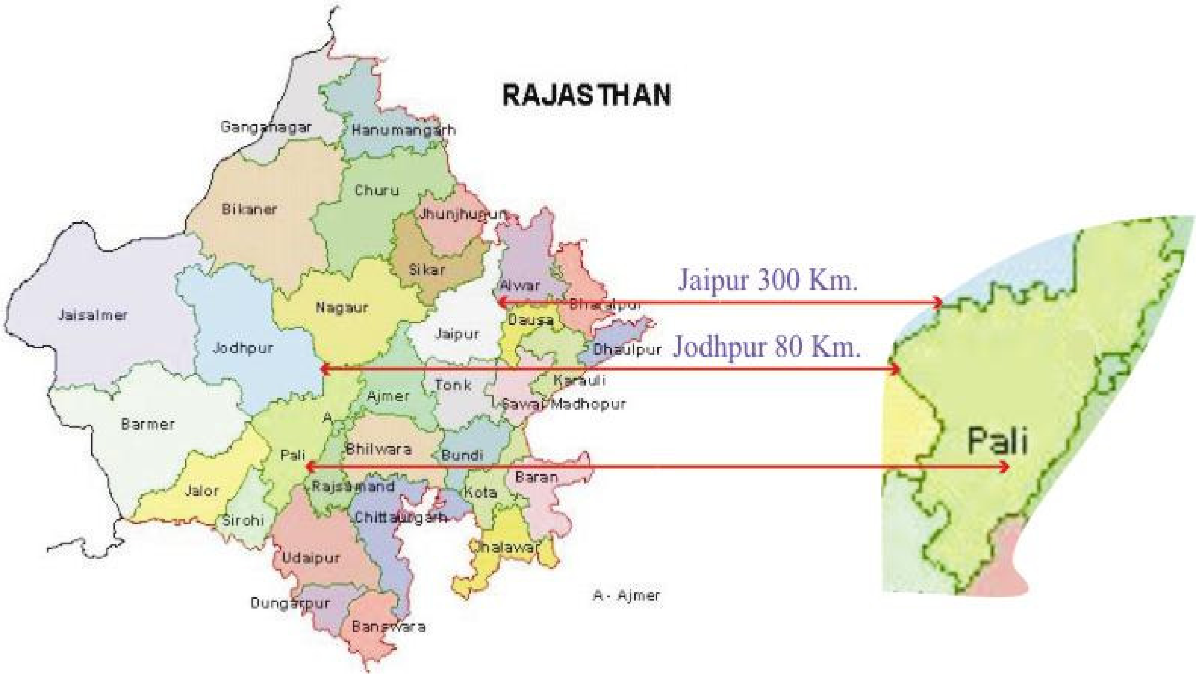


Fig. 1.1 – Pali – Geographical Map

Pali District is rich in minerals and the abundance of limestone deposits has made it home for 5 cement companies. There are several other SME units producing various lime based products. Despite there being non availability of requisite resources like raw material and consumables locally, a dense population of textiles dyeing and processing units has sprung up at Pali.

The Pali textile cluster is one of the biggest SME textile clusters in India having over 350 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. Some of the units hitherto functioning in residential colonies are in the process of shifting to a new Industrial Area named Punayata Road Induatrial Area. Over 150 industries are in the process of setting up their facilities in the Punayata Road Industrial area.

Balotra, Jodhpur and Bhilwara are other textile clusters in Rajasthan. These clusters work on more or less similar processes and use same machines, though their output differs. Details of energy consumption scenario at Pali textile cluster are furnished in Table 1.1 below:

Table1.1 Details of annual energy consumption scenario at Pali Textile Cluster

S. No	Type of Fuel	Unit	Value	% contribution (KLOE)
1	Electricity	MWh /year	51.3	16.6
2	Firewood	MT/year	27161	25.6
3	Steam Coke	Tonne/year	2967	5
4	Lignite	MT/year	16635	15.7
5	Diesel	Klitre/year	89.6	0.3
6	Residual Pet coke	Mt/Yr	11820	36.6

1.1.1 Energy usages pattern

Electrical energy Usage

The Cluster has two types of units – Hand Process and Power Process. Hand Process units mainly process cotton and consume very less electricity. These units consume electricity in the range of 4000 kWh to 5000 kWh per month. The hand process units outsource the finishing to other power process units. Power process units are energy intensive units and consume electricity in the range of 100000 kWh to 300000 kWh per month. Various Electricity consuming equipments in the hand process units are Fans, Tube Lights, and Computers etc. Power Process units have Stenter, Jet Dyeing Machine, Loop Agers, Boiler and Thermopac auxiliaries, Flat Bed Printing Machines etc. Stenter happens to be the biggest Electricity guzzler.

Thermal Energy Usage

Hand process units in the cluster are mainly involved in Table Printing, Kier Boiling and Jig dyeing. Heat for the process is obtained from direct burning of wood. Some units also have open type stenter wherein heating is done by directly burning wood beneath the clothes. Power Process units mainly use Thermal Energy Stenters, Kiers, Jet Dyeing Machines, Sanforizers, Loop Agers, Mercerisers, Scouring, Reduction and Clearance etc. These units use Residual Pet Coke, Lignite, Coal and Wood in Boilers and Thermopacs to make heat usable in machines. Typical Power Process Units use 100 MT to 300 MT RPC (85 MTOE to 256 MTOE) per month. The hand process units use 3 MT to 15 MT wood per month.

1.1.2 Classification of Units

The Textile units in the Pali Cluster can be categorized into two types based on availability of machinery in the units –

- Hand Process Units and
- Power Process Units

Pali Textile Cluster mainly consists of hand process units and over 250 out of a total population of 350 units are hand process units. These units are mainly owned by artisans or traditional colormen (Rangrej).

On the basis of type of cloth processed, the units can be classified as

- Cotton (Natural fiber) Processing Units
- Synthetic clothes (Manmade fibers) Processing Units

Based on output, the units can be classified as

- Dyeing Units
- Printing units
- Finishing Units

Scale of Operation

Most of the units in the Pali textile cluster are micro units. All the units are in Micro, Small or Medium sector with none of the units being in large scale sector.

Products Manufactured

Different types of products manufactured in Pali Textile Cluster. The marketed products are:

- ✓ Sarees (Lower Price Range)
- ✓ Rubia Blouse Clothes
- ✓ Lungies
- ✓ Turbans
- ✓ African Prints

1.1.3 Production process of Textile dyeing and finishing

The process adopted in Textile Dyeing and Finishing depends upon the fabric processed. The processes are different for Cotton, Polyester and Blended fabrics. The process flow chart for different processes depending upon fabric processed with location of steam requirement in the process are drawn below –

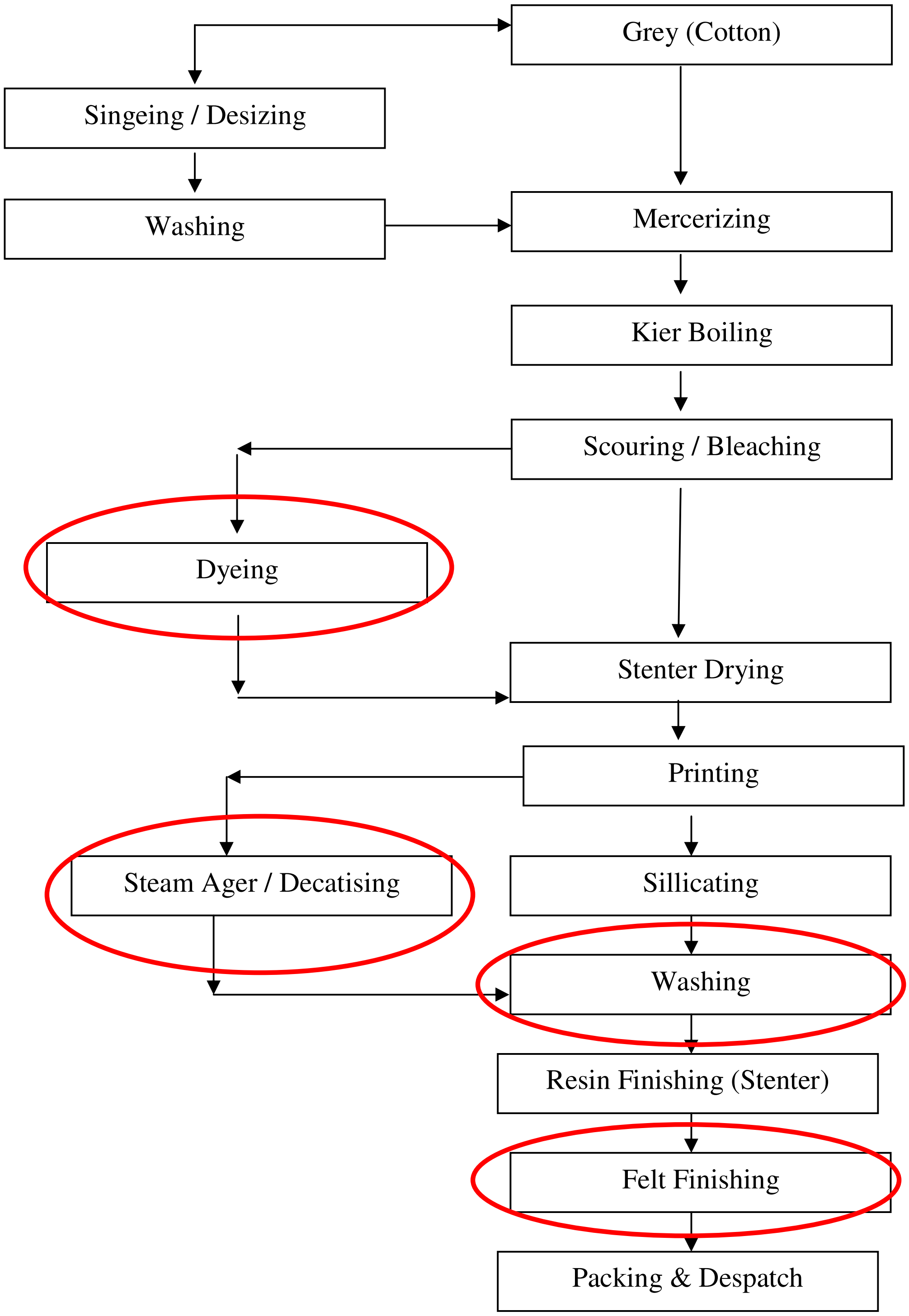


Fig. 1.2 – Process Flow Diagram of Cotton Dyeing and Printing

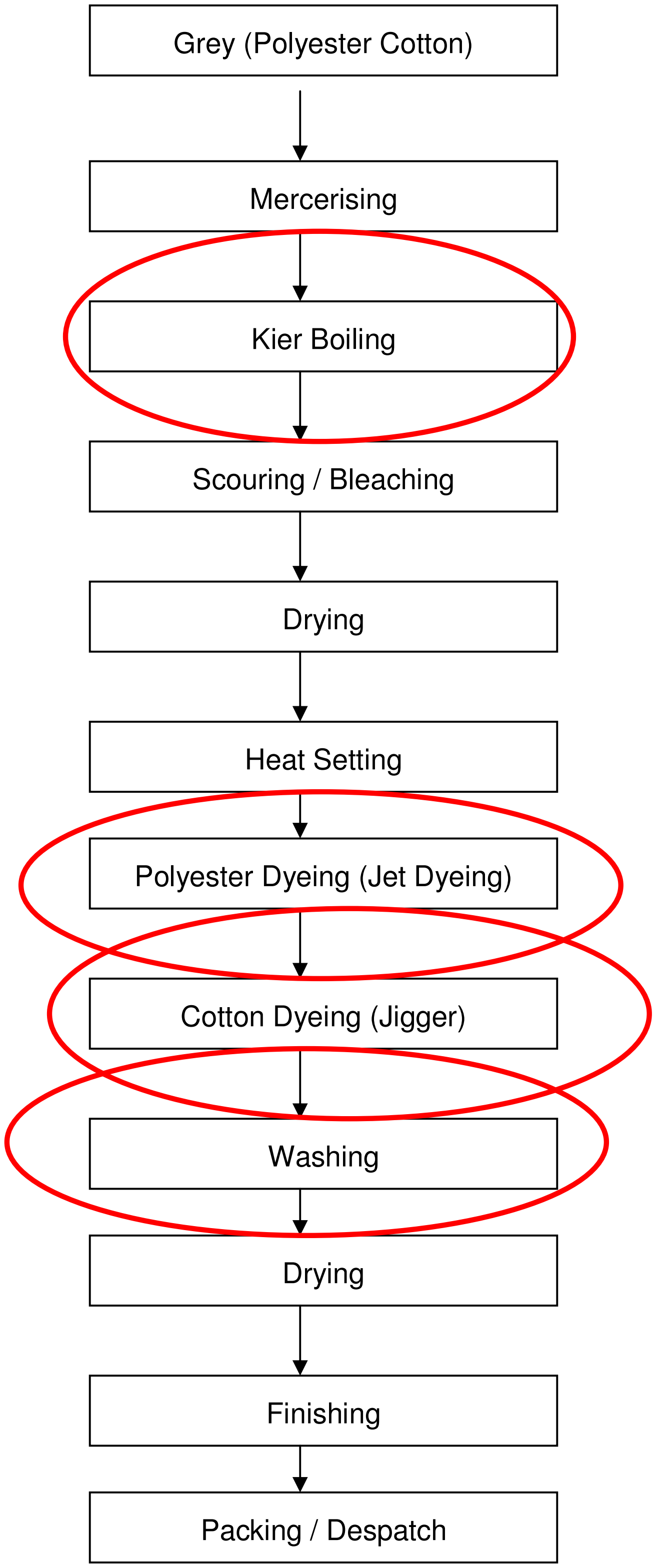


Fig. 1.3 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

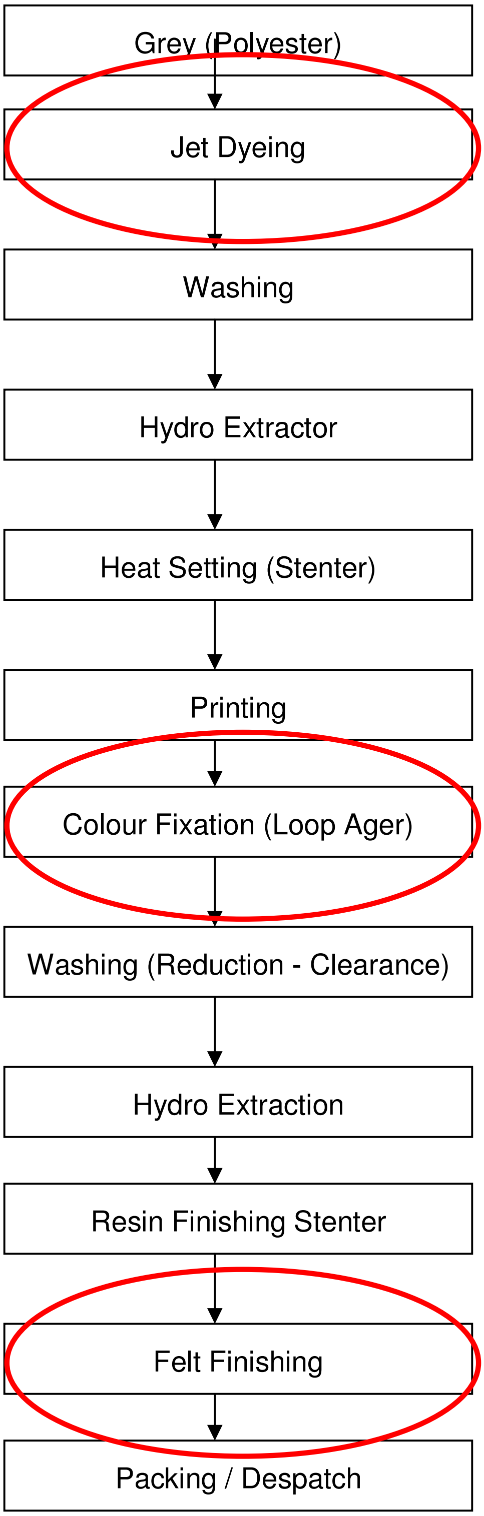


Fig. 1.4 – Process Flow Diagram of Polyester Printing and Finishing

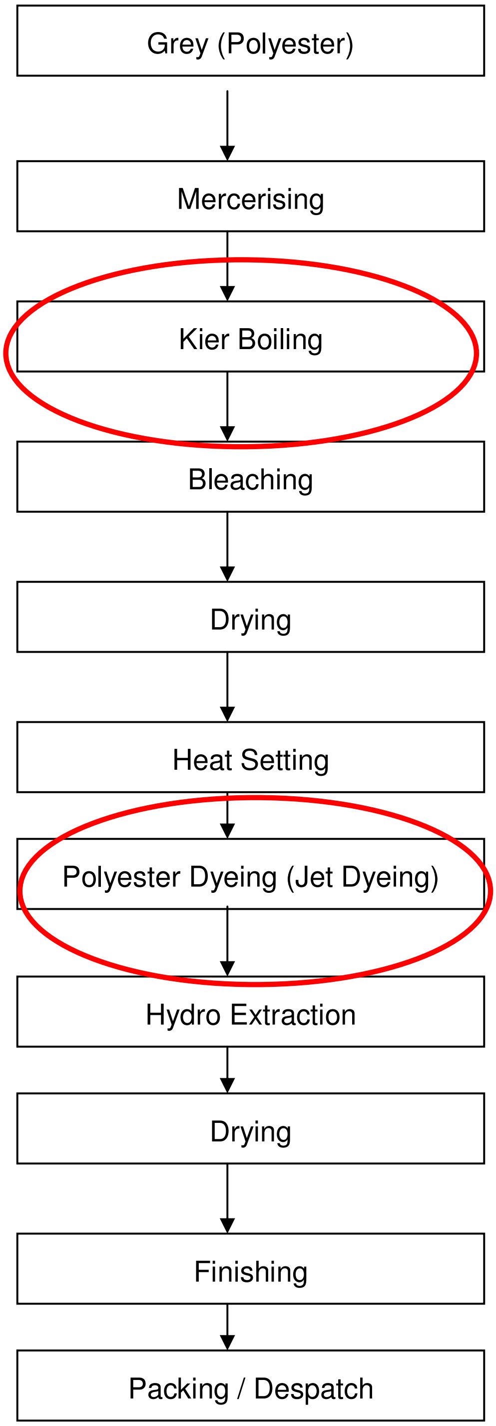


Fig. 1.5 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

1.2 Energy performance in existing situation

1.2.1 Average production

A typical unit works 5 days a week and the daily production of these units are in the following Table 1.2 below:

Table 1.2 Annual productions from a typical unit

Type of product	*Production (RM/Day)*		
Scale of Unit	**Micro**	**Small**	**Medium**
Finished Fabric	10000	30000	100000

1.2.2 Fuel consumption

Energy consumption both electrical and thermal by a typical textile dyeing and processing unit in Pali cluster is given in table 1.3 below:

Table 1.3 Annual energy consumption

Energy	*Electricity (kWh per year)*			*Thermal Energy (MTOE per year)*		
Scale of Unit	Micro	Small	Medium	Micro	Small	Medium
Consumption	48000	360000	2400000	30	100	300

1.2.3 Specific Energy Consumption (SEC)

The benchmark available for different processes in textile dyeing and processing industry in UK is given in Table 1.4 below:

Table 1.4 Specific Energy Consumption Values

S.No.	*Machine*	*Process*	*Energy Required (GJ/Te)*
1	Desizing Unit	Desizing	1.0-3.5
2	Kier	Scouring/Bleaching	6.0-7.5
3	J-Box	Scouring	6.5-10.0
4	Open Width range	Scouring/Bleaching	3.0-7.0
5	Low Energy Steam Purge	Scouring/Bleaching	1.5-5.0
6	Jig / Winch	Scouring	5.0-7.0

S.No.	Machine	Process	Energy Required (GJ/Te)
7	Jig / Winch	Bleaching	3.0-6.5
8	Jig	Dyeing	1.5-7.0
9	Winch	Dyeing	6.0-17.0
10	Jet	Dyeing	3.5-16.0
11	Beam	Dyeing	7.5-12.5
12	Pad / batch	Dyeing	1.5-4.5
13	Continuous / Thermosol	Dyeing	7.0-20.0
14	Rotary Screen	Printing	2.5-8.5
15	Steam Cylinders	Drying	2.5-4.5
16	Stenter	Drying	2.5-7.5
17	Stenter	Heat Setting	4.0-9.0
18	Package / Yarn	Preparation / Dyeing (Cotton)	5.0-18.0
19	Continuous Hank	Scouring	3.0-5.0
20	Hank	Dyeing	10-16.0
21	Hank	Drying	4.5-6.5

SOURCE – CARBONTRUST UK

SEC in Pali Cluster

For the units involved in Processing of Polyester and printing it to make Saree, the Specific Energy Consumption was observed and furnished in Table 1.5 below:

Table 1.5 Specific energy consumption

S.No	Particulars	SEC
1	Average Specific Electricity Consumption	1.2 kWh/kg (Best Observed Value – 0.95 kWh/kg)
2	Average Specific Thermal Energy Consumption	15000 kCal/kg (Best Observed Value – 10932 kCal/kg)

1.3 Identification of technology/equipment

1.3.1 Description of technology/ equipment

Process of Fabric Dyeing and Processing has been shown in Fig. 1.2 to 1.5. As is obvious, low temperature heating (Sub 100°C) is required in Scouring, Mercerising, bleaching, Jigger Dyeing for cotton, Reduction and Clearance. Also, higher temperatures are required in Jet Dyeing, Dye fixation and calendaring / Felt finishing. These processes heating are accomplished with steam and hence Boilers are an integral part of any process house. Units in Pali Textile Cluster have boilers of capacities 1 TPH to 4 TPH. Most of these boilers are package boilers having water wall at the back of the boiler serving as economizer.

Most of the Boilers in the Pali Textile Cluster were designed to operate on pulverized lignite or lump steam coal. Due to ban on Lignite supply from Gujarat, the units have shifted to RPC (Residual Pet Coke) supplied by Reliance industries Ltd.

For the purpose of fuel switching, the combustion was converted to bubbling fluidized bed and the lime bed was created to take care of high Sulphur content in the fuel. However, the conversion was done without engineering the system eroding combustion efficiency to lower levels.

Typical Steam Production and Distribution system is depicted in following sketch:-

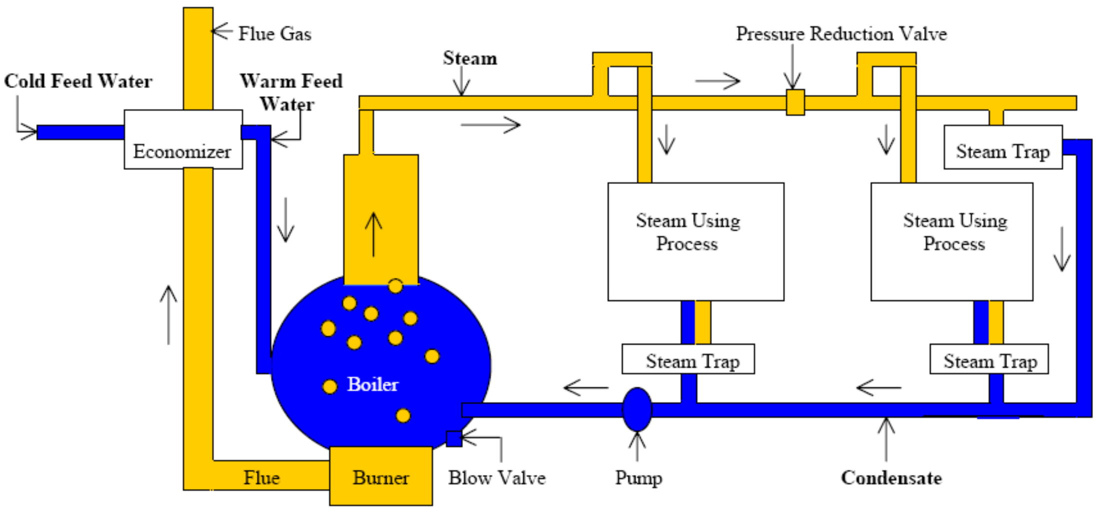


Fig. 1.6 – Typical Arrangement for steam generation and distribution in process heating

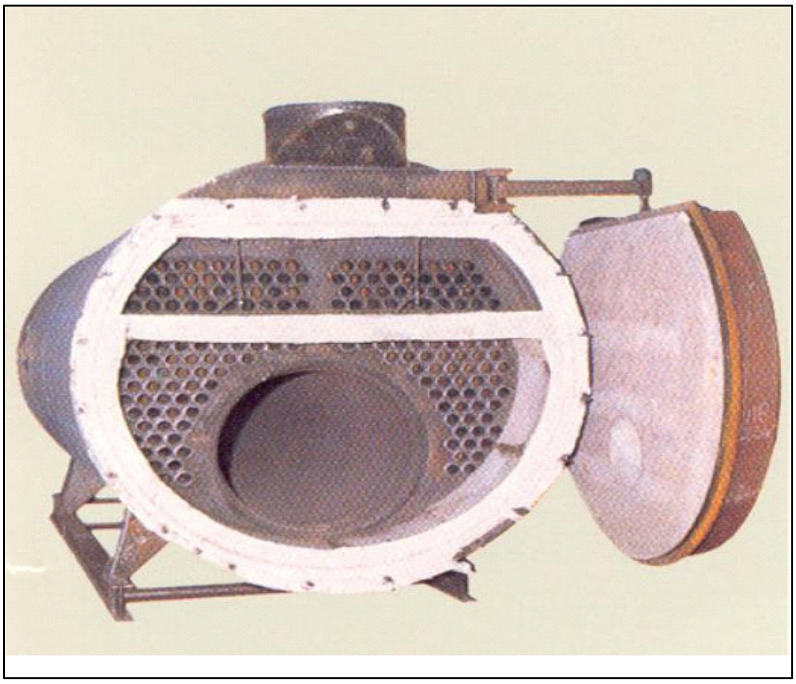


Fig. 1.7 – Typical Arrangement of tubes in Boiler

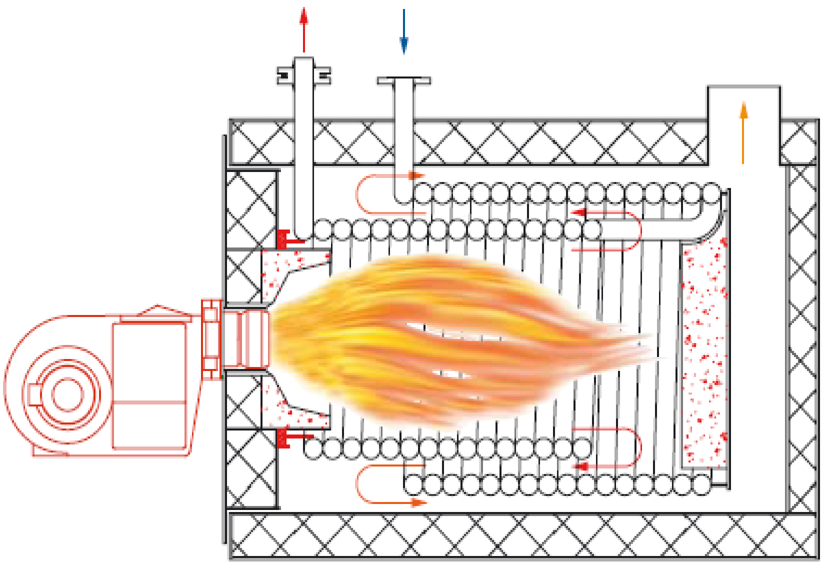


Fig. 1.8 – Combustion and heat transfer to water tubes in a multi pass boiler

Fig. 1.9 – Typical Arrangement of tubes in Boiler

The typical specification is attached as Annexure 6.

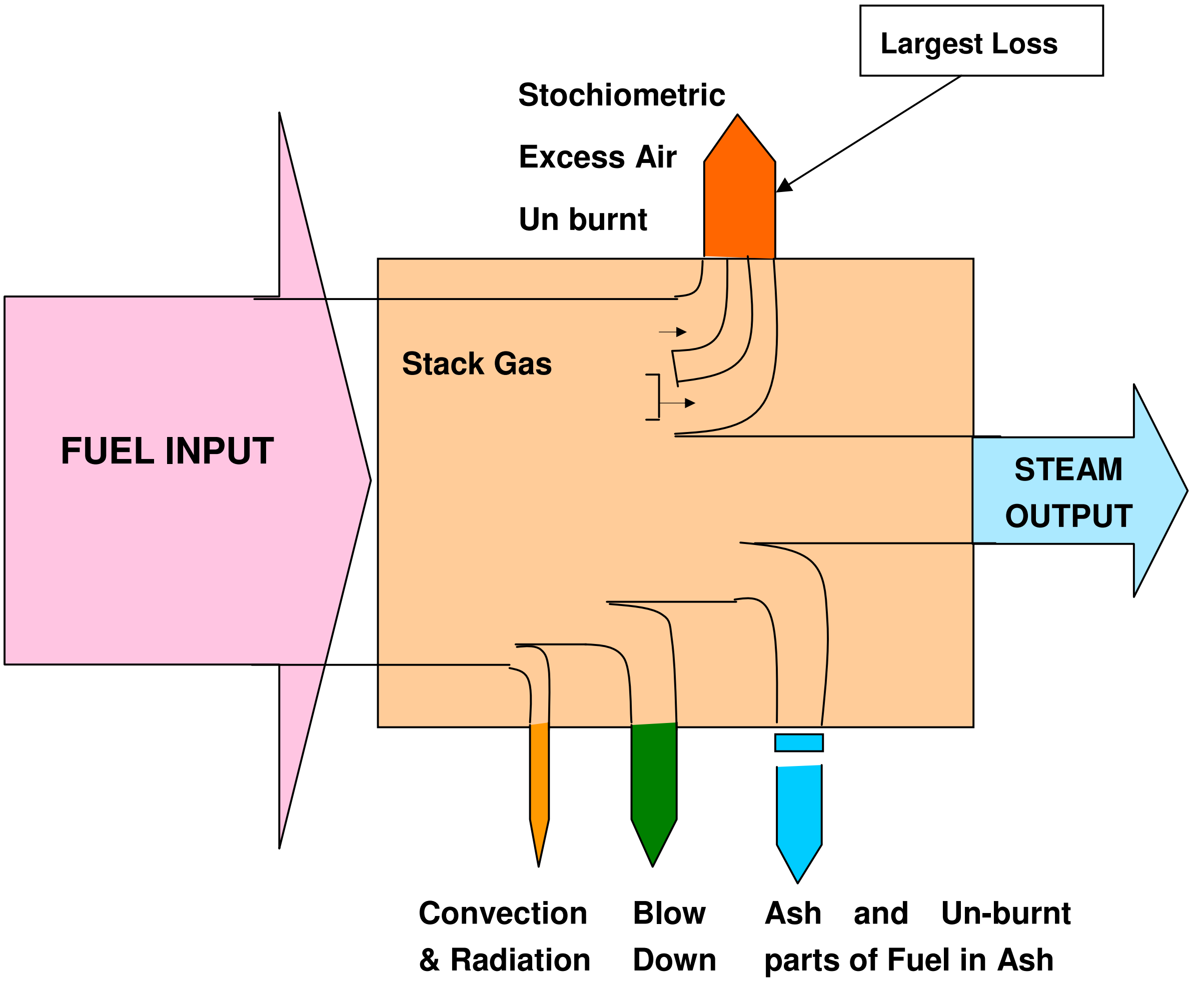
1.3.2 Role in process

Steam is used as heating medium in all processes other than stenter drying / finishing process. Processes requiring steam in a textile process house are Jigger Dyeing, Jet Dyeing, Scouring, Mercerising, Bleaching, Reduction and Clearance, Washing and shrinkage / Sanforizing.

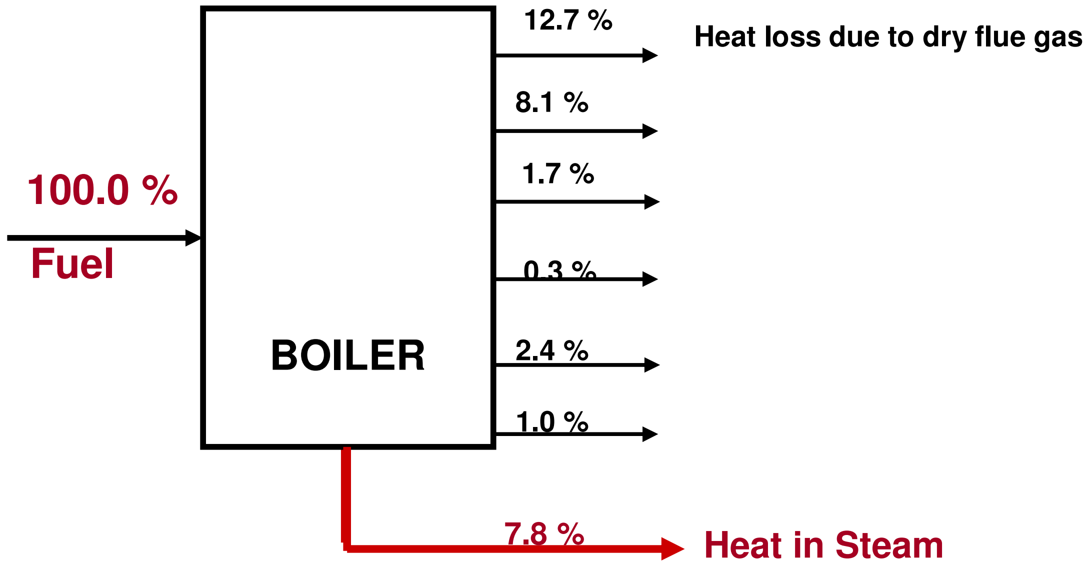
Typically, boilers in Pali Cluster raise steam to a pressure of 6kg/Cm^2 to 10kg/Cm^2 and then used in the process.

Energy Consumption details:

Energy flow diagram for a boiler is as below:-



Energy Balance in a typical boiler is depicted in the following figure.



The Sankey Diagram for a typical boiler is shown in the following figure.

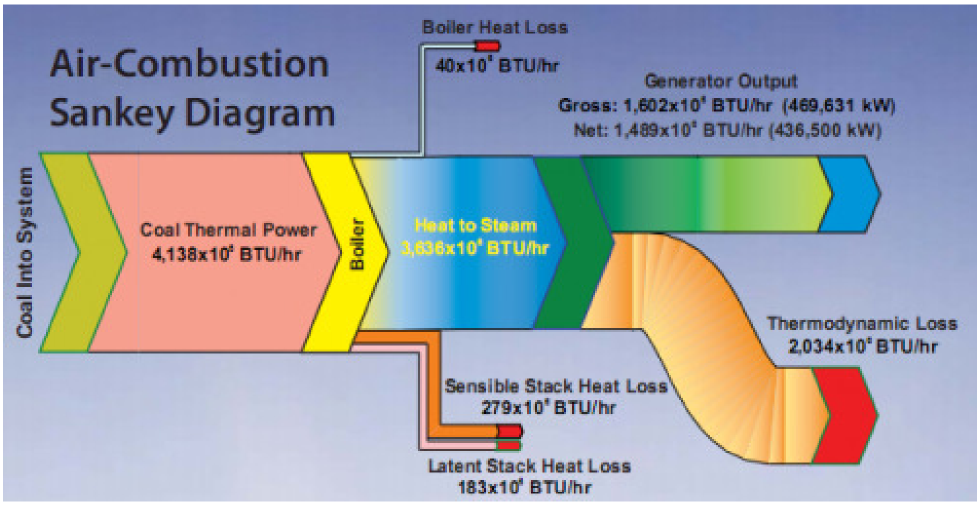


Fig. 1.10 Sankey Diagram for a typical boiler

The above figures show that loss of Energy through Flue Gas is the largest Energy Loss Stream. Obviously, Energy can be saved by reducing losses by way of sensible heat carried away by flue gases.

1.3.3 Energy audit methodology

The following methodology was adopted to evaluate the performance of boiler:-

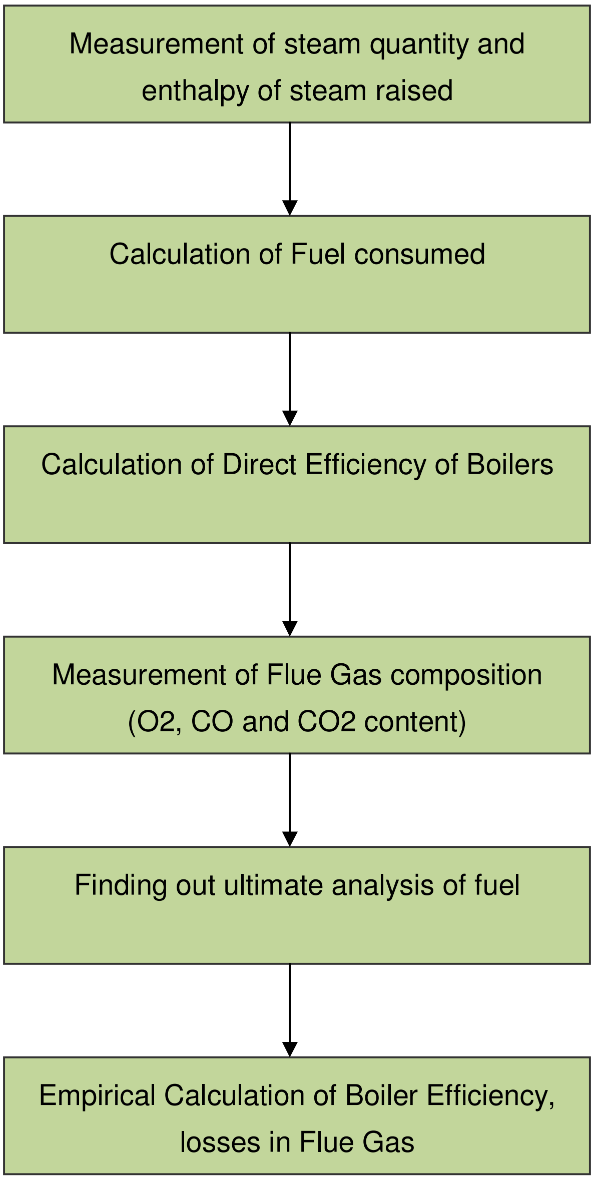


Fig. 1.11 Energy Audit methodologies

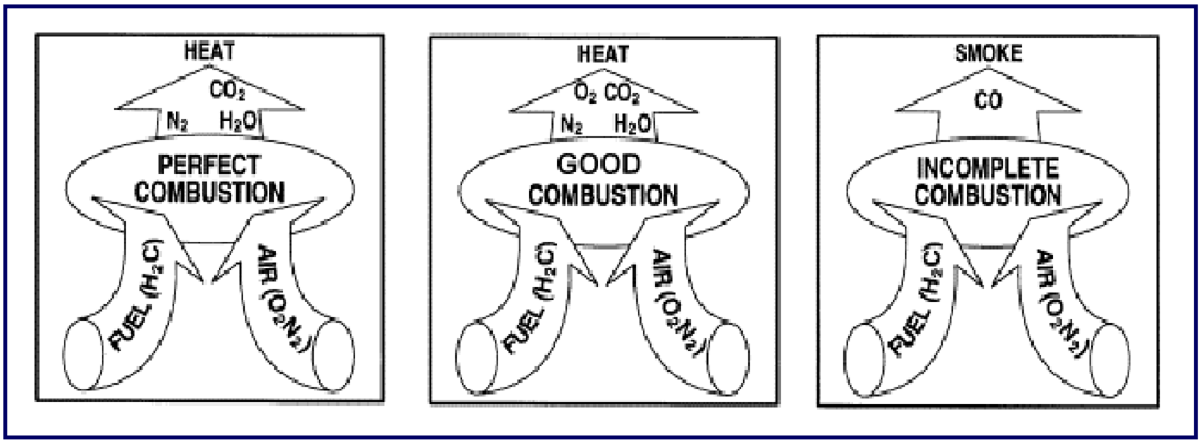
1.3.4 Design and operating parameters specification

Operating the boiler with an optimum amount of excess air will minimize heat loss up the stack and improve combustion efficiency. Combustion efficiency is a measure of how effectively the heat content of a fuel is transferred into usable heat. The stack temperature and flue gas oxygen (or carbon dioxide) concentrations are primary indicators of combustion efficiency which is shown in Table 1.5 below:

Table 1.5 Relation between Stack temperature and oxygen concentrations

Combustion Efficiency (% age)						
Excess % age		*Net Stack Temperature[1)] (°F)*				
Air	Oxygen	200	300	400	500	600
9.5	2.0	85.4	83.1	80.8	78.4	76.0
15	3.0	85.2	82.8	80.4	77.9	75.4
28.1	5.0	84.7	82.1	79.5	76.7	74.0
44.9	7.0	84.1	81.2	78.2	75.2	72.1
81.6	10.0	82.8	79.3	75.6	71.9	68.2

Given complete mixing, a precise or stoichiometric amount of air is required to completely react with a given quantity of fuel. In practice, combustion conditions are never ideal, and additional or "excess" air must be supplied to completely burn the fuel.



The correct amount of excess air is determined from analyzing flue gas oxygen or carbon dioxide concentrations. Inadequate excess air results in unburned combustibles (fuel, soot, smoke, and carbon monoxide) while too much results in heat lost due to the increased flue gas flow—thus lowering the overall boiler fuel-to-steam efficiency. On well-designed natural gas-fired systems, an excess air level of 10% is attainable. An often stated rule of thumb is that boiler efficiency can be increased by 1% for each 15% reduction in excess air or 40°F reduction in stack gas temperature.

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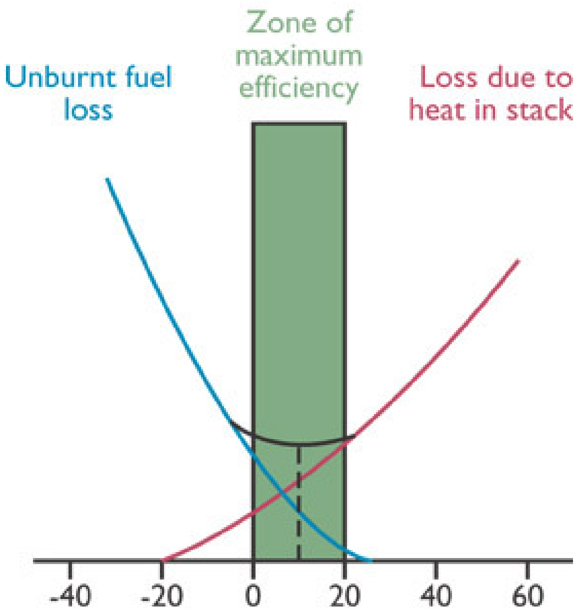


1.3.5 Operating efficiency analysis

The units in Pali cluster are not really aware of the ill effects of excess air in combustion. Most of the places excess Oxygen was found to be in the range of 15% to 17% making excess air to be in the range of 250 to 425% when the Excess air can be reduced to 65% for combustion of RPC globules. One of the units in Pali has installed the proposed system and has been reaping very good rewards.

1.4 Barriers in adoption of proposed technology/equipment

BEE promoted SME programme has the unique distinction of addressing all the identifiable barriers in adoption of Energy Efficiency Improvement technologies in SME sectors. Following actions have been taken in Pali Textile Cluster to remove the barriers:-

- Kick off Seminar to create awareness
- Energy Audit (Detailed and Preliminary) in over 78 units
- Capability building and involvement of institutional financers, local service providers and also domestic equipment manufacturers.
- Design and distribution of dissemination material containing most of the measures.

- Design and distribution of Cluster Manual containing technology gap assessment and cost benefit analysis of proposed Energy Conservation measures.
- Involvement of Industry Association, Department of Industries and local administration.

However, for the sake of identifying possible barriers to adoption of the proposed technologies, the following may be considered.

1.4.1 Technological Barrier

- The proposed technology is already installed in the cluster and is available readily.
- Non-availability of technology or aversion to adoption for any other reason does not seem to be the case for non replication. The system is being offered by one of the supplier having local agent. It is only lack of knowledge and comfort of proven guaranteed results that has been keeping the entrepreneurs away from adopting this technology.
- All major Boiler Manufacturers offer the proposed system as optional fitment to the system.
- There is a severe paucity of quality technical consultants in the cluster. This also inhibits adoption of technology as there is nobody to convince the entrepreneurs.
- Non availability of local after sales service provider for the equipments is a major obstacle to adoption of any new and modern technology involving electronics.
- The majority of the textile unit owners / entrepreneurs do not have in-depth technical expertise nor do they have technically qualified manpower. This is a major barrier in acquiring knowledge about any innovation in the sector.
- The entrepreneurs in the MSME sector are averse to investment risks and tend to invest in proven technology only. Adoption of technology is higher in bigger units and these bigger units also become agents for demonstration and hence replication. Lack of any bigger unit in the cluster also is an impediment to adoption of newer technology.

1.4.2 Financial Barrier

- The applicability of the proposition is in power process units only. These units have very healthy financial position. Lack of finances is not the reason for non adoption of the proposed technology. However, availability of easy finances and also financial incentives would trigger and also accelerate adoption of the technology.

- Implementation of the proposed project activity requires approx. ₹ 3 lakh investment and availability of easy finances would help replication of the system.
- The investment decisions normally favour creation of additional facility and investment for Energy Efficiency Improvement features last in the priority of entrepreneurs. Consequently, interventions like the one undertaken by BEE are necessary for promoting adoption of technologies.
- The subjective approach of the banks in deciding on grant of loans to entrepreneurs and also lack of pre declared formalities required for availing loan is the biggest impediment. On adherence to a time bound dispensation of the loan application is also an obstacle as the a new document is asked for ever time the entrepreneur visits the bank and the bank would refuse in the last moment citing untenable reason leaving the entrepreneur in the lurch. Facilitating delivery of finances is more important than packaging the finances.
- Most of the units in Pali textile cluster are debt free enterprises and the situation is ideal for any bank or financial institution to do advances. With end to economic slow down within sight, the demands are likely to pick up and the units would require scaling up their operations and also perking up their facility to meet enhanced demand. The inherent benefit of increase in profitability by precise process control is also up for taking.

1.4.3 Skilled manpower

The cluster very badly needs skilled manpower. There is no trained Dye Master, no trained electrician, no trained boiler operator or no trained maintenance man. The existing manpower has grown by on the job learning and has learnt the traditional methods of dyeing and processing. Propagation of learning of new technology is absolutely necessary.

1.4.4 Other barrier (If any)

Creation of Energy Champions is necessary to trigger large-scale adoption of proposed technologies. This is possible by sponsoring adoption of such technologies through financial help and also mitigation of investment risks through a mechanism that guarantees the savings. An ESCO can as well be involved in the process.

2.0 PROPOSED EQUIPMENT

2.1 Detailed description of technology proposed

All combustion requires the correct measure of oxygen; too much or too little can cause undesirable effects. However, the error is almost always intentionally on the high-side (too much oxygen) because the main effect on the high side is low efficiency. Too little air results in carbon monoxide formation, sooting and even explosion if accumulated soot and other non-combusted suddenly get enough oxygen to rapidly burn.

When boiler burners are manually tuned on a periodic basis, they are typically adjusted to about 3% excess oxygen which is about 15% excess air. This is because there are many ambient and atmospheric conditions that can affect oxygen/air supply. For example, colder air is denser and contains more oxygen than warm air; wind speed affects every chimney/flue/stack differently; and barometric pressure further affects draft. Therefore, an excess oxygen/air setting at the time of tuning assumes there will still be enough oxygen available for complete combustion when conditions worsen.

From an efficiency standpoint, the excess O_2 means there is more air in the combustion stream than there needs to be. That air also contains moisture, and it all is heated and then lost up the stack. The amount of excess O2 is about directly proportional to the efficiency lost; that is, 3% excess O_2 means 3% efficiency drop.

Although it may be possible to monitor and adjust the burner on a daily basis, it is not practical. Automatic O2 systems continuously monitor the flue gases and adjust the burner air supply. They are generically called **'O2 Trim Systems'.**

Components of the proposed system

An electronic sensor is inserted into the boiler flue, near the boiler, ahead of any dampers or other sources of air leakage into the boiler or flue. The sensor is connected to a control panel that measures oxygen and sends a signal to a control damper on the burner air supply.

The Oxygen Trim System contains the Zirconium probe, PLC controller cum display and preset mechanism integrated with VFD to modulate speed of FD fan. The unit also consists of a self calibration mechanism to ensure accuracy of less than 2%.

There are other advantages of the installation of an O2 Trim package in addition to fuel savings. They include:

Flue gas temperature monitoring and alarms, alerts when the boiler tubes are fouled (A 40 degree temperature rise above design results in a 1% fuel increase.) and shut down due to high flue gas temperature.

- O_2 monitoring and alarm due to low excess air or combustibles.
- There are two types of approaches for O_2 trim.
- Single point (jackshaft) positioning with a trim actuator.
- Parallel positioning (metering), separate actuators for the fuel valve(s) and FD damper.

The most common method today is parallel positioning. The components include:

- Controller: It accepts inputs from the fuel and air actuators, O2 analyzer, optional flue gas temperature sensor and either a master-loading signal for a plant master or lead lag sequencer or a header pressure or temperature sensor. The controller will interface with the burner management system for purge, low fire, fuel select and other functions.
- Boiler pressure or temperature sensor, mounted in the header.
- O2 analyzer that includes field repairable in-situ probe and electronics.
- Fuel valve actuator(s) (servomotors). One servomotor per valve. In some cases FGR is controlled and a servomotor is supplied for that function.
- Air damper actuator (servomotor).

When a measurement of oxygen in the flue gas is available, the combustion control Mechanism can be vastly improved (since the percentage of oxygen in flue is closely related to the amount of excess air) by adding an oxygen trim control module, allowing

- Tighter control of excess air to oxygen set point for better efficiency
- faster return to set point following disturbances
- Tighter control over flue emissions
- compliance with emission standards
- Easy incorporation of carbon monoxide or capacity override.

2.1.1 Equipment specification

A complete brochure of the equipment is placed at Annexure 1.

2.1.2 Suitability over existing equipment

The proposed system can be retrofitted to existing boiler with minimal modification to existing boiler and would need shut down of approximately one week.

2.1.3 Superiority over existing equipment

The system would improve precision of control on the existing process and hence would yield better results on productivity as well as quality fronts.

2.1.4 Availability of equipment

The system can be delivered within 3 to 4 weeks of placement of order through manufacturers in Ahmedabad.

2.1.5 Source of equipment

This technology has already been implemented in one of the textile process house at Pali and the results have been as per projections. Brochure from the same vendor has been enclosed. The equipment is readily available indigenously without any complications related to patent or copyright

2.1.6 Technical specification of equipment

Technical specification of proposed technology is attached at Annexure 7.

2.1.7 Terms and conditions in sales of equipment

No specific terms and conditions are attached to sale of the equipment.

2.1.8 Process down time during implementation

Process down time required in fitting of proposed technology in boiler is about 1 week and break up for process down time is given in Annexure 4.

2.2 Life cycle assessment and risks analysis

The unit consists of Sensors, VFD, PLCs, connections, contactors etc. There are no moving parts and hence deterioration is not a problem. However, bad power quality may lead to failure of the system. Being an electronic device, no problem is anticipated and the unit would go on working perpetually if better ambient is made available.

2.3 Suitable Unit for Implementation of Proposed Technology

The proposed system can be implemented in over 30 no boilers in Pali. Total potential for energy saving would be 3827.1 MT RPC (3269 MTOE) per year if the proposition is implemented in all the machines.

3.0 ECONOMIC BENEFITS FROM PROPOSED EQUIPMENT

3.1 Technical benefit

3.1.1 Fuel saving

The proposition would help save 98.06 MT RPC fuel in every boiler. Details of fuel saving is given in Annexure 4.

3.1.2 Electricity saving

Installation of proposed technology will lead to some amount of electricity saving due better control of motor speed but not taken into account since cannot be predicted exactly.

3.1.3 Improvement in product quality

None

3.1.4 Increase in production

None

3.1.5 Reduction in raw material

Raw material consumption is same even after the implementation of proposed technology.

3.1.6 Reduction in other losses

None

3.2 Monetary benefits

The monetary saving arising out of implementation of proposed technology in one Boiler would be ₹ 7.35 lakh per year. Detail of saving calculation is given in Annexure 4.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

Proposed equipment reduces the GHG emission by reducing electricity and fuel consumption.

3.3.2 Improvement in workers skill

Not contributing to any improvement in skill sets of workers. However, the automation would eliminate human intervention in precision control of process thereby reducing workload of the frontline workers. No retrenchment of labor is envisaged because of implementation of the proposed system.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

The fuel saving will have equivalent mitigation in terms of SPM and other pollutants otherwise likely to be released in the atmosphere.

3.4.2 Reduction in GHG emission

The equivalent saving in GHG emission for every Stenter would be 243 MT per year as per UNEP GHG Calculator.

3.4.3 Reduction in other emissions like SO_X

NIL

4.0 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Equipments cost

Cost of the project is about ₹ 2.79 Lakh (2.4 Lakh + 10.3% Excise+2% CST+ 3.5% Freight) as per the quotation from M/s SEMITRONICS attached as Annexure 7. The basic cost includes ₹ 45000/- as cost of one VFD to be installed in FD Fan.

4.1.2 Erection, commissioning and other misc. cost

Erection & commissioning cost is about ₹ 0.21 lakh. A detail of project installation cost is given in Table 4.1 below:

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	cost
1	Equipment cost	₹ (in Lakh)	2.79
2	Erection & Commissioning cost	₹ (in Lakh)	0.21
3	Other misc. cost	₹ (in Lakh)	Nil
4	**Total cost**	₹ (in Lakh)	**3.00**

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost which is ₹ 0.75 lakh.

4.2.2 Loan amount.

Remaining 75% cost of the proposed project will be taken from the bank which is ₹ 2.25 Lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below. The cost of equipment considered is inclusive of hot water storage tanks also.

The project is expected to achieve monetary savings of ₹ 7.35 lakh per annum.

- The Operation and Maintenance cost is estimated at 4% of cost of total project with 5% increase in every year as escalations.
- Interest on term loan is estimated at 10%.
- Depreciation is provided as per the rates provided in the companies act.

Based on the above assumptions, profitability and cash flow statements have been prepared and calculated in Annexure-3.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 3.00 lakh and monetary savings due to reduction in Electricity & Fuel consumption is ₹ 7.35 lakh hence, the simple payback period works out to be around 5 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 23.51 Lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 180.44%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 31.60%.

Details of financials indicators are furnished in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology

S.No.	Particular	Unit	Value
1	Simple payback period	Months	5
2	NPV	₹ (in lakh)	23.51
3	IRR	% age	180.44
4	ROI	% age	31.60
5	DSCR	ratio	9.74

4.4 Sensitivity analysis

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like when there is an increase in fuel savings or decrease in fuel savings. For the purpose of sensitive analysis, two following scenarios has been considered

- Optimistic scenario (Increase in fuel savings by 5%)
- Pessimistic scenario (Decrease in fuel savings by 5%)

In each scenario, other inputs are assumed as a constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Table 4.3 Sensitivity analysis in different scenario

Scenario	IRR (% age)	NPV (₹ in lakh)	ROI (% age)	DSCR
Pessimistic	172.21	22.24	31.49	9.27
Realistic	180.44	23.51	31.60	9.74
Optimistic	188.65	24.77	31.69	10.20

4.5 Procurement and Implementation Schedule

Total time period required for implementation of this technology is about 6 weeks and their details are given in Annexure 3.

Annexure -1: Information Brochure of equipment

SEMITRONIK

OXYGEN % INDICATOR AND CONTROLLER

Today no one can afford the luxury of wasting fuel. From the large power boilers used by the electrical utility companies to the small furnace operator or water heaters in cold countries, efficiency is the prime objective.

Combustion efficiency can be defined as the effectiveness of any combustion that operates in converting the internal energy contained in fuel into heat energy and making it available to the process.

In practice combustion efficiency is generally thought of as the total energy contained per unit of fuel-minus the energy carried away by hot flue gases exiting through the stacks expressed as a percentage.

Everyone knows of the three essential components of combustion :

❍ Fuel ❍ Air ❍ Heat

In fossil fuel there are really three elements of interest i.e. Carbon, Hydrogen and Sulphur. During combustion each reacts with Oxygen to release heat.

Pure Oxygen is rarely used for combustion. Air contains about 21 % Oxygen and 79 % Nitrogen by volume and available more readily than pure oxygen. If the burning is complete than the products generated will be nothing but Carbon Dioxide, Water and Nitrogen. This is known as stichiometric combustion. The heat released when the fuel burns completely is known as heat of combustion.

THE IMPORTANCE OF EXCESS AIR

In actual application it is impossible to achieve stichiometric combustion because burners cannot mix fuel and air perfectly. To ensure that all of the fuel is burned and that little or no combustibles appear in the flue gas, it is common practice to supply some amount of excess air. Not long ago it was not considered unusual to run a burner with large amount of excess air in order to avoid smoking stack. Today this is recognized as highly wasteful practice.

Too little excess air is inefficient because it permits unburned fuel in the form of combustibles to escape up the stack. But too much excess air is also inefficient because it enters the burner at ambient temperature and leaves the stack hot, thus stealing useful heat from the process. This leads to fundamental rule of combustion efficiency.

Maximum combustion efficiency is achieved when the correct amount of excess air is supplied so that sum of both unburned fuel loss and flue gas heat loss is minimized.

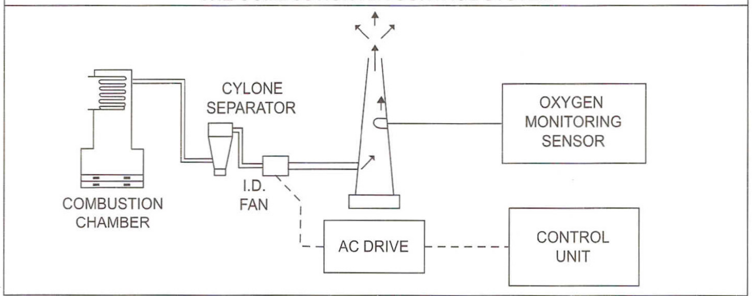
MAXIMIZING EFFICIENCY BY CONTROLLING EXCESS AIR

But how is the correct amount of excess air determined?

The most widely accepted practice for determining and maintaining correct amount of excess air is, flue gas analysis.

Development of Oxygen flue gas monitor has resulted in determining oxygen concentration in excess air leaving stack.

THE COMBUSTION AIR CONTROL SYSTEM



In recent years, the Zirconium Oxide cell has become the most prevalent Oxygen sensor for continuous monitoring of flue gases. The sensor has inherent ability to make Oxygen measurements in hot, dirty gases without sample conditioning which is quickly accepted by industrial users.

The cell has several significant advantages over the other Oxygen sensing methods. First, since the cell operates at high temperature there is no need to cool or dry flue gas before it is measured.

Most Zirconium Oxygen analysers make direct Oxygen measurements on the stack with nothing more than a filter to keep ash away from the cell.

The cell is also immune to vibration.

The advantage being the cell output increases with reduction of Oxygen.

The sensor consists of a Zirconium cell located at the end of stainless steel probe that is inserted directly into the flue gas system.

The voltage created by the Oxygen partial pressure different is carried down to the length of the probe and through our interconnecting cable to our electronics enclosure where it is conditioned into an output signal suitable for a control system. It is used for control of air for combustion input.

MODEL AVAILABLE

OXYGEN % INDICATOR AND CONTROLLER SYSTEM

MODEL 01C - 101

Electronic Unit

Complete electronics on plug-in type printed circuits board with power supply to operate on 220V + 10% 50 c/s with :

Display :
Digital to indicate % of Oxygen.

Control :
4-20 m or 0-10 V to either programmable logic controller or A.C. drives or two relay output for proportionate action or relays with changeover contacts rated with 1 Amp.

Sensor Assembly

Zirconium cell with due accessory and mounting connection arrangement housed in SS assembly.

Annexure -2: Detailed financial analysis

Assumption

Name of the Technology	Automatic Excess Air control system		
Details	**Unit**	**Value**	**Basis**
Installed Capacity			
No of working days	Days	300	Feasibility Study
No of Shifts per day	Shifts	3	Feasibility Study
Capacity Utilization Factor	%age		
Proposed Investment			
Equipment cost	₹ in lakh	2.79	
Erection and commissioning	₹ in lakh	0.21	
Investment without IDC	₹ in lakh	3.00	
EPC cost	₹ in lakh	0.00	
Total investment	₹ in lakh	3.00	
Financing pattern			
Own Funds (Equity)	₹ in lakh	0.75	
Loan Funds (Term Loan)	₹ in lakh	2.25	
Loan Tenure	yr	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%/yr	10	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4	Feasibility Study
Annual Escalation	% age	5	Feasibility Study
Estimation of Revenue			
Fuel saving (RPC)	Tonne	98.06	
Cost of fuel	₹/tonne	7500	
St. line Depn.	% age	5.28%	Indian Companies Act
IT Depreciation	% age	80.00%	Income Tax Rules
Income Tax	% age	33.99%	Income Tax

Estimation of Interest on Term Loan

₹ (in lakh)

Years	Opening Balance	Repayment	Closing Balance	Interest
1	2.25	0.12	2.13	0.26
2	2.13	0.24	1.89	0.20
3	1.89	0.48	1.41	0.17
4	1.41	0.50	0.91	0.12
5	0.91	0.60	0.31	0.06
6	0.31	0.31	0.00	0.60
		2.25		

WDV Depreciation

₹ (in lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	3.00	0.60
Depreciation	2.40	0.48
WDV	0.60	0.12

Projected Profitability

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Total Revenue (A)	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Expenses								
O & M Expenses	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17
Total Expenses (B)	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17
PBDIT (A)-(B)	7.23	7.23	7.22	7.22	7.21	7.20	7.19	7.19
Interest	0.26	0.20	0.17	0.12	0.06	-	-	-
PBDT	6.97	7.03	7.06	7.09	7.14	7.20	7.19	7.19
Depreciation	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
PBT	6.82	6.87	6.90	6.94	6.99	7.04	7.04	7.03
Income tax	-	2.23	2.40	2.41	2.43	2.45	2.45	2.44
Profit after tax (PAT)	6.82	4.64	4.50	4.52	4.56	4.60	4.59	4.58

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
rofit before tax	6.82	6.87	6.90	6.94	6.99	7.04	7.04	7.03
Add: Book depreciation	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Less: WDV depreciation	2.40	0.48	-	-	-	-	-	-
Taxable profit	4.57	6.55	7.06	7.09	7.14	7.20	7.19	7.19
Income Tax	-	2.23	2.40	2.41	2.43	2.45	2.45	2.44

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Liabilities								
Share Capital (D)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Reserves & Surplus (E)	6.82	11.46	15.96	20.48	25.04	29.63	34.22	38.81
Term Loans (F)	2.13	1.89	1.41	0.91	0.31	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	9.70	14.10	18.12	22.14	26.10	30.38	34.97	39.56

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Less Accm. Depreciation	0.16	0.32	0.48	0.63	0.79	0.95	1.11	1.27
Net Fixed Assets	2.84	2.68	2.52	2.37	2.21	2.05	1.89	1.73
Cash & Bank Balance	6.85	11.42	15.59	19.78	23.89	26.39	31.14	35.89
TOTAL ASSETS	9.70	14.10	18.12	22.14	26.10	28.44	33.03	37.62
Net Worth	7.57	12.21	16.71	21.23	25.79	30.38	34.97	39.56
Debt Equity Ratio	2.84	2.52	1.88	1.21	0.41	0.00	0.00	0.00

Projected Cash Flow

₹ (in lakh)

Particulars / Years	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Sources									
Share Capital	0.75	-	-	-	-	-	-	-	-
Term Loan	2.25								
Profit After tax		6.82	4.64	4.50	4.52	4.56	4.60	4.59	4.58
Depreciation		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Total Sources	3.00	6.97	4.80	4.66	4.68	4.72	4.75	4.75	4.74
Application									
Capital Expenditure	3.00								
Repayment Of Loan	-	0.12	0.24	0.48	0.50	0.60	2.25	-	-
Total Application	3.00	0.12	0.24	0.48	0.50	0.60	2.25	-	-
Net Surplus	-	6.85	4.56	4.18	4.18	4.12	2.50	4.75	4.74
Add: Opening Balance	-	-	6.85	11.42	15.59	19.78	23.89	26.39	31.14
Closing Balance	-	6.85	11.42	15.59	19.78	23.89	26.39	31.14	35.89

IRR

₹ (in lakh)

Particulars / months	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Profit after Tax		6.82	4.64	4.50	4.52	4.56	4.60	4.59	4.58
Depreciation		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Interest on Term Loan		0.26	0.20	0.17	0.12	0.06	-	-	-
Cash outflow	(3.00)	-	-	-	-	-	-	-	-
Net Cash flow	(3.00)	7.23	5.00	4.82	4.80	4.78	4.75	4.75	4.74
IRR	217.05								

NPV	24.92

ENERGY IS LIFE BEE CONSERVE IT

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13
Sub Total*(G)*	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Interest on Term Loan	0.26	0.20	0.17	0.12	0.06	0.00	0.00	0.00
Depreciation *(H)*	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Sub Total (I)	0.45	0.39	0.36	0.31	0.26	0.20	0.20	0.20
Sales (J)	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Contribution (K)	7.26	7.26	7.26	7.25	7.25	7.24	7.23	7.23
Break Even Point (L= G/I)	6.18%	5.40%	4.94%	4.33%	3.58%	2.72%	2.75%	2.78%
Cash Break Even {(I)-(H)}	4.00%	3.22%	2.76%	2.15%	1.40%	0.53%	0.56%	0.58%
Break Even Sales (J)*(L)	0.45	0.40	0.36	0.32	0.26	0.20	0.20	0.20

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	6.82	3.00	3.02	3.06	3.12	3.17	3.17	3.16	24.64
Net Worth	7.57	5.80	7.74	9.71	11.71	13.74	15.78	17.81	86.01
									29.51%

Debt Service Coverage Ratio

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	6.82	4.64	4.50	4.52	4.56	4.60	4.59	4.58	29.63
Depreciation	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.95
Interest on Term Loan	0.26	0.20	0.17	0.12	0.06	0.00	0.00	0.00	0.82
Total (M)	7.23	5.00	4.82	4.80	4.78	4.75	4.75	4.74	31.40

DEBT

Interest on Term Loan	0.26	0.20	0.17	0.12	0.06	0.00	0.00	0.00	0.82
Repayment of Term Loan	0.12	0.24	0.48	0.50	0.60	0.31	0.00	0.00	2.25
Total (N)	0.38	0.44	0.65	0.62	0.66	0.31	0.00	0.00	3.07
	19.00	11.32	7.45	7.74	7.19	15.33	-	-	10.24
Average DSCR (M/N)	10.24								

Annexure -3: Details of procurement and implementation

S. No.	*Activities*	*Weeks*					
		1	*2*	*3*	*4*	*5*	*6*
1	Order Placement						
2	Fabrication & Transportation.						
3	Installation and commissioning						

Break up for process down time

S. No.	*Activities*	*Days*		
		2	*4*	*6*
1	Cooling of system and hook up			
2	Modifications required in hearth.			
3	Tuning, monitoring and control and stabilisation.			

Annexure 4: Detailed equipment assessment report

Calculation of Energy Saving Potential from installation of automatic excess air control in Boiler

Ultimate analysis of fuel	C %	H2 %	S %	O2 %	N2 %	Ash %	Moisture%
	80.9	3.57	7.5	0	0.95	0.01	7

S. No	Particular	Unit	Value
1	Present O_2 level	% age	15
2	Theoretical air requirement	kg of air/kg of fuel	10.80
3	Excess air supply at present condition	% age	250
4	Actual mass of air supplied at present condition	kg of air/kg of fuel	37.81
5	Heat loss at exist excess air level	kCal/kg of fuel	1494.5
6	Proposed O_2 level required	% age	8
7	Excess air supply after implementation of technology	% age	61.54
8	Proposed Actual mass of air supplied	kg of air/kg of fuel	17.44
9	Heat loss after implementation of technology due to excess air	kCal/kg of fuel	719.76
10	Reduction in sensible heat loss	kCal/kg of fuel	744.79
11	Fuel firing rate	kg/hr	150
12	Reduction in sensible heat loss	kCal/hr	111718.5
13	GCV of fuel	kCal/kg	8200
14	Fuel saving per hour	kg/hr	13.62
15	Yearly fuel saving	MT	98.06
14	Cost of fuel (RPC)	₹ / MT	7500
15	Total monetary saving per year	₹ in lakh	7.35
16	Total Investment	₹ in lakh	3.0
17	General Payback Period	Months	5

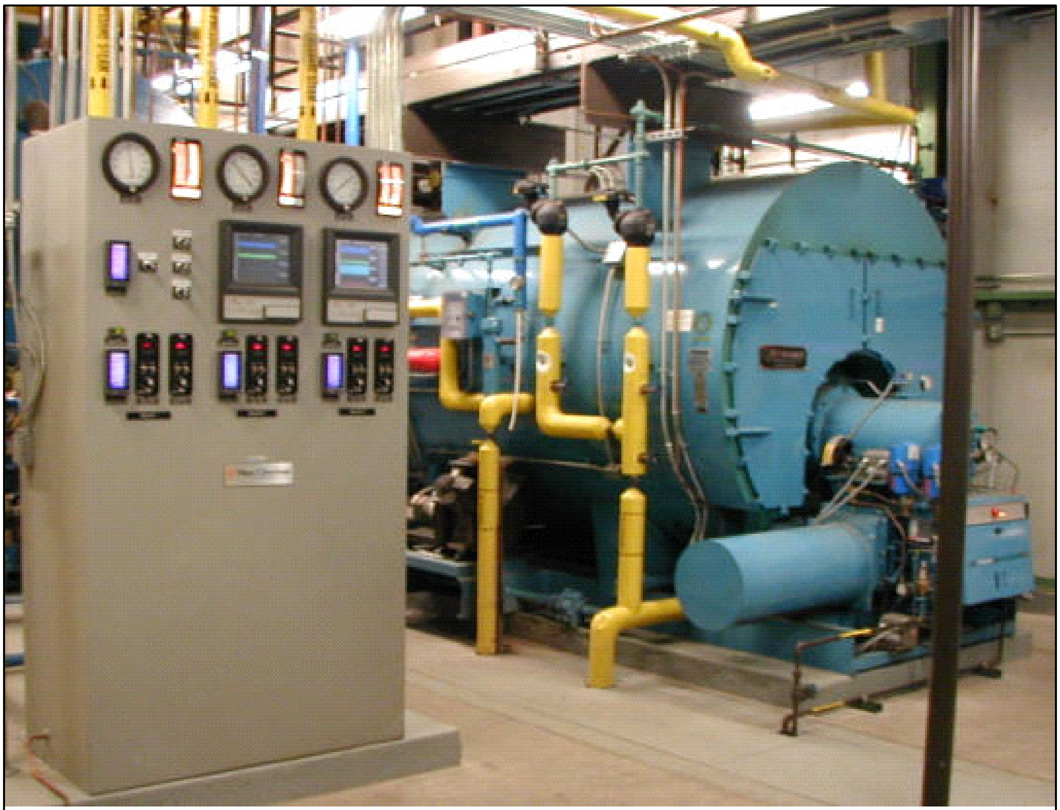
Any electricity saving not considered. However, savings would be –

Savings of Electricity in FD and ID Fan by reducing air handled	
% Excess Air handled by FD & ID Fan	250.00
% Excess Air proposed to be handled	61.54
Ratio of actual Excess Air to Proposed Excess Air	4.0625
Power drawn by FD Fan, kW	12
Power Drawn by ID Fan, kW	10
Saving in Power of FD & ID Fan per year based on Affinity Law, kW/Yr	121362.5
Monetary equivalent @ ₹ 4.5 per kWh	546131.2
Investment in Oxygen Trim + VFD in FD & ID Fan (₹)	500000

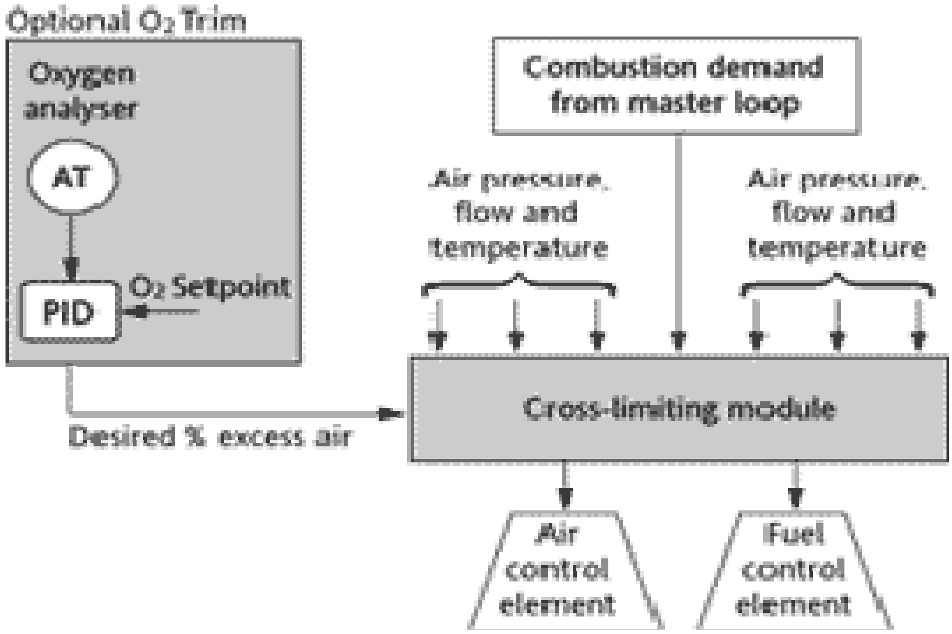
Annexure -5: Details of equipment service providers

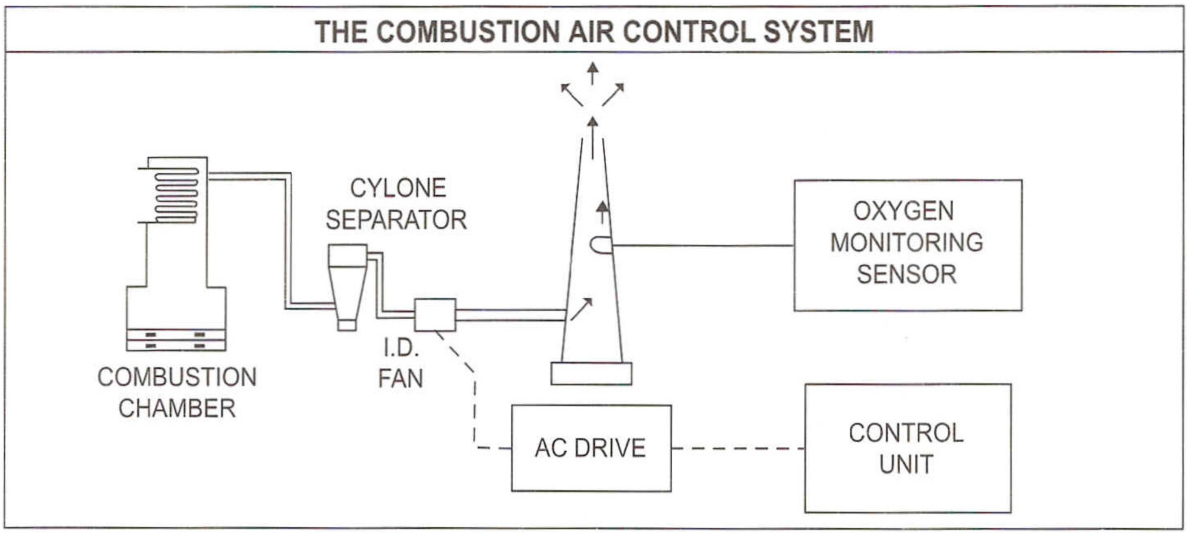
S.No.	Technology	Name of Service Provider	Address	Contact Person and No.
1.	Installation of Residual Moisture Control System	M/s SEMITRONICS	17 CD, Archana Industrial Estate, Rakhial Road, Ahmedabad 079-22741011	Mr. Parthav Shah
2	Installation of Residual Moisture Control System	M/s Montforts Germany through agent M/s ATE India Ltd.	Delhi Ofice	
3	Installation of Residual Moisture Control System	M/s PLEVA	PLEVA GmbH Rudolf-Diesel-Strasse 2 D-72186 Empfingen-Germany Tel.: (+49) (0) 74 85 10 04 Fax: (+49) (0) 74 85 10 09 E-mail: info@pleva-controls.de www.pleva-controls.de	

Annexure - 6Typical arrangement drawings for proposed system



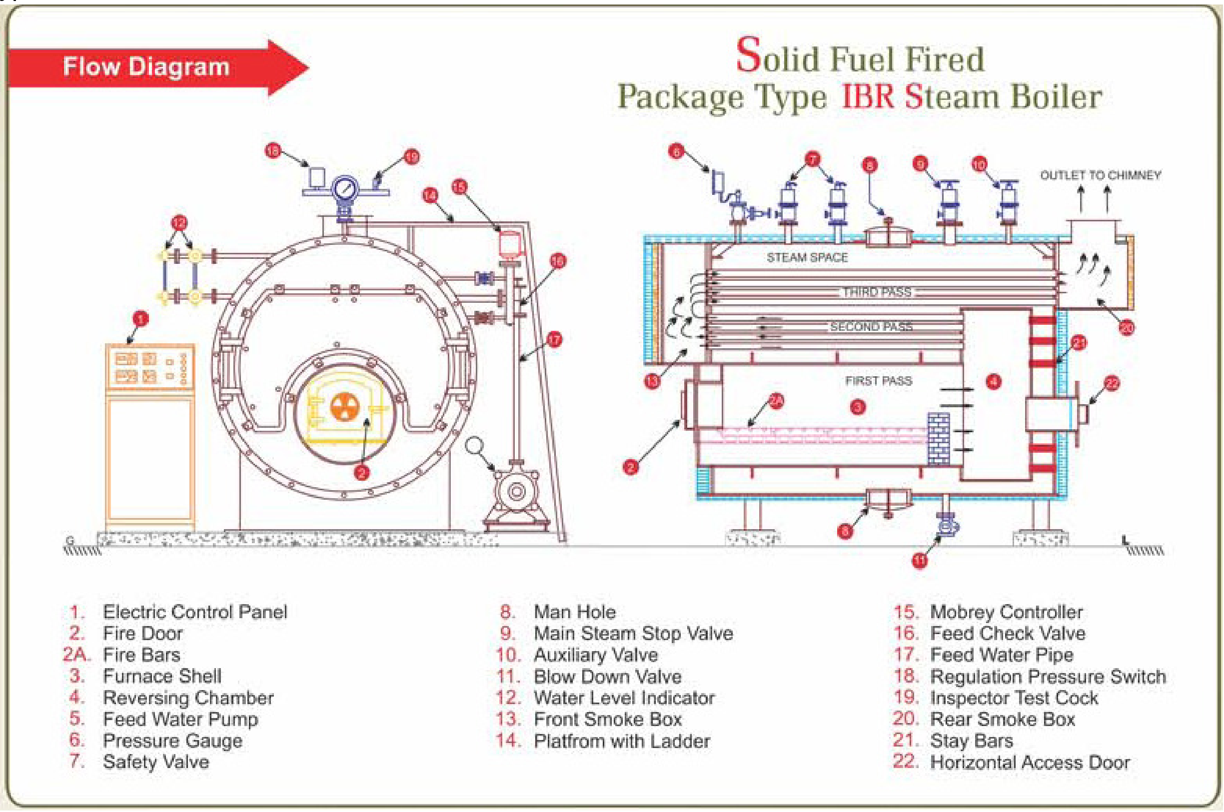
Combined Fuel as well as Air Control System





range control:	conventional
heating:	circulating oil
stenter chains:	pin chain
in principle according to drawing:	45-061385-3

Typical sketch of boiler and auxiliaries



Typical Specification of a Solid Fuel Fired Boiler

CAPACITY (F & A 100 °C Kgs/hr)	500	750	1000	1500	2000	2500	3000	4000	5000	6000	7000
FUEL	COAL / LIGNITE / WOOD / BRIQUETS										
PRESSURE Kg/cm^2 (g)	10.54										
THERMAL EFFICIENCY %											
COAL	78±2										
LIGNITE	76±2										
WOOD	72±2										
H. T. A. (M^2)	19.22	32.22	44.05	66.70	79.60	101.35	127.45	183.93	205.78	244.04	316.93
FUEL CONSUMATION											
COAL (Kgs./Hr.)	79	119	159	239	316	395	474	632	790	948	1105
LIGNITE (Kgs./Hr.)	111	167	223	335	456	570	685	912	1140	1368	1596
WOOD (Kgs./Hr.)	129	194	259	389	514	643	772	1029	1286	1543	1800
PUMP											
CAPACITY (LTRS/HR.)	750	1000	1500	2000	3000	3200	4000	5000	7000	8000	10000
HEAD (MTRS.)	120	120	120	120	120	120	120	120	120	120	120
POWER(H.P.)	5	5	5	7.5	10	10	10	12.5	15	15	20
I. D. FAN											
CAPACITY(M^3/Min)	30	45	60	90	120	150	180	240	300	360	420
HEAD (mmWG)	250	250	250	250	250	250	250	250	250	250	250
POWER (H.P.)	3	5	5	7.5	10	12.5	15	25	30	35	40
OVERALL DIMENSION	ALL DIMENSIONS ARE IN MM										
LENGTH	2350	2900	3200	3550	4150	4750	4750	5000	5100	5600	6300
WIDTH	2250	2350	2350	2600	2600	2600	2850	3350	3400	3775	4100
HEIGHT	2350	2450	2450	2750	2750	2850	3200	3650	3800	4050	4450

Annexure – 7 Quotation for Proposed Technology

9227575707

SEMITRONIK INSTRUMENTS

August 7, 2009

The Petroleum Conservation Research Association
(under Ministry of Petroleum & Natural Gas, Govt. of India)
G-2, Shantiniketan Apartment
291, Adarsh Nagar
Jaipur

Dear Sir, **Kind attn : Mr. Suman Kumar (Joint Director)**

Ref : Your email dated 2/8/09
Sub : 1. Fabric Temperature indicator and controller for heat setting application.
2. Oxygen % Monitoring and controlling system for Boiler.

We acknowledge with thanks the receipt of your email as referred above and have noted the contents thereof.

Accordingly we are pleased to give our technical as well as commercial offer as below:

Technical Specifications:-

1. **Fabric Temperature Indicator and controller** – It is a unique way to measure the temperature of the fabric using non-contact type infrared sensors. These sensors are mounted on the top of the chambers and the length of the fabric is scanned continuously and the data is logged. A desired fabric temperature and dwell time for a particular lot can be set and accordingly control action is provided to make sure the temperature is reached and the dwell time is attained. The system helps maintain uniform quality of the fabric across its length and makes sure the machine runs at the most optimum speed, saving time and energy.

The complete system is subject to the following scope of supply:

Hardware System: -

- **Infrared Sensors** - housed in a sturdy stainless steel body, hermetically sealed and IP65 standard.
- **Analogue and Digital I/O Board** to scan and control the speed of the machine based on difference in set and actual value.
- **Panel PC** – a specially designed industrial computer to withstand heat, dust and vibrations. It has a small form factor so that it can be easily deployed into a control panel. It is provided with touch screen functionality for ease of use.

Software System: -

- **PLC Software** - interfaced with the analogue and digital I/O boards to read the speed of the machine on input and output end, fabric temperature and control the speed based on desired dwell time. The user interface is designed to ease of operator interaction with a touch screen.

System Output: -

- Relay output to control the machine speed.
- 4 -20 ma with galvanic isolation for PLCs and A.C.Drives.

MUMBAI OFFICE : 1A, Abhishek Co-Op. Soc. Ltd. G.D. Ambekar Marg, Dadar (CRly.) Mumbai-400 014. (India) TEL.: 24147788, 32957649 FAX : (022) 24130266
SURAT OFFICE : 407, Trade Centre, Behind Reshamwala Market, Ring Road, Surat - 395 002. (India) TEL.: 2354847 FAX : (0261) 2324746 (R) 2680026, 7438600

2. **Oxygen % monitoring & controlling system (Combustion Air Trimming (CAT) Control System)** to trim the combustion air by controlling the speed of the ID / FD fan for the elimination of wastage of Thermal as well as Electrical energy on the boiler / thermic fluid heaters. The complete system is subject to the following scope of supply :

a. Oxygen measuring sensor, zirconium (ZrO_2) housed in a sturdy stainless steel body with the self heating arrangement. The sensor measures the % oxygen of the exhaust air in the chimney.
b. Intelligent Control Circuit module with display of actual Oxygen %. The control module within the system automatically controls the RPM of ID/FD fans with due interlock.
c. AC Drive for ID/FD fans (Optional)

Price details:-

Sr no	Item description	Price per unit (Rs.)
1.	Fabric Temperature Indicator and controller complete set with 4 sensors	**1,80,000/-**
2.	*Oxygen % Indicator and controller (i.e. Combustion* Air Trimming Control system, measuring on-line oxygen in the fuel gas) Model OMC/101	**1,95,000/-**

The above prices are Net, Ex.works - Ahmedabad subject to packing / forwarding @ 3.5% and taxes, excise etc. will be charged extra as applicable at the time of delivery.

Delivery : within 3/4 weeks from the date of receipt of order
Payment : 30% advance along with order and balance against proforma invoice
Erection : Kindly note all required information pertaining to erection & commissioning will be supplied along with unit. However, if services of our engineer are required, same will be at extra.

For your reference, sending herewith following :

1. Technical catalog of above systems
2. Installation drawing
3. Economics' involved in installation of the system

Etc. etc.

In case any more information is required, kindly feel free to contact us.

Thanking you in anticipation,

(N J Shah)

encl : as above

ks

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

Petroleum conservation Research Association

(Under Ministry of Petroleum and Natural Gas)
Sanrakshan Bhawan, 10 Bhikaji Cama Place, New Delhi-66
Ph. : +91-11- 26198856, Fax : +91-11-26109668
Website: www.pcra.org

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri, New Delhi-110058
Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com