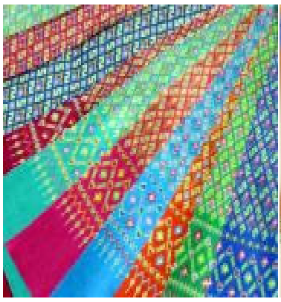
DETAILED PROJECT REPORT
ON
BLOWER SPEED OPTIMIZATION IN STENTERS
(PALI TEXTILE CLUSTER)







Bureau of Energy Efficiency

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BLOWER SPEED OPTIMIZATION IN STENTERS

PALI TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Blower Speed Optimization in Stenters

Textile SME Cluster, Pali, Rajasthan (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PAL/TXT/BSO/02**

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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
- CERs - Certified Emission Reduction
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- 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
- RPC - Reliance Pet Coke
- SME - Small and Medium Enterprises
- TFH - Thermic Fluid Heater
- VFD - Variable Frequency Drives

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 100 gm 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 payback 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, major flaws were observed in process control of Stenters. None of the units were found to be equipped with automatic process control facilities leading to large scale deviation from process parameters causing wastage of energy. The basic process parameters for the stenters are Residual Moisture, Humidity in Exhaust, Temperature of the fabric, Dwell Time for Heat Setting and Velocity of Air Jet etc. However, none of these are controlled and setting is done on manual estimation basis which has possibility of error.

Typically one stenter consumes between 40 to 55 kWh per hour electricity and 50 to 60 kg per hour RPC. The implementation of VFD for optimization of blower speed of stenters has potential to save 72000 kWh of electricity per year in each stenter.

This DPR highlights the details of the study conducted for assessing the potential for installation of blower optimization in Stenter , 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, sensitivity analysis for three different scenarios 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)	2.60
2	Electricity Saving	KWh	72000
3	Monetary benefit	₹ (in Lakh)	3.31
4	Debit equity ratio	Ratio	3:1
5	Simple payback period	Month	10
6	NPV	₹ (in Lakh)	9.61
7	IRR	% age	98.30
8	ROI	% age	29.71
9	DSCR	ratio	5.01
10	CO_2 saving	tonne	64
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 in Fig. 1 below:

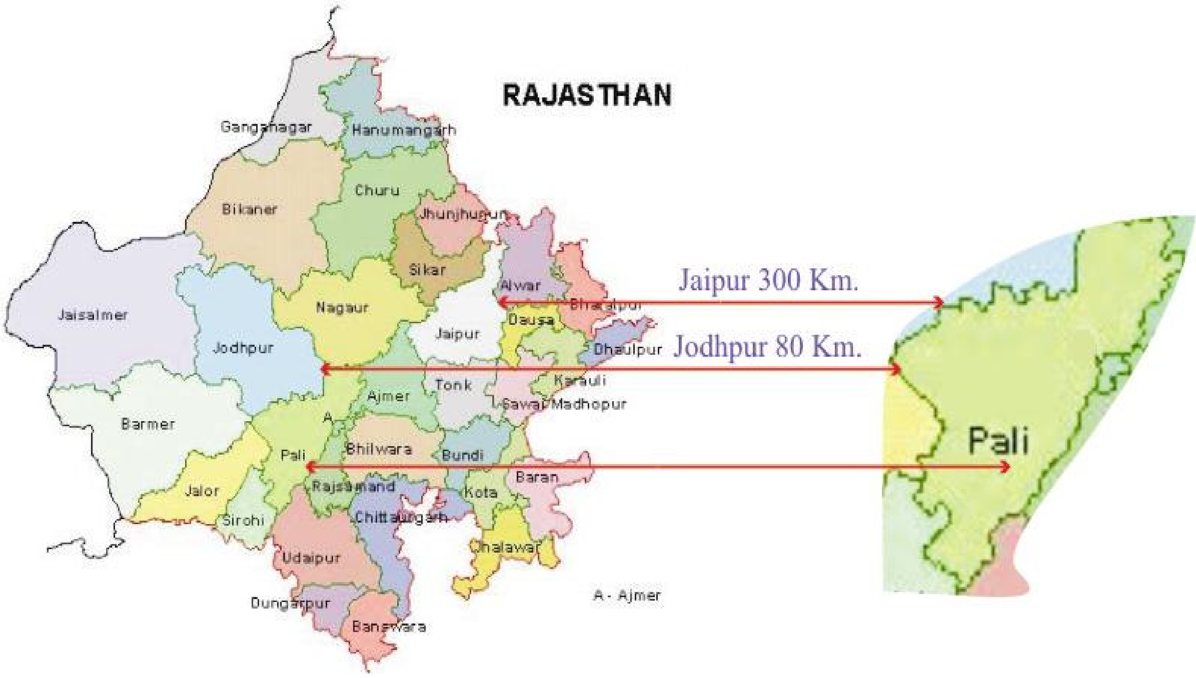


Fig. 1.1 – Pali – Geographical Map

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	2716l	25.6
3	Steam Coke	Tonne/year	2967	5
4	Lignite	MT/year	16635	15.7
5	Diesel	kilolitre/year	89.6	0.3
6	Residual Pet Coke	MT/Year	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 1,00,000 kWh to 3,00,000 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 Jigger 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 stenter in the process are drawn below –

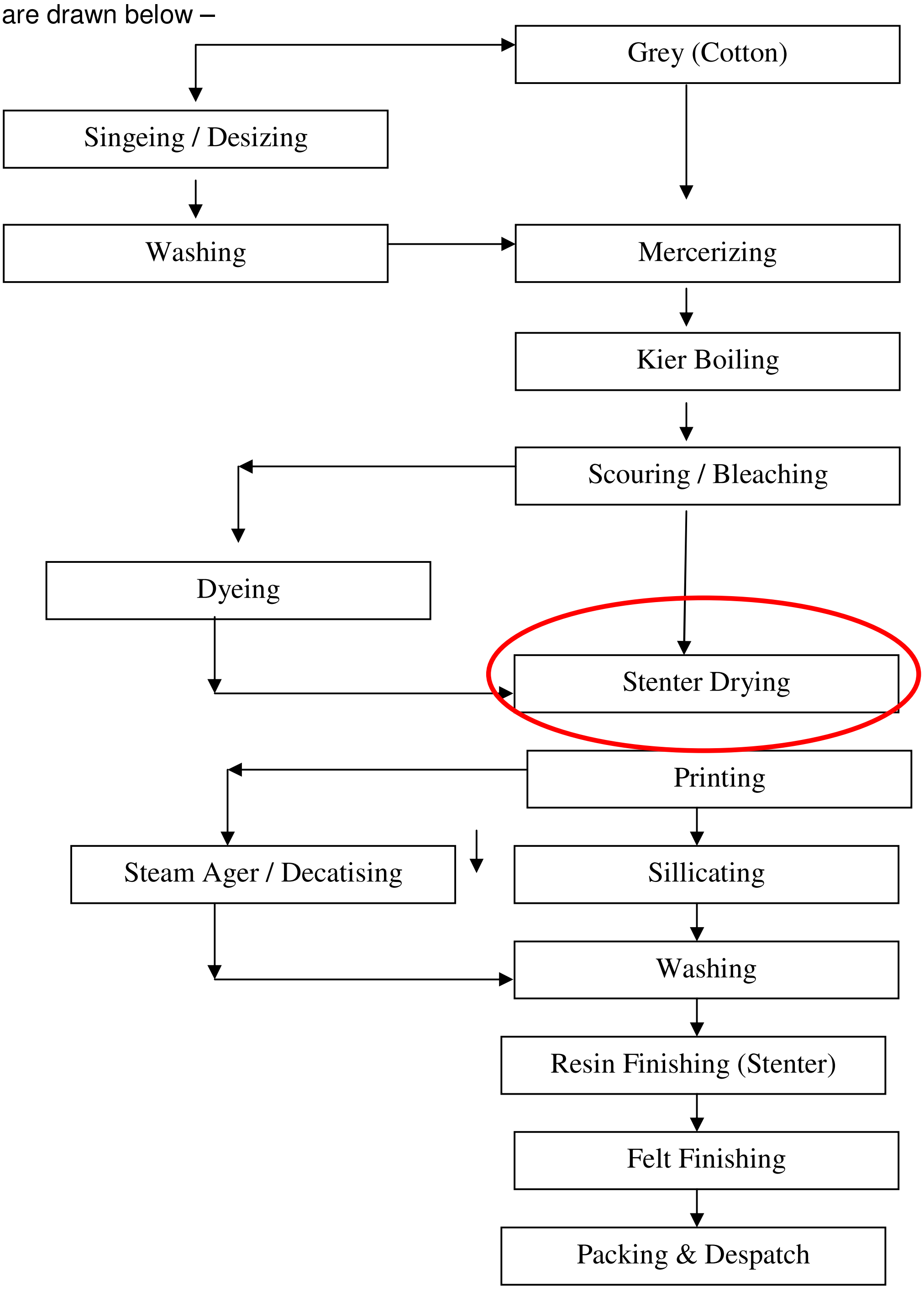


Fig. 1.2 – Process Flow Diagram of Cotton Dyeing and Printing

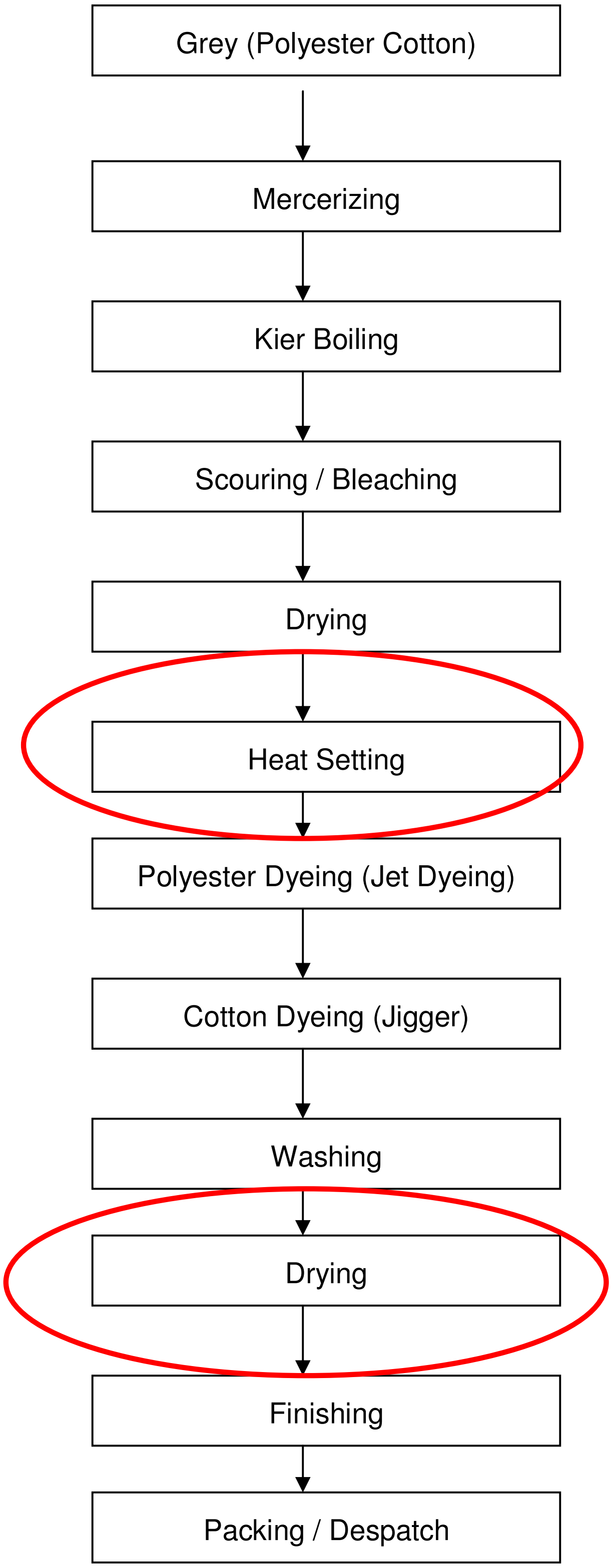


Fig. 1.3 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

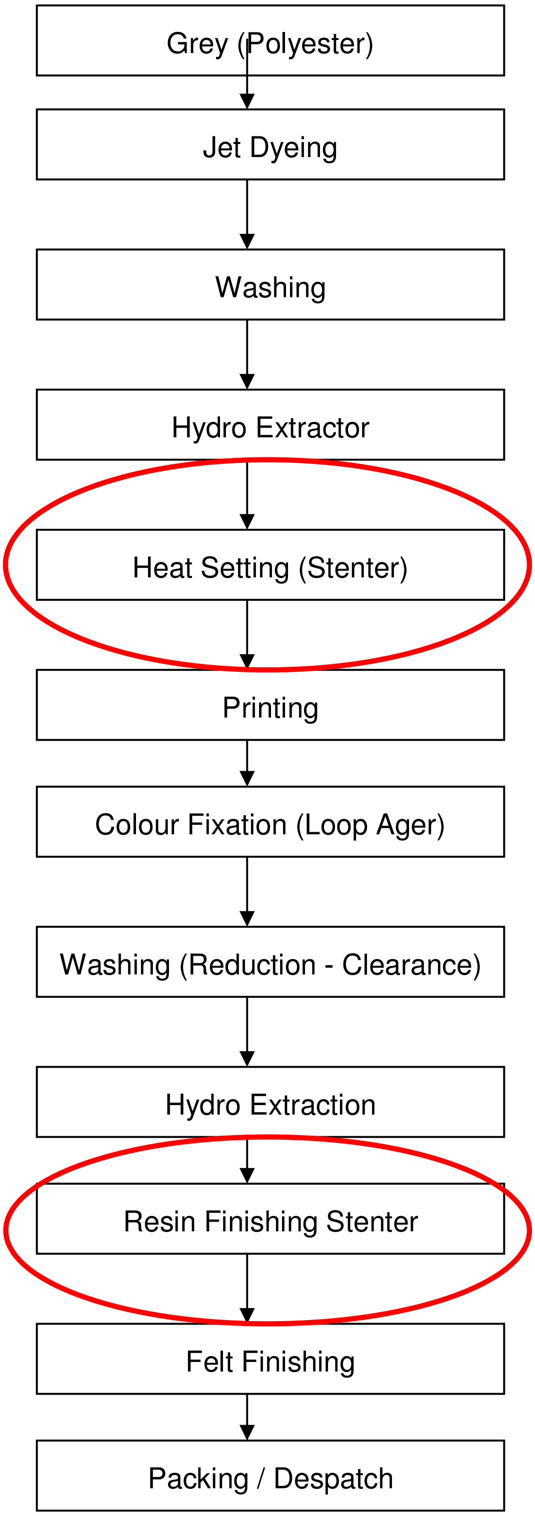


Fig. 1.4 – Process Flow Diagram of Polyester Printing and Finishing

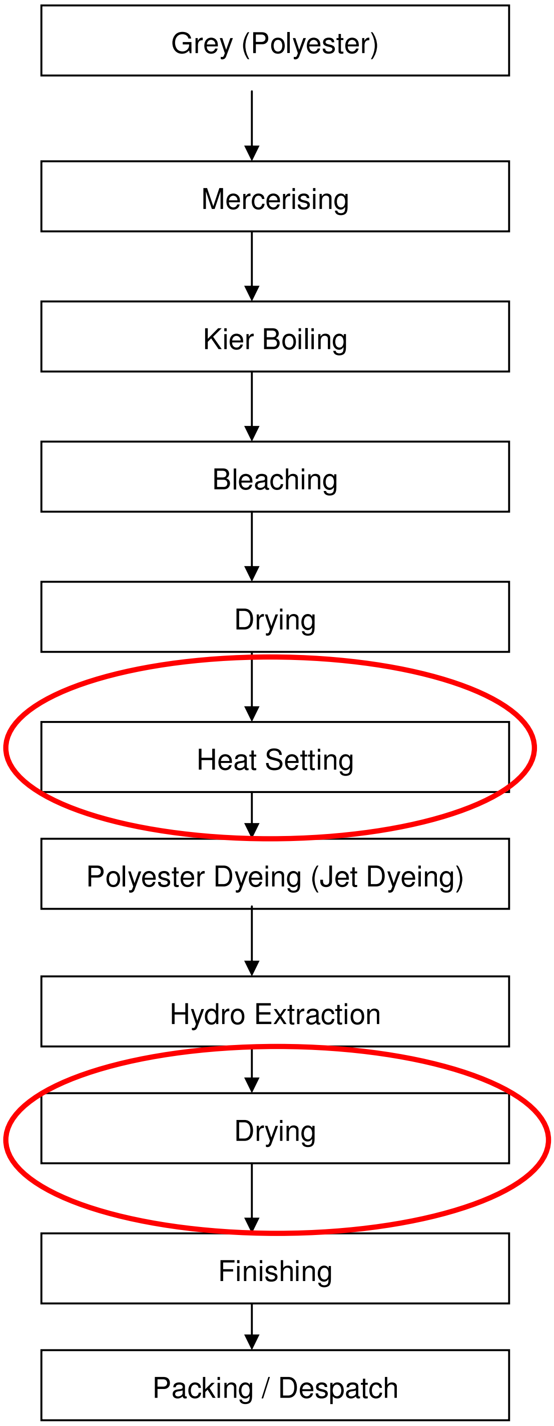


Fig. 1.5 – Process Flow Diagram of Polyester Dyeing and Finishing

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 .0- 16.0
21	Hank	Drying	4.5 - 6.5

SOURCE – CARBONTRUST UK

SEC at 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

Pretreatment of textiles and also Dyeing, Printing, washing etc. involve use of water which needs to be removed from fabric before undertaking final finishing or thermosol process or heat setting. Stenters are mainly used in textile finishing for heat-setting, drying, thermosol processes and finishing. Thus Stenter is one of the most common machinery found in a textile dyeing and finishing industry.

It can be roughly estimated that, in fabric finishing, each textile substrate is treated on average 2.5 times in a stenter. Pali has a population of more than 100 stenters installed in industries. The stenters available in Pali are both open and closed type. These stenters are used for assigning requisite finish, temperature stability and dye curing.

In Cotton Dyeing, stenter is used after pretreatment and dyeing as a finishing process. In Cotton Printing, Stenter is used before printing but after pretreatment. In case of Polyester or PC Dyeing, stenter is used twice, once for heat setting and then again for final finish. Similarly, in case of Polyester and PC Blend Printing, stenter is used twice, once for heat setting and then for final finishing after dye curing.

Stenter happens to be the largest Energy Consuming Machinery available in a textile Dyeing and Finishing Industry. For a 5 Chamber Stenter, the connected load is approx 90 HP and the Thermal Energy Consumption rating is 4.0 lakh kCal per hour. The major Electrical Energy load happens to be that of 10 no. of fans provided for circulation of hot air having motor rating of 7.5 HP each.

Thermal Energy required for stenters is supplied by Thermopac. The hot thermal fluid at a temperature of 235°C to 300°C is pumped to the stenter with the help of a continuous running pump. The blowers blow air onto a grid of heat exchanger tubes containing hot thermic fluid which then is guided onto the fabric through nozzles. The blower motors are generally two speed motors for controlling speed of the blower. Some of the new Stenters have been provided with VFD for control of speed. Some units have installed VFD as retrofit to the stenter blower motors, but this has been done to reduce starting current due to a wrong notion of reducing load on motor and hence the likely benefits of energy saving by modulating the fans are not being accrued.

The temperature in each compartment is controlled in modern stenters with the help of a motor operated flow control valve which bypasses hot fluid if temperature in a chamber exceeds preset temperature. Varying the speed of the motor rotating the endless chain can also vary the speed of the fabric.

To give a –surely rough - assessment energy consumption of energetic optimized stenters is in the range of 3500 - 4500 kJ per kg of textile. However energy consumption depends strongly on the process that is carried out.

A typical stenter is depicted in the following photograph:-

Fig. 1.6 – Photograph of Stenter

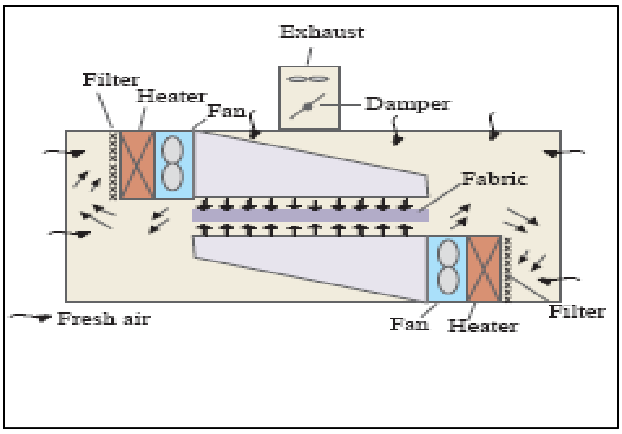


Fig. 1.7 – Schematic diagram of air flow in stenter

Theoretical Background for Proposed Technology

The basic job of stenter is to dry the fabric and the drying rate is a function of distance between nozzle & fabric and also the speed of the air jet. The evaporation rate was found to increase with increase in air velocity through the nozzle. But beyond a certain point, the flow of air becomes tangential and hence despite increase in power consumption, there is no increase in drying rate. The global leaders in Stenter manufacturing have optimized on the distance of fabric from nozzles, air jet velocity and also the design of nozzle so as to improve drying rate. Modern Indian stenters come with computerized monitoring and control system having speed control as well. But none of the stenters in Pali has air jet velocity control system.

Analysis of drying process in hot air and various stages in drying:

1st stage: heating of the material with temperature rising to the wet bulb temperature.

2nd stage: establishment of constant temperature conditions until all the water has been transported to the surface of the material. This wet bulb temperature is independent of the temperature and moisture content of the air used for drying. A high evaporative capacity is achieved with high temperature air circulation.

3rd stage: a further increase in temperature occurs when all the water has evaporated; at this point the material assumes the same temperature as the drying air.

As is obvious, air jet increases drying rate and also heat transfer rate and hence is essential in processes requiring these processes. However, Heat Setting requires increasing the temperature to a certain level and then holding there for specified time period. Obviously, intense air velocity is not needed during dwelling.

Above discussion clearly indicates potential for saving energy by controlling air velocity so as to keep it optimal and also by optimizing velocity during dwelling time.

Consequently, it is proposed to install VFD in the stenter fans so as to monitor and control fan speed as per requirements and hence save Electrical Energy.

1.3.2 Role in process

Textile stenters have two main purposes – convection drying so as to remove the moisture in the fabric and secondly to provide for fabric width control. During the previous stages of processing the fabric is subjected to length wise tension to varying degrees resulting in shrinkage in width. In the stenter, width control is achieved with the aid of a series of clips or pins mounted on a pair of endless chains. Apart from these functions, stenters are also used for the following:

- Dry-heating process like, heat setting of synthetic fabrics and their blends
- Dry curing process namely, resin finishing with built-in catalysts

In Pali, Stenter is used for drying as well as finishing of Cotton and also for Heat Setting as well as Finishing of Polyester and PC Blend. Stenter is indispensable for Dyeing and Printing of polyester and Blends. Cotton fabric is processed on open stenter. Stenter is generally not used for Drying purpose as drying is done in open air by hanging the fabric in sun. Mechanical dewatering process is also used in case of Polyester and PC Blend. All the stenters are equipped with 3 bowl mangles for dewatering which is used if any chemical is applied with water as carrier.

Analysis of cost of ownership of stenter as per PLEVA given in Table 1.6 below reveals that there is a saving potential of 27% minimum.

Table 1.6 Life Cycle Cost Analysis of stenters

S.No.	Cost Head	% age Weightage
1	Machine Cost	16
2	Labor Cost	11
3	Heat energy	23
4	Electricity	12
5	Maintenance	6
6	Spare Parts	3
7	Others	2
8	Potential of Energy Savings	27

Energy Consumption details

Energy break up for Heat setting in a stenter is as given in Table 1.7 below:

Table 1.7 Energy break up for Heat setting in a stenter

S.No.	Component	Energy Content (GJ/Te)	% age
1	Evaporation	0.2	4.3
2	Air Heating	3.55	76.2
3	Fabric	0.25	5.4
4	Case	0.23	4.9
5	Chain	0.1	2.1
6	Drive	0.33	7.1
7	Total	4.66	100

Energy break up for a typical stenter is shown in Table 1.8 below:

Table 1.8 Energy break up for a typical stenter

S.No.	Component	Energy Content (GJ/Te)	% age
1	Evaporation	2.54	41
2	Air Heating	2.46	39.7
3	Fabric	0.29	4.6
4	Case	0.39	6.3
5	Chain	0.09	1.5
6	Drive	0.43	6.9
7	Total	6.2	100

As is obvious from above table, only 5.4% of heat given to stenter is utilized in heating the fabric in case of Heat Setting. Heat gained by fabric in any typical stenter operation is 4.6% only. It is further evident that approx. 95% stenters is used for the purpose of moisture evaporation, released to atmosphere or wasted.

Typical Sankey diagram for a stenter having no Energy Conservation Measures is as below:

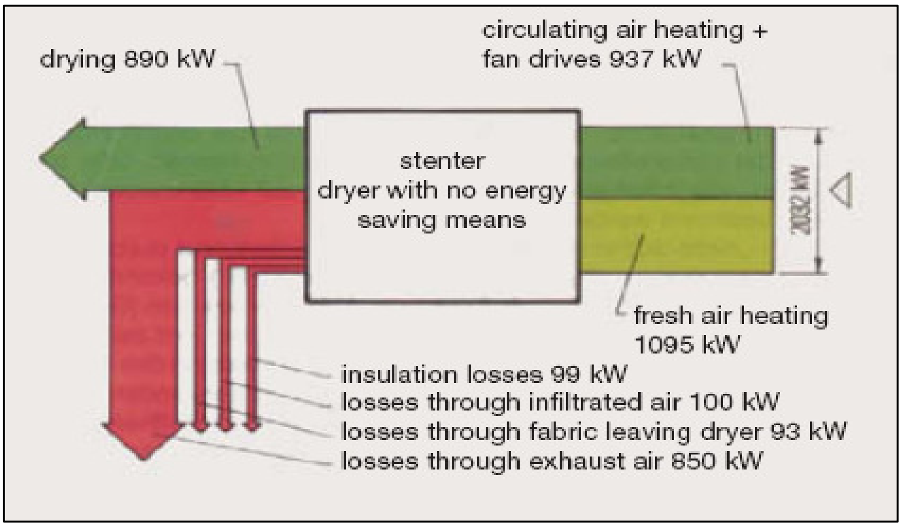


Fig. 1.8 – Sankey diagram for a stenter without Energy Conservation Measure

Typical Sankey Diagram for a stenter with Energy Conservation Measures is as below:

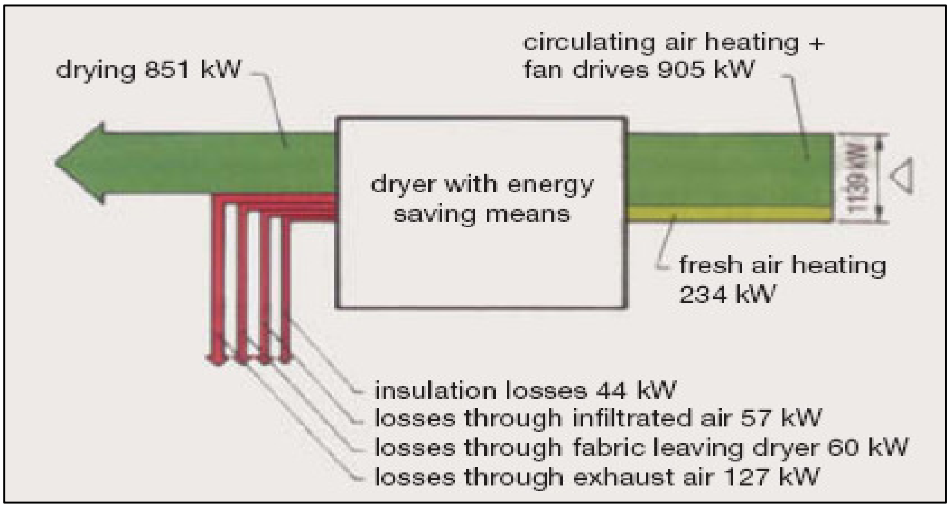


Fig. 1.9 – Sankey diagram for a stenter with Energy Conservation Measure

1.3.3 Energy audit methodology

The following methodology was adopted to evaluate the performance of Stenters which is shown in Fig. 1.10 below:

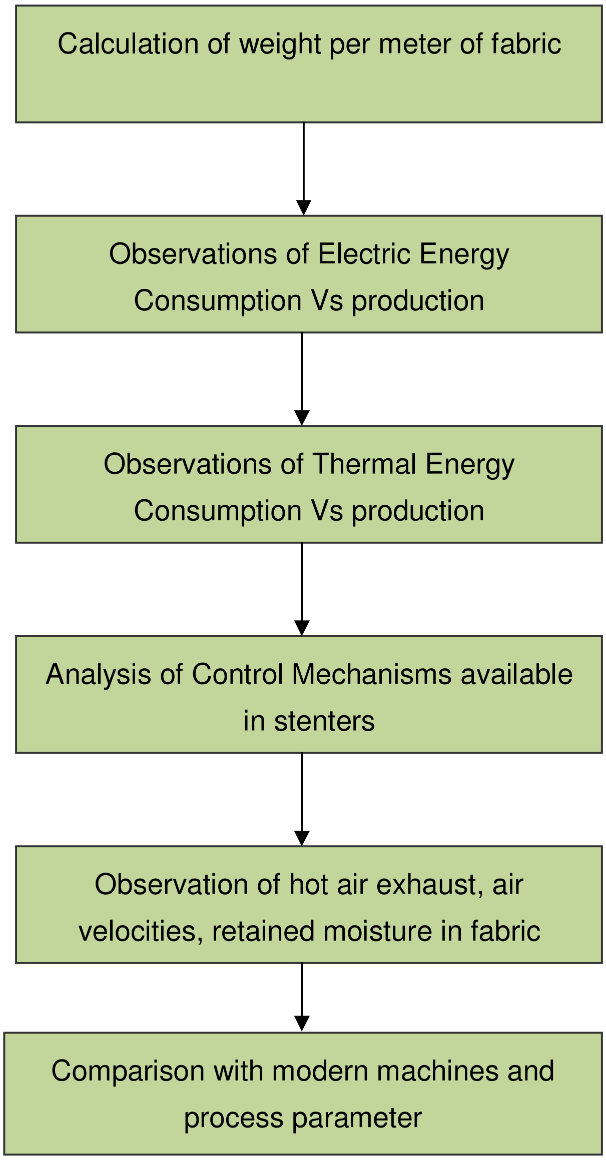
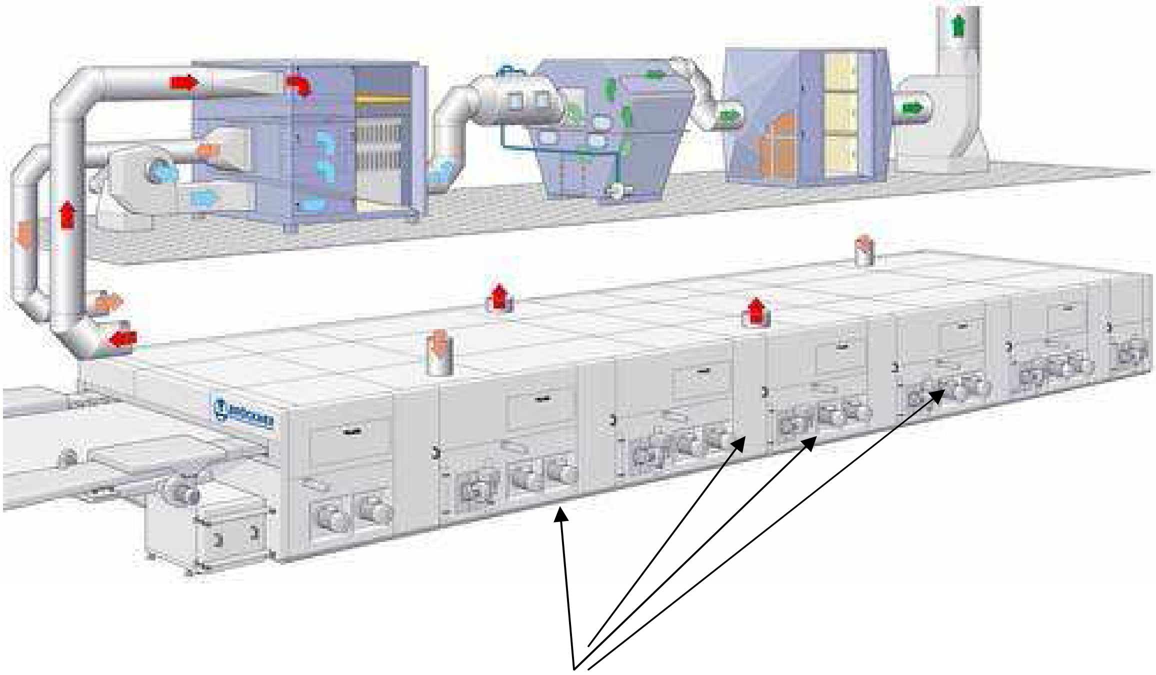


Fig. 1.10 Energy Audit methodologies

1.3.4 Design and operating parameters specification

Typical specification of stenters is placed at Annexure 2. For the given jet configuration and jet area jet velocity determines the heat and mass transfer rates at the evaporated surface and these are both more at higher velocities. In stenters the velocity varies from machine to machine ranging from less than 10 to about 40 m/s. The location of fans is depicted in the following Fig 1.11.



Fans

Fig. 1.11 Location of fans in stenter

1.3.5 Operating parameter & efficiency analysis

The Indian norms for stenters are as below:-

Parameter	*Details*
Entry moisture regain	Uniform across the width and as low as possible, of the order of 60 to 80% depending upon the type of squeeze
Exit moisture regain	Same as for cylinder dryers
Steam pressure	6 to 8 kg/cm^2, as permitted by machinery manufacturer
Jet temperature, ^oC	120 to 150, depending on heat load
Wet bulb temperature, ^oC	55 to 60, depending on jet temperature
Jet velocity m/s	30 to 40
Specific evaporation E_o, kg/(h-m^2)	25 to 30
Running speed per meter of chamber length	5.5 to 6.6
Specific steam consumption, kg steam/kg evaporation	2.0

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 VFDs are readily available in India and many industries in Pali have already installed it.
- The proposed system is not new for the Indian Industry and what is needed is benchmarking process parameter and making the VFD modulate fan speed based these benchmarked parameters.
- Multi National Stenter manufacturers are offering the proposed technology as a standard add on to new systems. Even Indian manufacturers offer the system as an add on.
- The entrepreneurs are in Micro, Small and medium sector and they do not have trained or educated manpower. 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. ₹ 10 Lakh (2.5 lakh for each stenter and 4 stenters per unit) and can be managed by loan only as internal accruals may not suffice.
- 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

Background

Air Jet is mainly required in the evaporation process and to some extent in the fabric heating process. The holding process requires maintaining above specified temperature and hence air jet velocity is not critical here. Even in the evaporation process, maximum evaporation takes place at an air jet velocity of 32 ft/sec beyond which the speed has no use.

Thus, installation of VFD in Stenter Fans to have a complete auto feedback modulation system stands to give huge benefits in terms of Energy Savings. VFDs can be used to:-

a) Modulate speed in the first section to heat fabric very fast. Modulate speed of fans in the second and third chamber so as to ensure air jet velocity of 32 ft/sec.

b) Modulate fans speed in the fourth and fifth chamber so as to maintain temperature above rated temperature.

Most of the stenters in Pali Cluster have 2 speed fans or VFD for regulation of fan speeds. Strangely, VFDs have been installed to smoothen the starting current and hence work mainly as soft starter. The VFD is not at all used for modulating air supply in the system and energy saving feature of auto feedback control system or even manual speed modulation and hence no benefit is accruing to the units. In one of the units, the fan in the fifth chamber has been removed completely and still the stenter is running at the same speed.

It is proposed to permanently run the fans of fourth and fifth chamber on slow speed in stenters having 2 speed fans or reduce speed in these chambers by installing VFD. Also, speed of other chambers can be reduced by installing VFD so as to achieve desired speeds.

Description of equipment

The proposed equipment is simple in technology, implementation and maintenance as VFDs have gained acceptance in industrial units and find very common application in Pali as well. The system is available in modules off the self. However, implementation would require careful establishments of benchmarks and integration of the system to accrue maximum Energy Savings.

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 Stenters Machine without any modification to existing Machinery.

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 is available off the shelf. The whole process would take over 3 weeks for installation.

2.1.5 Source of equipment

Indian as well as MNC manufacturers are supplying the equipment in India.

2.1.6 Technical specification of equipment

Technical specification of proposed technology is attached at Annexure 2.

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

The proposed system is interdependent on existing system and integration would need shutdown of over a week.

2.2 Life cycle assessment and risks analysis

There are no moving parts in the proposed system hence it is likely to run for a long time (Minimum 10 years) if proper power quality is maintained.

2.3 Suitable Unit for Implementation of Proposed Technology

The proposed system can be implemented in almost all of over of 100 no. of Stenters. Total potential for energy saving would be 72 lakh kWh 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

No fuel is likely to be saved by implementation of the proposed system.

3.1.2 Electricity saving

The proposition would help save 72000 kWh electricity per year in every stenter. Detail of electricity saving calculation is given in Annexure 5.

3.1.3 Improvement in product quality

The system comes with precision process control protocol and hence product quality would certainly improve.

3.1.4 Increase in production

Precise process control will certainly improve production; however, the quantum of improvement will depend upon extant level of inefficiency.

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 Stenter would be ₹ 3.31 lakh per year.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

Proposed equipment reduces the GHG emission by reducing electricity 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

No saving in effluent generation is anticipated. However, saving in electricity may be considered to be equivalent saving at the point of generation and hence reduction in emission and SPM levels to that extent can be attributed to the proposition.

3.4.2 Reduction in GHG emission

The equivalent saving in GHG emission for every Stenter would be 64 MT per year as per UNEP GHG Calculator. Consequently, total GHG emission reduction potential for 100 stenters in the cluster would be over 6400 MT.

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 one set of equipment is about ₹ 2.50 lakh based on the availability of the best system in the market. In the absence of a ready to buy system and a supplier, the cost estimate is the best estimate.

4.1.2 Erection, commissioning and other misc. cost

Erection & commissioning cost is ₹ 0.10 lakh and miscellaneous cost.

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	cost
1	Equipment cost	₹ (in Lakh)	2.50
2	Erection & Commissioning cost	₹ (in Lakh)	0.10
3	Interest during implementation	₹ (in Lakh)	0.00
4	Other misc. cost	₹ (in Lakh)	Nil
5	Total cost	₹ (in Lakh)	2.60

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost which is 0.65 lakh.

4.2.2 Loan amount.

Remaining 75% cost of the proposed project will be taken from the bank which is 1.95 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 ₹ 3.31 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 ₹ 2.60 lakh and monetary savings due to reduction in Electricity & Fuel consumption is 3.31 lakh hence, the simple payback period works out to be around 10 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 9.89 Lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 104.88%. 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 28.82%.

Table 4.2 Financial indicators of proposed technology

S.No.	Particular	Unit	Value
1	Simple payback period	Months	10
2	NPV	₹ (in lakh)	9.61
3	IRR	% age	98.30
4	ROI	% age	29.71
5	DSCR	ratio	5.01

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	93.69	9.03	29.50	4.77
Realistic	98.30	9.61	29.71	5.01
Optimistic	102.88	10.19	29.90	5.25

4.5 Procurement and Implementation Schedule

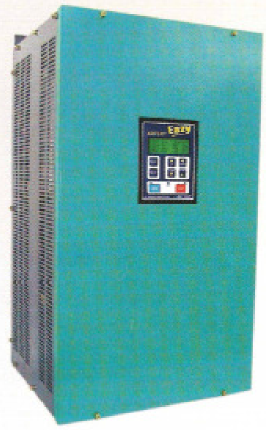
Total time period required for implementation of this technology is about 6 weeks and their details are given in Annexure 4.

ANNEXURE

Annexure -1: Information Brochure of equipment

The World's Most

Improved Efficiency, Higher Reliability & Unmatched Performance



- 5th Generation CSTBT IGBT - Highly Reliable
- Space Vector PWM Control Method
- LCD Display & Drive Support Software for PC
- In-built PID and mini PLC
- Speed Search & Power Loss Carry Through
- True overload and Ground Fault Protection
- Modbus-RTU Connectivity for Networking
- 8 Selectable Paramonitoring on Single Screen
- Fault History upto Last Ten Faults
- User Programmable 8 Analog & 15 Digital I/O's

Easy to Install & Wire

- The AXPERT-EAZY has been downsized considerably in comparison with conventional models to mimize the installation space.
- Well-defined terminations for power and control circuit allows user to easily install and wire the inverter. Use of connector with captive screws on the main control board facilitates single-handed installation.

Easy to Operate & Program

- Self-explanatory full parameter name is displayed on Digital Operation Panel for easy programming. This allows user to set parameters without refereeing to the manual in most cases...
- Navigation of parameters made easy with self-explanatory functional keys NORM, MODE, GROUP, UP & DOWN. RUN & STOP keys for easy operation in local mode.

Easy to Control

- Control is made easy with user programmable 8-Analog and 15-Digital I/Os, In-built MODBUS-RTU connectivity and PID Controller. The Digital Operation Panel can be extended to 100 meter for remote operation.

Easy to Economize

- Auxiliary Drive feature allows the user to control two different motors with single inverter in many applications.

Easy to Maintain

- One-touch fan replacement. The cooling fan, one of the common service parts can be easily removed for replacement.
- Total Conductive Time and Total Run Time provides the information about the inverter and machine usage for the monitoring of serviceable parts.

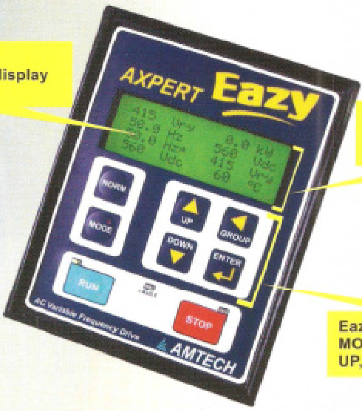
Easy to Protect

- The 32-bit High Speed Digital Signal Processor protects the inverter against the short circuit or ground fault conditions. User setable over load function protects the load against the over load conditions.
- Soft stall current limit reduces the output frequency if the output current exceeds the set level before the inverter trips. Input and Output Phase Loss to prevent loading on the other phases.

Easy-To-Use AC Drive

Digital Operation Panel

LCD Display:
20 character X 4 Line display with back light

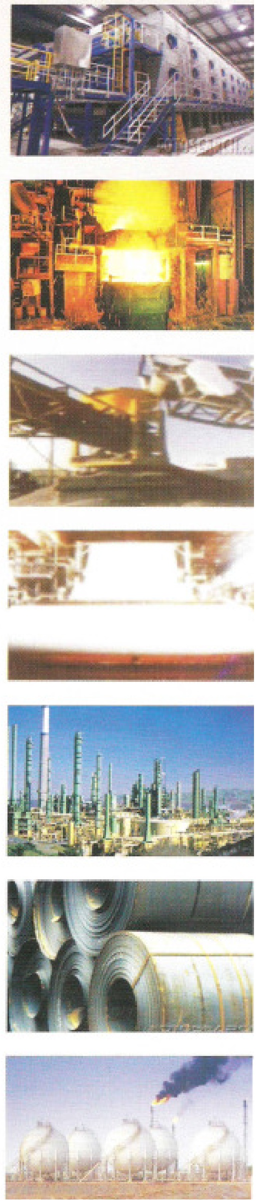


User Selectable 8 parameter Display on Single Screen

Eazy Navigation through MODE, NORM, GROUP, UP, DOWN Keys

Fault History upto Last Ten Faults with 4 important parameters

Applications



Full range of functions for fans and pumps

- Square law V/F function ensures the efficient energy saving
- In-built PID Control
- Speed Search Function allows the user to start the inverter with rotating machine without any damage or tripping.
- Power Loss Carry Through allows the uninterrupted operation of the machine during the momentary power supply fluctuations.
- Restart Function to restart the inverter for maximum 10 times after fault clearance.
- Under Current Level to prevent the machine from running idle.
- 8-Preset speed operation
- Reverse direction lock to inhibit the reverse direction start
- Control circuit Sink / Source logic to connect various types of programmable controllers.

And many other segments

Food processing Industry	Bread, confectionery, tea and noodle making machines, power milling machines, mixers, slivers and fruit selection machines
Chemical Industry	Mixers, extruding machines, centrifugal separators, painting machines, pulverizers
Packaging Industry	Trimming machines, packing machines, wrapping machines, band tighteners
Metal & Steel Industry	Various rolling and shearing machinery, mechanical pressing, winding and take-up machines
Textile Industry	Weaving machines, knitting machines, dyeing/finishing machines, sewing machine
Cement Industry	Kinn Coal burner firing fan, Cooling tower, Conveyors
Paper Industry	Main Paper Machine, Paper winding, Replace old eddy current coupling drive

ENERGY IS LIFE BEE CONSERVE IT

Annexure 2 – Technical specification

STANDARD SPECIFICATIONS

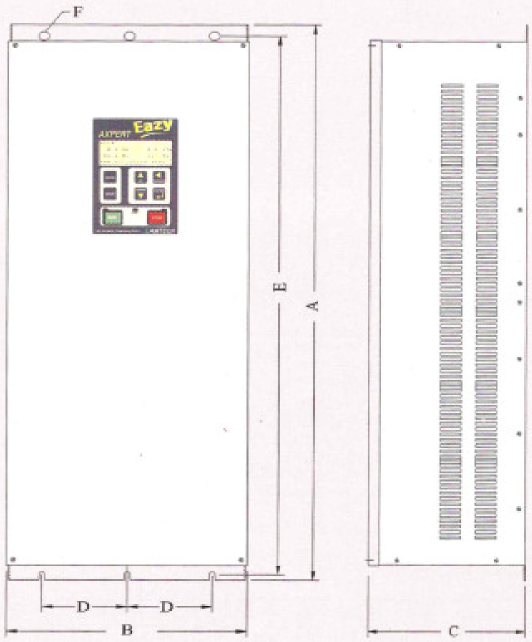
Power	380~460Vac, 3-Phase, 3-Wire, 50/ 60 Hz									
Tolerance	Voltage tolerance: +/-10%, Frequency tolerance: +/-5%									
AMT □□□	045	055	075	090	110	132	160	200	250	315
Rated Amp	84	100	135	160	200	235	285	360	450	530
Motor kW	45	55	75	90	110	132	160	200	250	315

Control Functions	Control Method	Space Vector PWM Control
	Frequency Range	0.1~600Hz Constant or Variable Torque
	Output Frequency Resolution	0.1Hz (Digital), Max Frequency/ 4096 (Analog)
	Output Frequency Stability	0.01% (0~50 degree centigrade)
	V/ Hz Characteristics	2-Preprogrammed patterns, 1-Custom 3-point setting pattern
	Voltage Boost	0~20%
	Acceleration/ Deceleration Time	0.1~1200 Seconds (2 Ranges)
	Switching Frequency	2~10kHz selectable with 1kHz resolution
	Overload Capacity	105% continuous, 150% Overload for 60 seconds at every 10 minutes
Operation Specifications	Catch On Fly	When enabled, rotating motor can be started at any moment
	Power Loss Carry Through	Up to 5 seconds for smooth operation of the system during power loss
	DC Braking	DC Braking start frequency 0.1~50 Hz, Time: 0~25 seconds, Brake current: 15 to150%
	Frequency Setting Input	Digital Input: Digital Operation Panel (Local) or Serial RS485
		Potentiometer: 2 k Ohm
		FSV: 0~5Vdc or 0~10Vdc (or Inverse)
		FSI: 0~20mA or 4~20mA (or Inverse)
	Torque Setting Input	Digital Input: Digital Operation Panel (Local) or Serial RS485
		Potentiometer: 2 k Ohm
		FSV: 0~5Vdc or 0~10Vdc (or Inverse)
		FSI: 0~20mA or 4~20mA (or Inverse)
	Programmable Analog Inputs	VIN: 0~10Vdc (or Inverse)
		IIN: 0~20mA or 4~20mA (or Inverse)
	Input Commands	Run, Stop, Reverse, Jog, Preset input-0, 1 & 2, Frequency Increase/ Frequency Decrease for static potentiometer, Run command with maintained / momentary facility, Ramp select, Aux drive select, Emergency stop, Fault reset, Ext Fault, Terminal select, Ref select 0 & 1.
	Digital Inputs / Digital outputs	2-Fixed inputs for Run and Stop, 6-Programmable Sequence Inputs, 4-Programmable Sequence Outputs
	Potential Free Contacts	2-Programmable relays: 1-NO, 1-NC for 2A @ 240Vac
		1-Fault relay: 1-NO, 1-NC for 2A @ 240Vac
	Programmable Analog Outputs	2-Programmable analog voltage outputs VO1 & VO2: 0~10Vdc
		2-Programmable analog current outputs IO1 & IO2: 4~20mA
	Network connectivity	RS-485 for PC Interface with Modbus-RTU protocol
	Auto Restart	Adjustable up to 5 times for ten faults
	Slip Compensation	0~5Hz
	Skip Frequency	3-steps with 0~10Hz
	Multi Step Frequency	8-steps
	Sequence input	Sink/ Source selectable throw jumper

STANDARD SPECIFICATIONS

Display	Display and Keypad module	20-Character, 4-Line LCD panel, 8-Key keypad, 3-Status indicating LED for Run, Stop and Fault
Protective Specifications	Protective Function	Current Limit, Over current fault, Timed over current fault, Load side short circuit fault, Under current fault, Over voltage fault, Under voltage fault, Temperature fault, Input / Output phase loss fault, Ground fault, External fault, Charging fault, Current sensor fail fault, EEPROM Fault, 4~20mA reference missing fault, Auto tuning fault, Emergency stop, Communication loss, Input phase reverse fault.
	Smooth Operation	Speed Search, Auto Restart and Power Loss Carry Through functions
	Fault history	Last ten faults with status and operational parameters like output frequency, output current, dc bus voltage and heat sink temperature.
	Electronic thermal overload	150% Overload for 60 Seconds
Environment	Installation location	Indoor
	Ambient temperature	0 to 50 degree centigrade
	Storage temperature	-20 to 70 degree centigrade
	Altitude (above sea level)	3300ft without derating, above 3300ft derate 5% per 1000ft
	Humidity	0~95% maximum non-condensing
	Enclosure	IP00

EXTERNAL DIMENSION



Model	Dimensions (mm)						Weight (kg)
	A	B	C	D	E	F	
AMT 045	708	374	320	157.5	678	10	40
AMT 055	830				800		55
AMT 075							
AMT 090	970	490		214.5	940		80
AMT 110							
AMT 132							
AMT 160	1185	510		200	1155		105
AMT 200							
AMT 250							
AMT 315	1330	550		220	1300		140

Annexure -3: Detailed financial analysis

Assumption

Name of the Technology	BLOWER OPTIMIZATION STENTER		
Rated Capacity	NA		
Details	**Unit**	**Value**	**Basis**
Installed Capacity			
No of working days	Days	300	
No of Shifts per day	Shifts	3	(Assumed)
Capacity Utilization Factor	%age		
Proposed Investment			
Equipment cost	₹ (in lakh)	2.50	
Civil works, Erection and Commisioning	₹ (in lakh)	0.10	
Other cost	₹ (in lakh)	0.00	
Total Investment	₹ (in lakh)	2.60	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	0.65	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	1.95	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity Saving	KWh	72000	
Cost	₹/KWh	4.6	
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	1.95	0.06	1.89	0.23
2	1.89	0.12	1.77	0.18
3	1.77	0.24	1.53	0.17
4	1.53	0.48	1.05	0.13
5	1.05	0.69	0.36	0.08
6	0.36	0.36	0.00	0.01
		1.95		

WDV Depreciation

₹ (in lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	2.60	0.52
Depreciation	2.08	0.42
WDV	0.52	0.10

Projected Profitability

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31
Total Revenue (A)	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31
Expenses								
O & M Expenses	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15
Total Expenses (B)	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15
PBDIT (A)-(B)	3.21	3.20	3.20	3.19	3.19	3.18	3.17	3.17
Interest	0.23	0.18	0.17	0.13	0.08	0.01	-	-
PBDT	2.98	3.02	3.03	3.06	3.11	3.17	3.17	3.17
Depreciation	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
PBT	2.84	2.88	2.89	2.92	2.97	3.03	3.04	3.03
Income tax	0.31	0.88	1.03	1.04	1.06	1.08	1.08	1.08
Profit after tax (PAT)	2.54	2.00	1.86	1.88	1.92	1.95	1.96	1.95

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
rofit before tax	2.84	2.88	2.89	2.92	2.97	3.03	3.04	3.03
Add: Book depreciation	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Less: WDV depreciation	2.08	0.42	-	-	-	-	-	-
Taxable profit	0.90	2.60	3.03	3.06	3.11	3.17	3.17	3.17
Income Tax	0.31	0.88	1.03	1.04	1.06	1.08	1.08	1.08

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Reserves & Surplus (E)	2.54	4.53	6.40	8.28	10.20	12.15	14.11	16.06
Term Loans (F)	1.89	1.77	1.53	1.05	0.36	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	5.08	6.95	8.58	9.98	11.21	12.80	14.76	16.71

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Less Accm. Depreciation	0.14	0.27	0.41	0.55	0.69	0.82	0.96	1.10
Net Fixed Assets	2.46	2.33	2.19	2.05	1.91	1.78	1.64	1.50
Cash & Bank Balance	2.61	4.63	6.39	7.93	9.29	11.02	13.12	15.21
TOTAL ASSETS	5.08	6.95	8.58	9.98	11.21	12.80	14.76	16.71
Net Worth	3.19	5.18	7.05	8.93	10.85	12.80	14.76	16.71
Debt Equity Ratio	2.91	2.72	2.35	1.62	0.55	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	0.65	-	-	-	-	-	-	-	-
Term Loan	1.95								
Profit After tax		2.54	2.00	1.86	1.88	1.92	1.95	1.96	1.95
Depreciation		0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Total Sources	2.60	2.67	2.13	2.00	2.02	2.05	2.09	2.09	2.09
Application									
Capital Expenditure	2.60								
Repayment Of Loan	-	0.06	0.12	0.24	0.48	0.69	0.36	-	-
Total Application	2.60	0.06	0.12	0.24	0.48	0.69	0.36	-	-
Net Surplus	-	2.61	2.01	1.76	1.54	1.36	1.73	2.09	2.09
Add: Opening Balance	-	-	2.61	4.63	6.39	7.93	9.29	11.02	13.12
Closing Balance	-	2.61	4.63	6.39	7.93	9.29	11.02	13.12	15.21

IRR

₹ (in lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		2.54	2.00	1.86	1.88	1.92	1.95	1.96	1.95
Depreciation		0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Interest on Term Loan		0.23	0.18	0.17	0.13	0.08	0.01	-	-
Cash outflow	(2.60)	-	-	-	-	-	-	-	-
Net Cash flow	(2.60)	2.90	2.32	2.17	2.15	2.13	2.10	2.09	2.09
IRR	98.30%								

NPV	9.61

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11
Sub Total(G)	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
Interest on Term Loan	0.23	0.18	0.17	0.13	0.08	0.01	0.00	0.00
Depreciation (H)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Sub Total (I)	0.39	0.35	0.33	0.30	0.24	0.18	0.17	0.17
Sales (J)	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31
Contribution (K)	3.23	3.23	3.23	3.22	3.22	3.21	3.21	3.20
Break Even Point (L= G/I)	12.06%	10.78%	10.29%	9.33%	7.61%	5.64%	5.37%	5.43%
Cash Break Even {(I)-(H)}	7.82%	6.53%	6.04%	5.07%	3.35%	1.37%	1.09%	1.14%
Break Even Sales (J)*(L)	0.40	0.36	0.34	0.31	0.25	0.19	0.18	0.18

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	2.84	2.88	2.89	2.92	2.97	3.03	3.04	3.03	23.61
Net Worth	3.19	5.18	7.05	8.93	10.85	12.80	14.76	16.71	79.46
									29.71%

Debt Service Coverage Ratio

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	2.54	2.00	1.86	1.88	1.92	1.95	1.96	1.95	12.15
Depreciation	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.82
Interest on Term Loan	0.23	0.18	0.17	0.13	0.08	0.01	0.00	0.00	0.80
Total (M)	2.90	2.32	2.17	2.15	2.13	2.10	2.09	2.09	13.77

DEBT

Interest on Term Loan	0.23	0.18	0.17	0.13	0.08	0.01	0.00	0.00	0.80
Repayment of Term Loan	0.06	0.12	0.24	0.48	0.69	0.36	0.00	0.00	1.95
Total (N)	0.29	0.30	0.41	0.61	0.77	0.37	0.00	0.00	2.75
	0.23	0.18	0.17	0.13	0.08	0.01	0.00	0.00	0.80
Average DSCR (M/N)	5.01								

Annexure -4: 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	Hook up after installation			
2	Tuning and benchmarking speeds for different fabric.			
3	monitoring to achieve stable performance.			

Annexure 5: Detailed equipment assessment report

Calculation of Energy Saving Potential

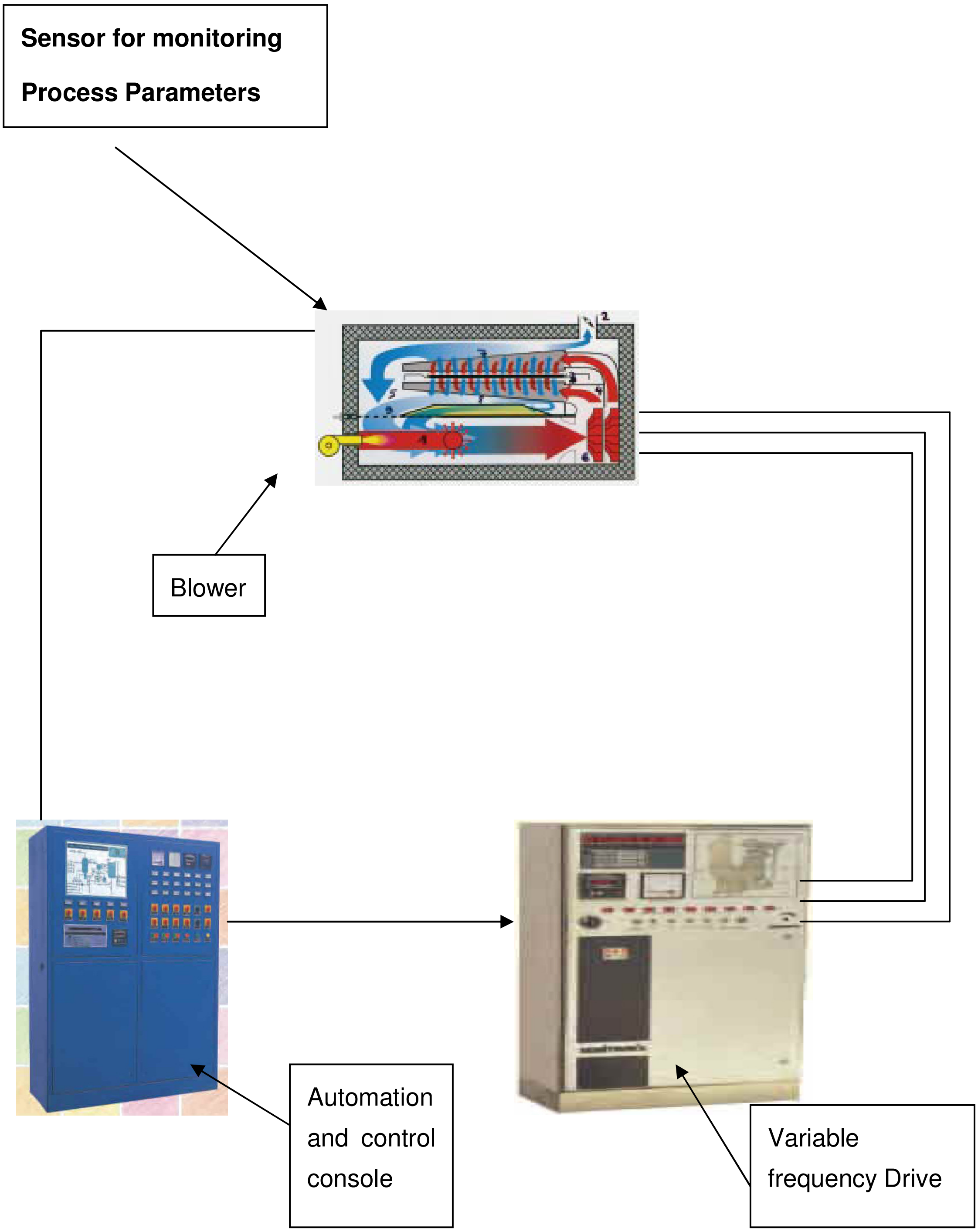
Calculation of Savings by modulation of stenter fans by installing VFD	
All the stenters in Pali have 5 chambers and 10 fans of 7.5 HP (5.6 kW), some of them have been provided with two speed or VFD	
Power Consumed by Stenter Fans at high speed	4.2 kW
Power Consumed by Stenter Fans at slow speed	1.7* kW
Considering that fans in last two chambers i.e. 4^{th} and 5^{th} are run on slow speed, Saving in electricity per hour	=4(4.2-1.7) = 10 kWh
Total operating days	24
Number of working days	300
Yearly electricity saving	72000 kWh
Cost of electricity	₹ 4.6/ kWh
Equivalent Monetary Savings	₹ 3.31 lakh
Cost of 5 no. VFD of 12 kW each to run 2 motors each	₹ 2.5 lakh
General Pay Back Period	9.1 months

**The savings are based on blower speed and on the basis of actual measurement of power.*

Annexure -6: Details of equipment service providers

S.No.	Technology	Name of Service Provider	Address	Contact Person and No.
1.	VFD for Blowers	M/s Semitronics	17 CD, Archana Industrial Estate, Rakhial Road, Ahmedabad 079-22741011	Mr. Parthav Shah
2	VFD for Blowers	M/s Danfoss	Danfoss Industries Pvt. Ltd. 296, Old Mahabalipuram Road, Solinganallur, Chennai - 600 119	Mr. N Rengarajan, Mr. Palanisamy P.L. 044 – 66501555 rengarajan@danfoss.com, plp@danfoss.com
3	VFD for Blowers	M/s L&T	Larsen & Toubro Limited L&T House, Ballard Estate, P.O. Box 278, Mumbai 400 001, India	
4	VFD for Blowers	M/s Amtech	E-6, GIDC Industrial Zone Gandhinagar Gujrat 079-2322532423227294 info@amtechelectronics.com	Vishal Visa 9909910261

Annexure – 7 Typical arrangement drawings for proposed system



Annexure – 8 Quotation for Proposed Technology

AMTECH ELECTRONICS

AMTECH
ELECTRONICS (INDIA) LTD.
MOTION CONTROL SYSTEM
E-6, GIDC ELECTRONICS ZONE
GANDHINAGAR - 382 028 (INDIA).
PHONE : +91-079-23289101,23289102,23289103
FAX : +91-079-23289111
GRAM : AXPERT
E-mail : info@amtechelectronics.com
WeB : www.amtechelectronics.com

AEIL/VV/PP/Q-1174/10-11
Date: 17th Dec-2010

To,
M/s PCRA
Jaipur
Mob: 9214043746
E-mail: kumars@pcra.org

Kind Attn: Shri Suman Kumar

Sub: Offer for 30KW AC VFD Module for Thermic Fluid Pump

Ref: Your mail inquiry dated: 13/12/2010

Dear Sir,

We acknowledge with thanks for the receipt of your enquiry regarding requirement of AC Variable frequency drive suitable for 415V, 3Phase 50 Hz Induction motor. Herewith please receive our most competitive offer for the same as under

QUOTATION

Sr. No	Description	QTY	Unit Price (In Rs.)	Disc.	Total Disc. Amount (In Rs.)
01	**AXPERT VT240S AC Variable frequency drive - 415V, 3Phase, 50 Hz** **Model:** - AXPERT VT240S 030H **Rating:** - 30KW	1	95,000/-	30%	**66,500/-**

We trust that the above is in line with your requirement. However If you need further information / clarification please feel free to contact us. We ensure you the best of attention at all time. We look forward for your valuable purchase order.

Thanking you,
For Amtech Electronics (I) Ltd.

Vishal Visa
(9909910261)

AMTECH ELECTRONICS

AMTECH
ELECTRONICS (INDIA) LTD.
MOTION CONTROL SYSTEM
E-6, GIDC ELECTRONICS ZONE
GANDHINAGAR - 382 028 (INDIA).
PHONE : +91-079-23289101,23289102,23289103
FAX : +91-079-23289111
GRAM : AXPERT
E-mail : info@amtechelectronics.com
WeB : www.amtechelectronics.com

AEIL/VV/PP/Q-1174/10-11
Date: 17th Dec-2010

COMMERCIAL TERMS & CONDITIONS

- The prices quoted are Ex-Works, Gandhinagar
- Packing and Forwarding will be extra @ 2%.
- Freight will be extra at actuals.
- Excise Duty will be charged extra @ 10% OR applicable at time of dispatch.
- Education Cess will be charged extra @ 2% on excise, + 1% S & H Edu. Cess OR applicable at time of dispatch.
- Central Sales Tax will be charged extra @ 2% against Form "C" OR applicable at time of dispatch.
- Central Sales Tax will be charged extra @ 5% without Form "C" OR applicable at time of dispatch.
- Octroi, if applicable, will be charged extra at actuals.
- Insurance will be in your account.
- Delivery: 4-6 week after receipt of advance. "LD/Penalty on delivery are not acceptable"
- Payment Terms: 100% advance & balance against proforma invoice prior to dispatch
- Warranty: 12 months from the date of commissioning or 18 months from the date of supply, whichever is earlier.
- Charges for supervision of Installation and Commissioning: Will be extra @ Rs.5, 000 per day per engineer + 2nd AC rail fare extra plus lodging and boarding and conveyance charges to be provided by you extra.
- Service tax extra @ 10.30% on supervision of Installation and Commissioning OR applicable at time of dispatch.
- Validity: 30 days from the date of this offer.
- Your order is to be placed on:

Amtech Electronics (India) Limited
E-6, GIDC Electronics Zone
Gandhinagar – 382 044

AN ISO 9001:2008 COMPANY

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