DETAILED PROJECT REPORT
ON
INSTALLATION OF EXHAUST HUMIDITY CONTROL SYSTEM IN STENTERS
(PALI TEXTILE CLUSTER)

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INSTALLATION OF EXHAUST HUMIDITY MEASUREMENT AND CONTROL SYSTEM IN STENTERS

PALI TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Installation of Exhaust Humidity Measurement and Control System in Stenter

Textile SME Cluster, Pali, Rajasthan (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PAL/TXT/EHC/07**

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List of Abbreviations

- BEE - Bureau of Energy Efficiency
- 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
- SME - Small and Medium Enterprises
- TFH - Thermic Fluid Heater
- 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, 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, 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 Exhaust humidity measurement and control has a potential to save 5 to 30% energy. To be on safer side, only 5% saving has been considered. The proposition would help save 15120 kWh of electricity and 15.12 MT RPC.

This DPR highlights the details of the study conducted for assessing the potential for installation of exhaust humidity measurement and control in Stenter, possible energy saving, and its monetary benefit, availability of the technology/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)	3.65
2	Fuel Saving (RPC)	MT/year	15.12
3	Electricity saving	kWh	15120
4	Monetary benefit	₹ (in Lakh)	1.83
5	Debit equity ratio	Ratio	3:1
6	Simple payback period	years	2
7	NPV	₹ (in Lakh)	3.06
8	IRR	% age	32.87
9	ROI	% age	22.10
10	DSCR	ratio	1.56
11	CO_2 saving	MT	54
12	Process down time	Days	1

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.

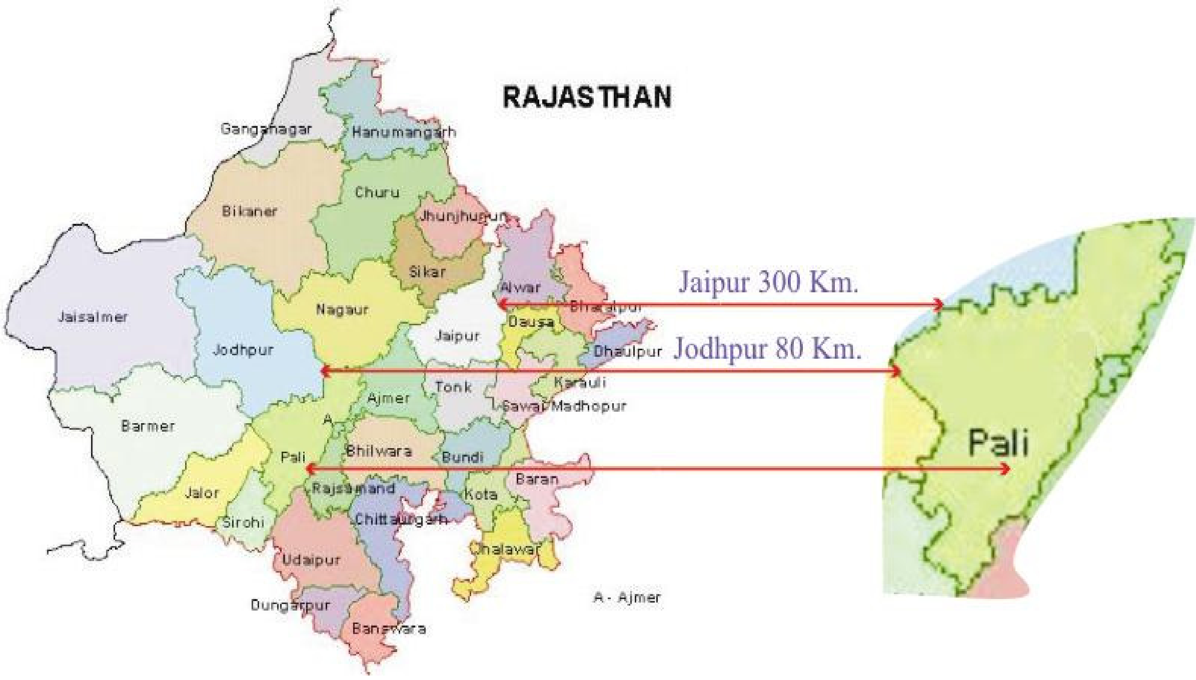


Fig. 1.1 – Pali – Geographical Map

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 stenter in the process are drawn below –

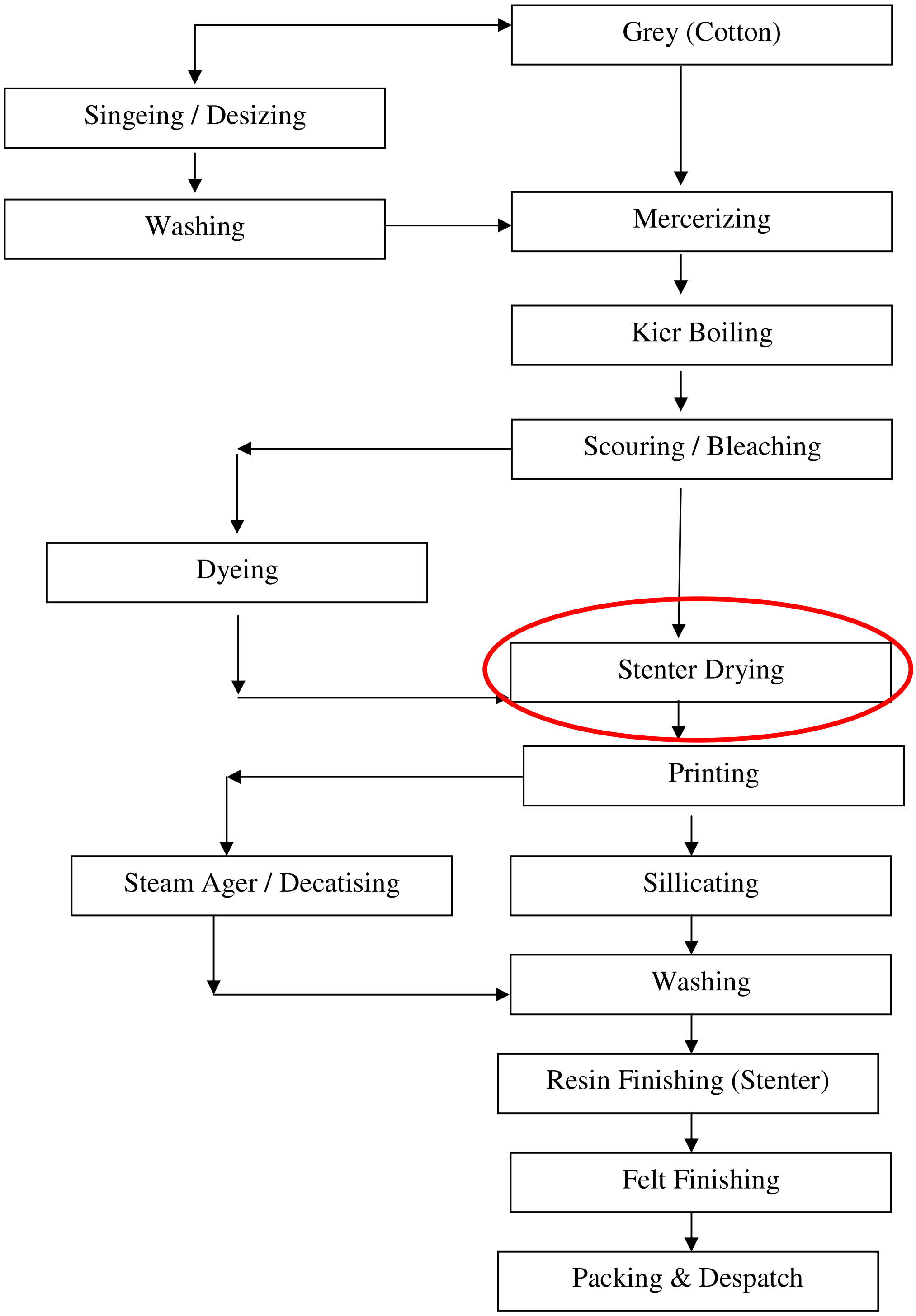


Fig. 1.2 – Process Flow Diagram of Cotton Dyeing and Printing

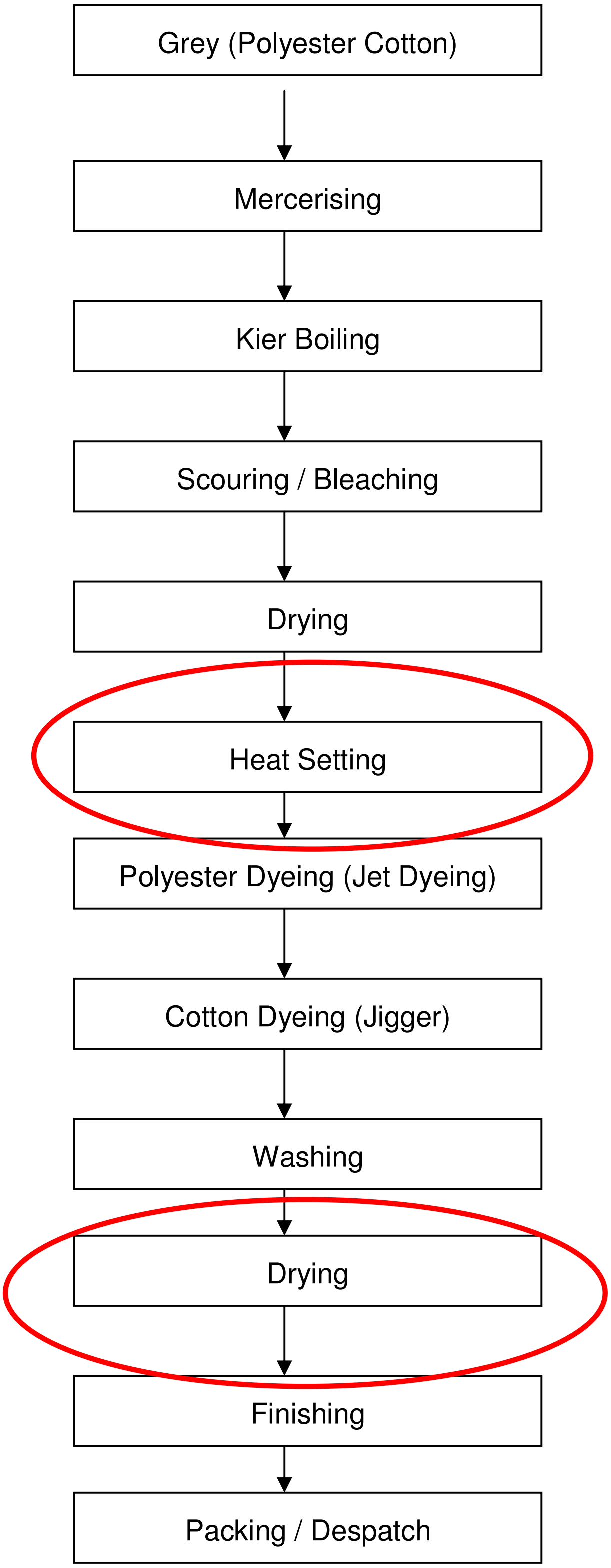


Fig. 1.3 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

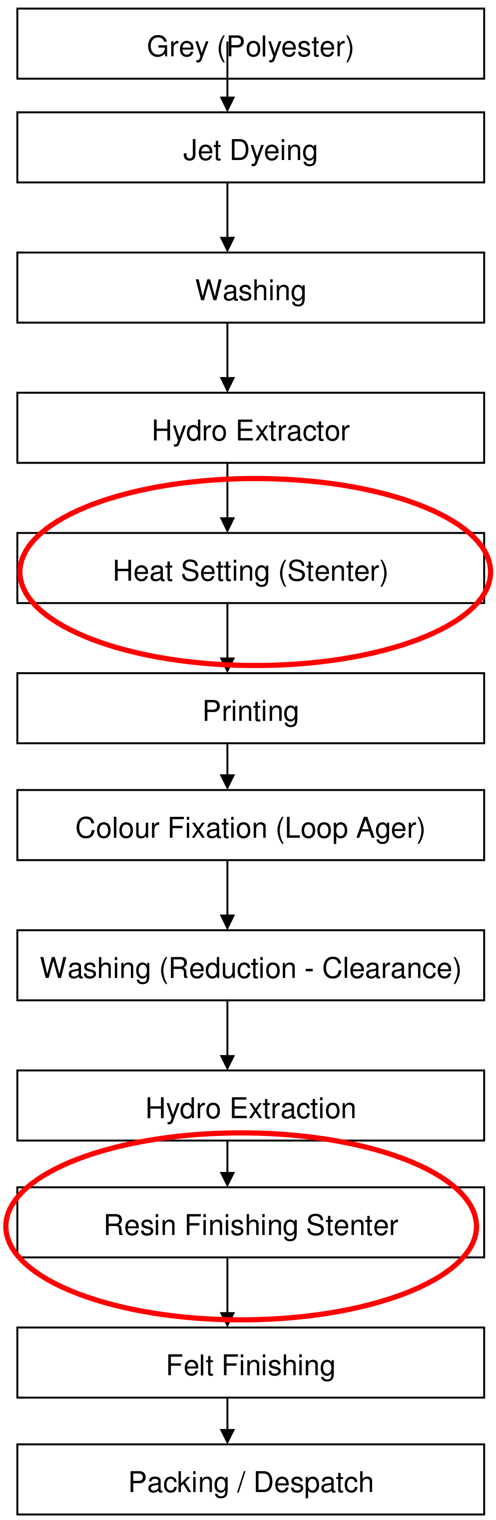


Fig. 1.4 – Process Flow Diagram of Polyester Printing and Finishing

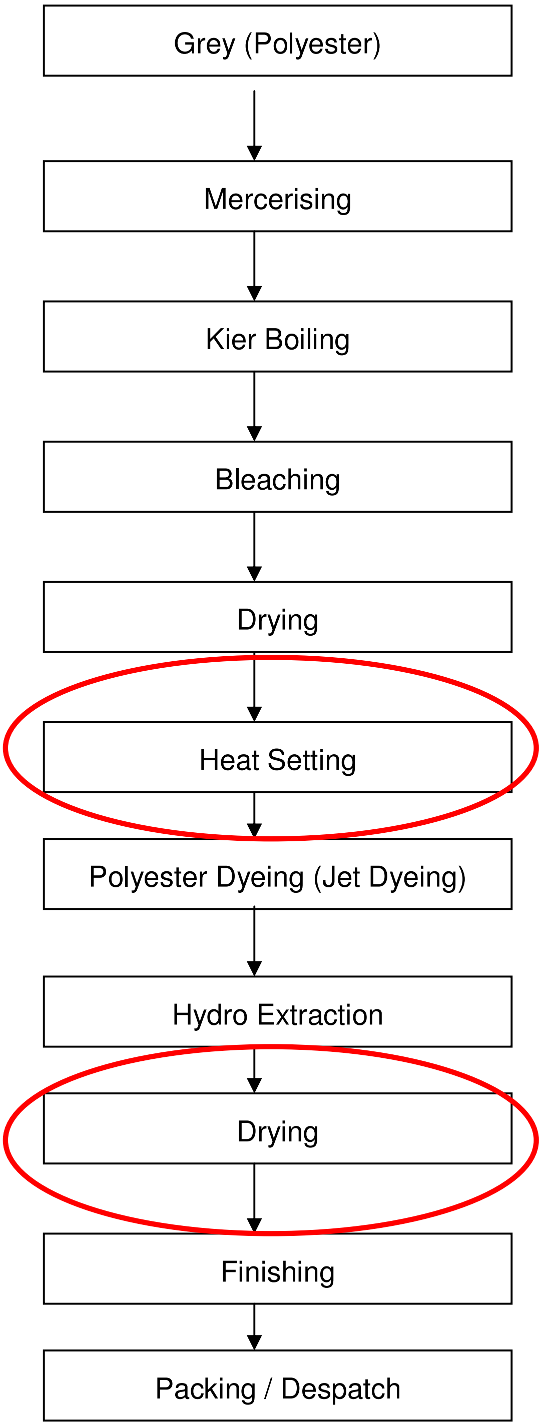


Fig. 1.5 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

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

Pretreatment of textiles and also Dyeing, Printing, washing etc. involve use 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.

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

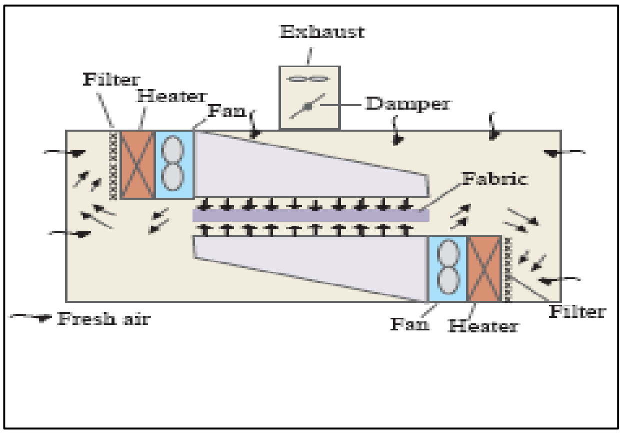


Fig. 1.7 – Schematic of air flow in stenter

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 purposes:

a. Dry-heating process like, heat setting of synthetic fabrics and their blends

b. 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 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 1.7below:

Table 1.7 Energy break up for Heat setting in a stenter

S.No.	Component	Energy Content (GJ/Te)	% age
1	Evaporation	0.20	4.30
2	Air Heating	3.55	76.20
3	Fabric	0.25	5.40
4	Case	0.23	4.90
5	Chain	0.10	2.10
6	Drive	0.33	7.10
7	Total	4.66	100

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

Table 1.8 Energy break up for a typical stenter

S.No.	Component	Energy Content (GJ/Te)	% age
1	Evaporation	2.54	41.0
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	6.20	100.0

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:

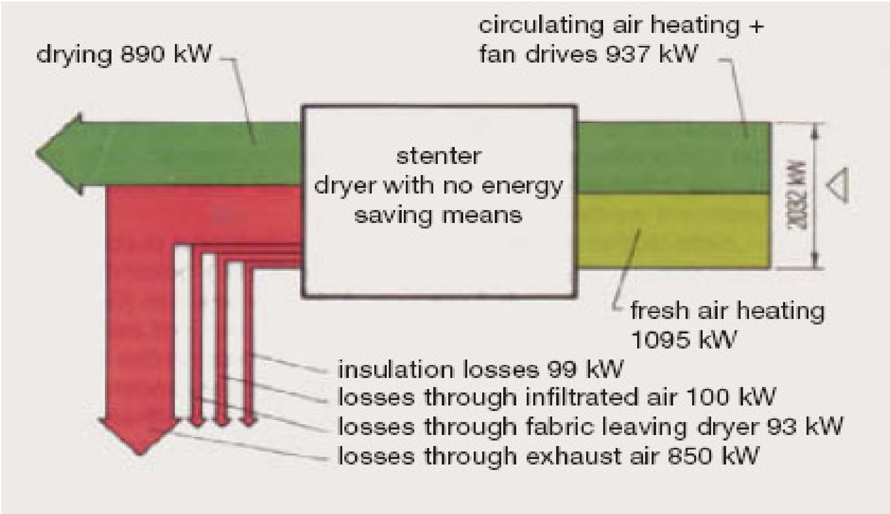


Fig. 1.8 – Sankey diagram for a stenter without Energy Conservation Measure

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

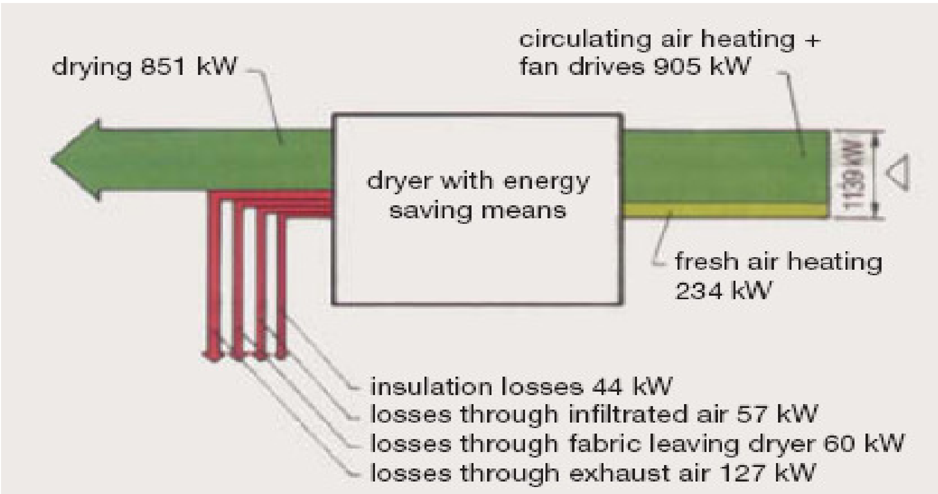


Fig. 1.9– Sankey diagram for a stenter with Energy Conservation Measure

1.3.3 Energy audit methodology

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

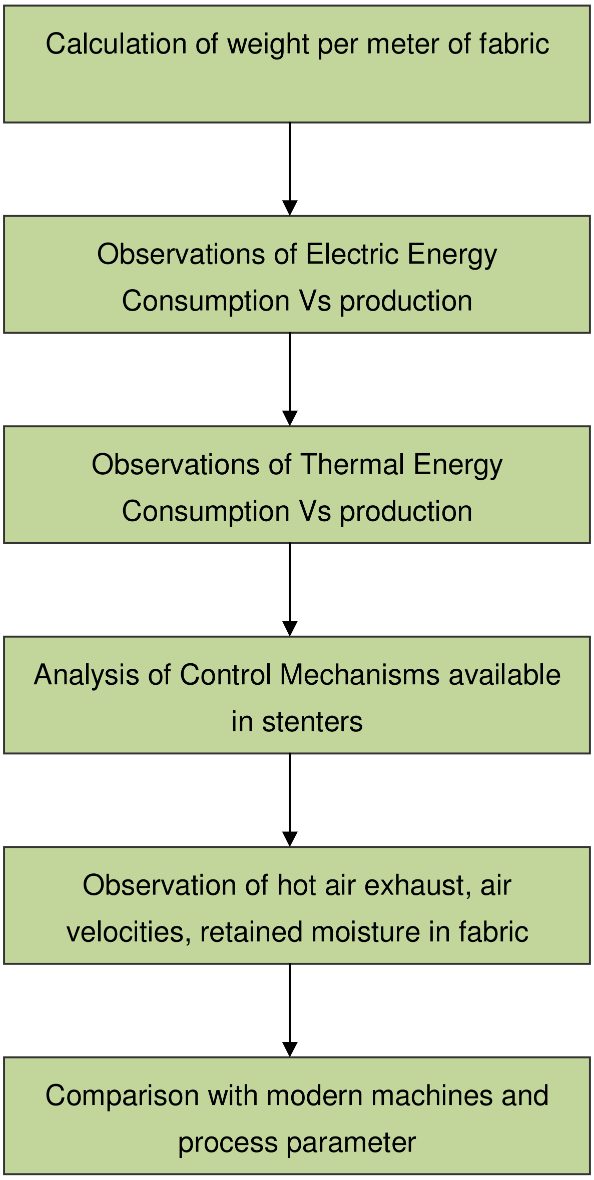


Fig. 1.10 Energy Audit methodologies

1.3.4 Design and operating parameters specification

Typical specification of stenters is placed at Annexure 8. Optimisation of exhausts can be achieved by controlling the exhaust humidity to between 0.1 and 0.15 kg water/ kg dry air. This is called the Wadsworth criterion. Reduction in fresh air consumption in stenter from 10kg/kg of fabric to 5 kg/kg of fabric transpires to Energy Saving of 57%.

In most of the units in Pali Cluster, the exhaust air fan is kept in off position and the exhaust air comes out from fabric exit opening.

.

When drying, there is an optimum exhaust rate which should be adhered to. Since a significant number of stenters still rely on manual control of exhausts, which basically means 'fully open all the time', the potential for energy saving is considerable. Manual control of exhausts is generally very difficult since the expected airflow patterns and the ones found in practice vary considerably. Hence the tendency to leave them fully opens.

Optimisation of exhausts can be achieved by controlling the exhaust humidity to between 0.1 and 0.15 kg water/ kg dry air. This is called the Wadsworth criterion. It is not unusual to come across stenters where the exhaust humidity is 0.05 kg water/ kg dry air. Which means a considerable waste of energy? Instruments are available which automatically control the dampers to maintain exhaust humidity within this specified range thereby cutting air losses without significantly affecting fabric throughput. These vary from wet/dry bulb temperature systems to fluidic oscillators measuring the variation in sound through a special filter head.

1.3.5 Operating efficiency analysis

As is obvious from Table 1.7, 41% of total energy given to stenter is utilized in evaporation of moisture. Thus the moisture present in the fabric gets evaporated and is taken out of the stenter with exhaust air. A mixture of hot air and water vapour leaves the dryer via the exhaust air duct. The energy required to heat the intake air makes up a significant proportion of the overall costs involved in operating the machine. The hot air/steam ratio is therefore a contributory factor in determining the economic efficiency of the entire drying process and must be considered more closely as the energy costs rise. The quantity of water evaporated per unit of time varies continually depending on the fabric weight, infeed and residual moisture, width of fabric and speed. It is not possible to achieve the most efficient use of hot air by constantly adjusting the exhaust air damper. Instead, the moisture content of the exhaust air must be constantly measured and the air dampers and extractor fans must be adjusted in line with the drying conditions or be automatically regulated.

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, being generic in nature, is readily available.
- Non-availability of technology or aversion to adoption for any other reason does not seem to be the case. The system is being offered by most of Stenter manufacturers. It is only lack of knowledge and comfort of proven guaranteed results that has been keeping the entrepreneurs away from adopting this technology.
- Stenter manufacturers are offering the proposed technology as a standard add on to new systems. Even agencies working in optimization and control system for textile sector offer the product. However, the proposition is not being presented with guaranteed cost benefit analysis to the entrepreneurs. 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. ₹ 3.5 lakh investment per machine and can be managed by loan only as internal accruals may not suffice. However, the units have upto 4 Stenter and hence investment of ₹ 14 lakh in one go would be a problem.
- 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.

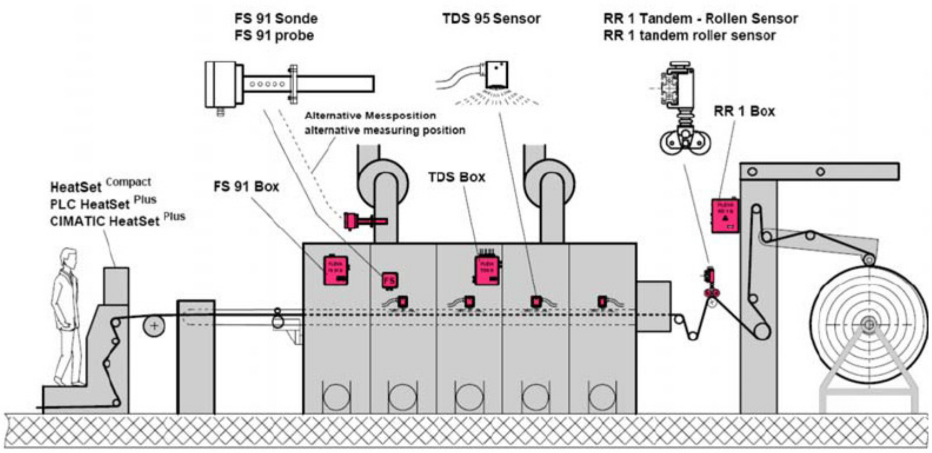
1.4.4 Other barrier (If any)

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

None of the units in Pali have installed the proposed system. A typical system is depicted below.



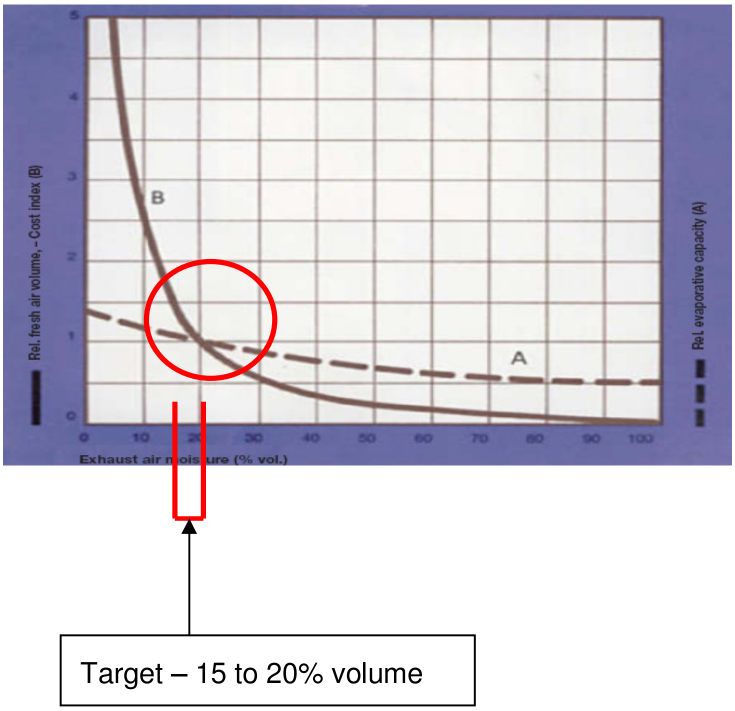
- Exhaust Humidity Control - PLEVA sensor FS 91
- Fabric Temperature Measurement - PLEVA TDS95
- Residual Moisture - PLEVA sensor RR 1.3

Fig. 2.1 Exhaust humidity control

By installing the proposed system, the moisture %age required to be present in the finished fabric is set and speed of the fabric is varied so as to attain exact moisture %age. Fig. 2.2 depicts the relationship between residual moisture and speed of fabric in a stenter.

As per the case studies available, 5 to 30% saving has been generated out of the proposition. To be on safer side, a saving of 5% has been considered for calculations.

The costs of heating in stenter is dependent on the required volume of fresh air and consequently on the steam content in the exhaust air. Whereas the evaporative capacity (A) is relatively flat, the cost index (B) rises steeply, especially where the exhaust air damper is wide open, i.e. the steam content is low. It is therefore recommendable to adjust the exhaust air damper so that there is maximum possible moisture in the exhaust air without the output being noticeably reduced.



A- Energy Efficiency Index

B- Energy Consumption Index = Exhaust Gas – Air Aspiration

Fig. 2.2 – Exhaust Moisture Vs Energy Consumption / Energy Efficiency

A reduction in fresh air intake by 50% reduces energy consumption by 57% as per the established thumb rules. Also, as per a case study, 30% energy saving was achieved by control of exhaust air moisture. A minimal 5% reduction in Energy can safely be considered by way of exhaust moisture measurement and control system.

Exhaust air moisture measuring systems These systems are used to measure the moisture of exhaust air in the exhaust air duct (driers) and to adjust the exhaust air dampers and fans accordingly using servomotors. This helps to prevent heat losses due to the exhaust air being too dry. Pleva FM 32 (developed by Pleva and Babcock) is almost maintenance-free and may even be used where the exhaust air is polluted. Principle: A small partial gas stream is passed through the measuring device. The actual measuring cell consists of a bare, straight stainless steel pipe in which gas is cooled below the dew point. The input and output temperature of the gas and the heat being discharged on the stainless steel pipe are measured. The gas moisture is then calculated in the computer. Measuring range: Moisture of 20–500 g/kg or from 10–250 g/m3, at overpressures of 100–1000 Pa (0.001–0.01 bar) and temperatures between 70–250−C. The FM 915 (Pleva) operates with a lithium chloride measuring chamber.

The Mahlo AML operates on the principle of varying spread speeds of sound in air and water vapour: a sound is produced by a source of sound directly exposed to the exhaust air stream. The pitch of this sound is dependent on the ratio of air/water vapour. The frequency of the sound can be measured precisely using heat-insensitive means. The direct temperature influence is compensated electronically (_ Fluidic oscillator). Measuring range is normal up to 30% volume water vapour, and can be extended to 100% volume.

Description of equipment

In the Exhaust Moisture control System, a sensor senses moisture quantity in the exhaust and depending upon the settings of PLC, gives signal to the VFD installed in the pump so as to ensure rated moisture % all the time. A typical arrangement is depicted below:-

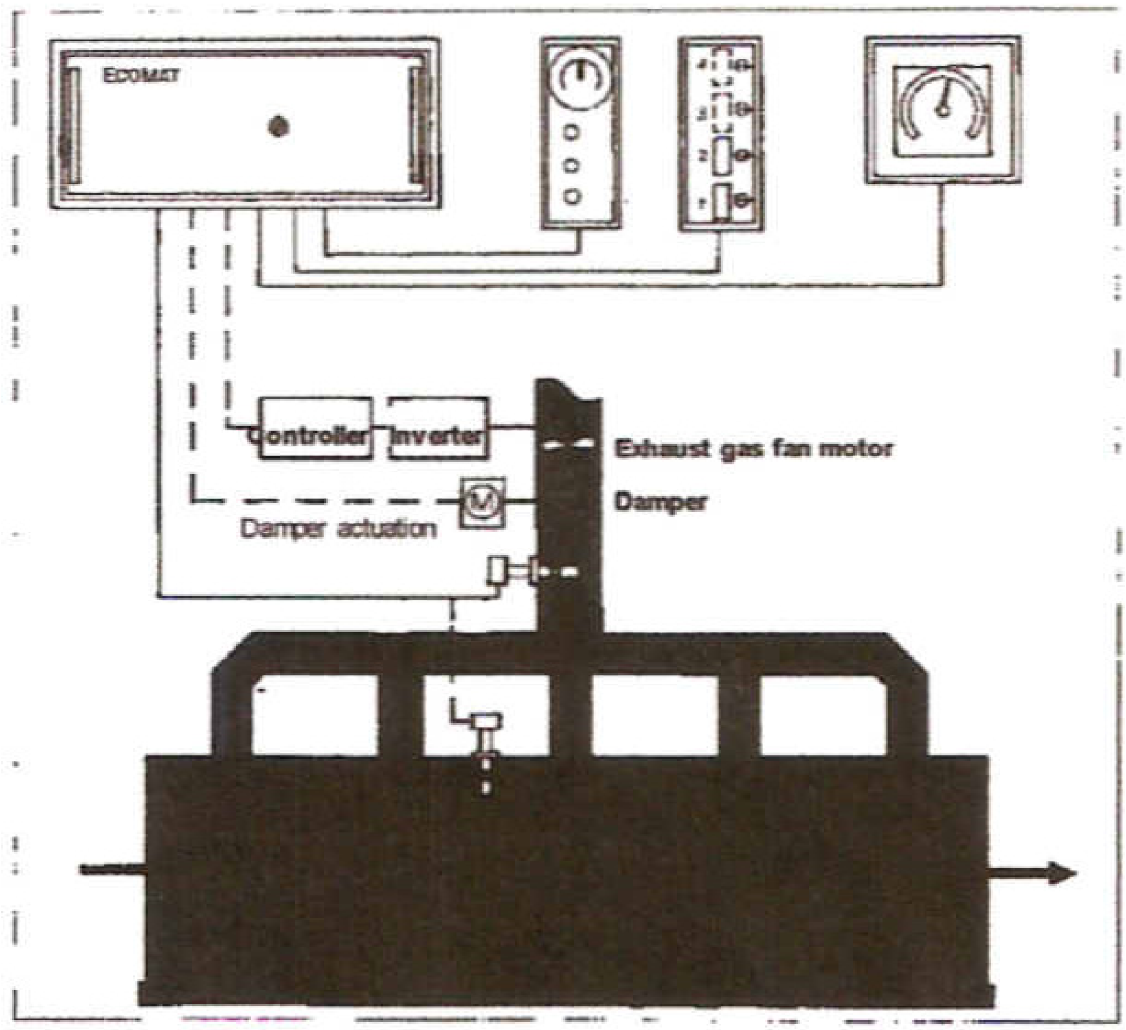


Fig. 2.3 Arrangement for Exhaust Moisture Control

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 with minimal 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 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 in Annexure 1.

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 independent of existing system and integration would need work as much as that needed to make an electricity connection. However, tuning of the system and performance monitoring would take maximum one day.

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 50 no. out of 100 no. of Stenters. Total potential for energy saving would be 2700 MT 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 15.12 MT RPC fuel per year in every stenter. Further, details of fuel saving are given in Annexure 4.

3.1.2 Electricity saving

Proposed technology not only helps in saving of RPC consumption but also about 15120 kWh of electricity saving is envisaged out of implementation of the proposed system. Details of electricity saving is given in Annexure 4.

3.1.3 Improvement in product quality

The system comes with precision process control protocol and is aimed at ensuring process parameters needed for a very critical product feature in the textile dyeing and finishing process. Consequently, the product quality is expected to improve tremendously.

3.1.4 Increase in production

The Precise process control will result in minimum productivity improvement of 5% on hourly basis.

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 ₹ 1.83 lakh per year. Detail of monetary saving 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 in electricity as well as 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

None

3.4.2 Reduction in GHG emission

The equivalent saving in GHG emission for every Stenter would be 54 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 one set of equipment is about ₹ 1.75 lakh (0.5 lakh + Excise +Taxes and Cartage) as per the quotation from M/s SEMITRONICS attached as Annexure 7. One stenter would need 2 sets of such equipments and hence the total cost implication would be ₹ 3.5 Lakh.

4.1.2 Erection, commissioning and other misc. cost

Erection & commissioning cost is about ₹ 0.15 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)	3.5
2	Erection & Commissioning cost	₹ (in Lakh)	0.15
3	Interest during implementation	₹ (in Lakh)	Nil
4	Other misc. cost	₹ (in Lakh)	Nil
5	**Total cost**	₹ (in Lakh)	**3.65**

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost which is ₹ 0.91 lakh.

4.2.2 Loan amount.

Remaining 75% cost of the proposed project will be taken from the bank which is ₹ 2.74 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 ₹ 1.83 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-2.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 3.65 lakh and monetary savings due to reduction in Electricity & Fuel consumption is ₹ 1.83 lakh hence, the simple payback period works out to be around 24 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 3.06 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 32.87%. 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 22.10%.

Details of financial indicators are shown in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology

S.No.	Particular	Unit	Value
1	Simple payback period	Months	24
2	NPV	₹ (in lakh)	3.06
3	IRR	% age	32.87
4	ROI	% age	22.10
5	DSCR	ratio	1.56

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	30.73	2.71	22.02	1.48
Realistic	32.87	3.06	22.10	1.56
Optimistic	35.30	3.41	22.18	1.64

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

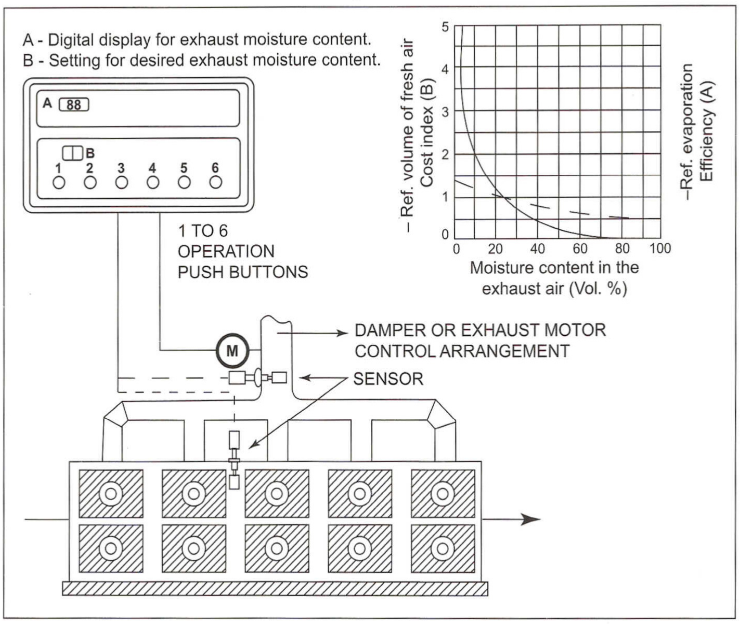
EXHAUST AIR CONTENT MEASURING AND AUTOMATIC CONTROL SYSTEM

FOR APPLICATION TO MONITOR EXHAUST MOISTURE AND OXYGEN CONTENT AND CONTROL SYSTEM FOR STENTER, LOOP STEAMER/BOILER AND THERMOPACK

- Energy is expensive, hence wastage should be avoided & should not blow the heat of dryer through the roof & must cut exhaust volume to the actual need.
- To minimise fuel consumption by controlling the moisture content of exhaust air continuously by controlling exhaust damper or exhaust fan.
- Improve quality of fabric by controlling oxygen content with optimum energy consumption for loop steamer.

FINDS APPLICATION ON

- Stenter frame (textile, carpet).
- Dryer for tubular fabric/yarn.
- Printing machine.
- Sizing machine with infra-red dryer.
- Heat-setting for carpet yarns.
- Drying wood for paper-making machine.
- Flat surface dryer (building slabs, card-board, wooden boards).
- Dryer for webs of endless fabric (leather, fibre, foamed material).
- Baking oven.
- Conditioning with high humidity.



SPECIAL FEATURES

- On-line measurement.
- High responsiveness and great measuring accuracy.
- Extremely simple and thus very fast installation.
- Any desired cable length between measuring probe and evaluation electronics.
- Calibration can be carried out extremely quickly.
- Requires virtually no maintenance.
- Can be used at extremely high temperature (upto 600°C).
- No moving parts.
- Extremely robust and can thus be used with very high air pollution levels.
- Can be used with dryers directly heated by gas.
- Available as a complete measuring and control system.

The installation of the unit leads:

REDUCES PRODUCTION COST

Elimination of wastage of energy during drying or steaming process thus drying/production cost can be reduced.

SHORT PAYBACK PERIOD

In normal course also amount invested for this unit can be recovered in a short period.

MODEL AVAILABLE

MODEL EMC-102

Ambient temperature	: Max. 50°C.
Mains supply	: 230V/115V +/- 10%.
Power consumption	: Approx. 80 VA.
Output signal	: 4-20mA (linear) with galvanic isolation (optional) or two relay output.
Measuring ranges	: 0-30%. 0-100%.
Dimensions	: 170 X 325 X 300 mm

FACILITY AVAILABLE

- Serial interface for PLC and computer.
- Software package for management information.

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Annexure -2: Detailed financial analysis

Assumption

Name of the Technology	Exhaust Humidity control		
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			
Waste heat Recovery system	₹ (in lakh)	3.50	
Civil works, Erection and Commisioning	₹ (in lakh)	0.15	
Other cost	₹ (in lakh)	0.00	
Total Investment	₹ (in lakh)	3.65	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	0.91	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	2.74	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	Feasibility Study
Annual Escalation	%age	5	Feasibility Study
Estimation of Revenue			
Fuel saving(RPC)	Tons/year	15.12	
Cost	₹/tons	7500	
Electricity saving	kWh	15120	
Cost of electricity	₹/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	2.74	0.12	2.62	0.32
2	2.62	0.24	2.38	0.25
3	2.38	0.48	1.90	0.22
4	1.90	0.72	1.18	0.16
5	1.18	0.82	0.36	0.08
6	0.36	0.36	0.00	0.01
		2.74		

WDV Depreciation

₹ (In lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	3.65	0.73
Depreciation	2.92	0.58
WDV	0.73	0.15

Projected Profitability

₹ (In lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
Total Revenue (A)	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
Expenses								
O & M Expenses	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.21
Total Expenses (B)	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.21
PBDIT (A)-(B)	1.68	1.68	1.67	1.66	1.65	1.64	1.63	1.62
Interest	0.32	0.26	0.25	0.23	0.17	0.06	-	-
PBDT	1.36	1.41	1.42	1.43	1.48	1.58	1.63	1.62
Depreciation	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
PBT	1.17	1.22	1.23	1.24	1.28	1.39	1.44	1.43
Income tax	-	0.28	0.48	0.49	0.50	0.54	0.56	0.55
Profit after tax (PAT)	1.17	0.94	0.74	0.75	0.78	0.85	0.89	0.88

Computation of Tax

₹ (In lakh)

Particulars / Years	1	2	3	4	5	6	7	8
rofit before tax	1.17	1.23	1.26	1.31	1.37	1.44	1.44	1.43
Add: Book depreciation	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Less: WDV depreciation	2.92	0.58	-	-	-	-	-	-
Taxable profit	(1.55)	0.84	1.45	1.50	1.57	1.63	1.63	1.62
Income Tax	-	0.29	0.49	0.51	0.53	0.55	0.56	0.55

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Reserves & Surplus (E)	1.17	2.12	2.89	3.68	4.53	5.41	6.30	7.18
Term Loans (F)	2.62	2.38	1.90	1.18	0.36	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	4.70	5.41	5.70	5.77	5.80	6.32	7.21	8.09

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	3.65	3.65	3.65	3.65	3.65	3.65	3.65	3.65
Less Accm. Depreciation	0.19	0.39	0.58	0.77	0.96	1.16	1.35	1.54
Net Fixed Assets	3.46	3.26	3.07	2.88	2.69	2.49	2.30	2.11
Cash & Bank Balance	1.25	2.15	2.62	2.90	3.11	3.83	4.91	5.98
TOTAL ASSETS	4.70	5.41	5.70	5.77	5.80	6.32	7.21	8.09
Net Worth	2.09	3.03	3.80	4.60	5.44	6.32	7.21	8.09
Debt Equity Ratio	2.87	2.61	2.08	1.29	0.39	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	0.91	-	-	-	-	-	-	-	-
Term Loan	2.74								
Profit After tax		1.17	0.95	0.77	0.80	0.84	0.88	0.89	0.88
Depreciation		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Total Sources	3.65	1.37	1.14	0.96	0.99	1.03	1.08	1.08	1.07
Application									
Capital Expenditure	3.65								
Repayment Of Loan	-	0.12	0.24	0.48	0.72	0.82	0.36	-	-
Total Application	3.65	0.12	0.24	0.48	0.72	0.82	0.36	-	-
Net Surplus	-	1.25	0.90	0.48	0.27	0.21	0.72	1.08	1.07
Add: Opening Balance	-	-	1.25	2.15	2.62	2.90	3.11	3.83	4.91
Closing Balance	-	1.25	2.15	2.62	2.90	3.11	3.83	4.91	5.98

IRR

₹ (In lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		1.17	0.95	0.77	0.80	0.84	0.88	0.89	0.88
Depreciation		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Interest on Term Loan		0.32	0.25	0.22	0.16	0.08	0.01	-	-
Cash outflow	(3.65)	-	-	-	-	-	-	-	-
Net Cash flow	(3.65)	1.68	1.39	1.17	1.15	1.12	1.09	1.08	1.07
IRR	32.87%								

NPV	3.06

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.15
Sub Total(G)	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.15
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Interest on Term Loan	0.32	0.26	0.25	0.23	0.17	0.06	0.00	0.00
Depreciation (H)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Sub Total (I)	0.55	0.49	0.48	0.46	0.41	0.30	0.24	0.24
Sales (J)	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
Contribution (K)	1.72	1.71	1.71	1.70	1.70	1.69	1.68	1.68
Break Even Point (L= G/I)	31.87%	28.77%	28.18%	27.06%	24.26%	17.97%	14.36%	14.57%
Cash Break Even {(I)-(H)}	20.67%	17.53%	16.90%	15.75%	12.90%	6.56%	2.91%	3.07%
Break Even Sales (J)*(L)	0.58	0.53	0.52	0.50	0.44	0.33	0.26	0.27

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	1.17	1.23	1.26	1.31	1.37	1.44	1.44	1.43	7.00
Net Worth	2.09	3.03	3.80	4.60	5.44	6.32	7.21	8.09	31.66
									22.10%

Debt Service Coverage Ratio

₹ (In lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	1.17	0.95	0.77	0.80	0.84	0.88	0.89	0.88	2.53
Depreciation	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.58
Interest on Term Loan	0.32	0.25	0.22	0.16	0.08	0.01	0.00	0.00	0.25
Total (M)	1.68	1.39	1.17	1.15	1.12	1.09	1.08	1.07	3.36

DEBT

Interest on Term Loan	0.32	0.25	0.22	0.16	0.08	0.01	0.00	0.00	0.25
Repayment of Term Loan	0.12	0.24	0.48	0.72	0.82	0.36	0.00	0.00	1.90
Total (N)	0.44	0.49	0.70	0.88	0.90	0.37	0.00	0.00	2.15
	3.85	2.83	1.69	1.31	1.24	2.94	-	-	1.56
Average DSCR (M/N)	1.56								

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	Modification in exhaust duct.			
2	Fabrication & Transportation.			
3	commissioning and trials			

Annexure 4: Detailed equipment assessment report

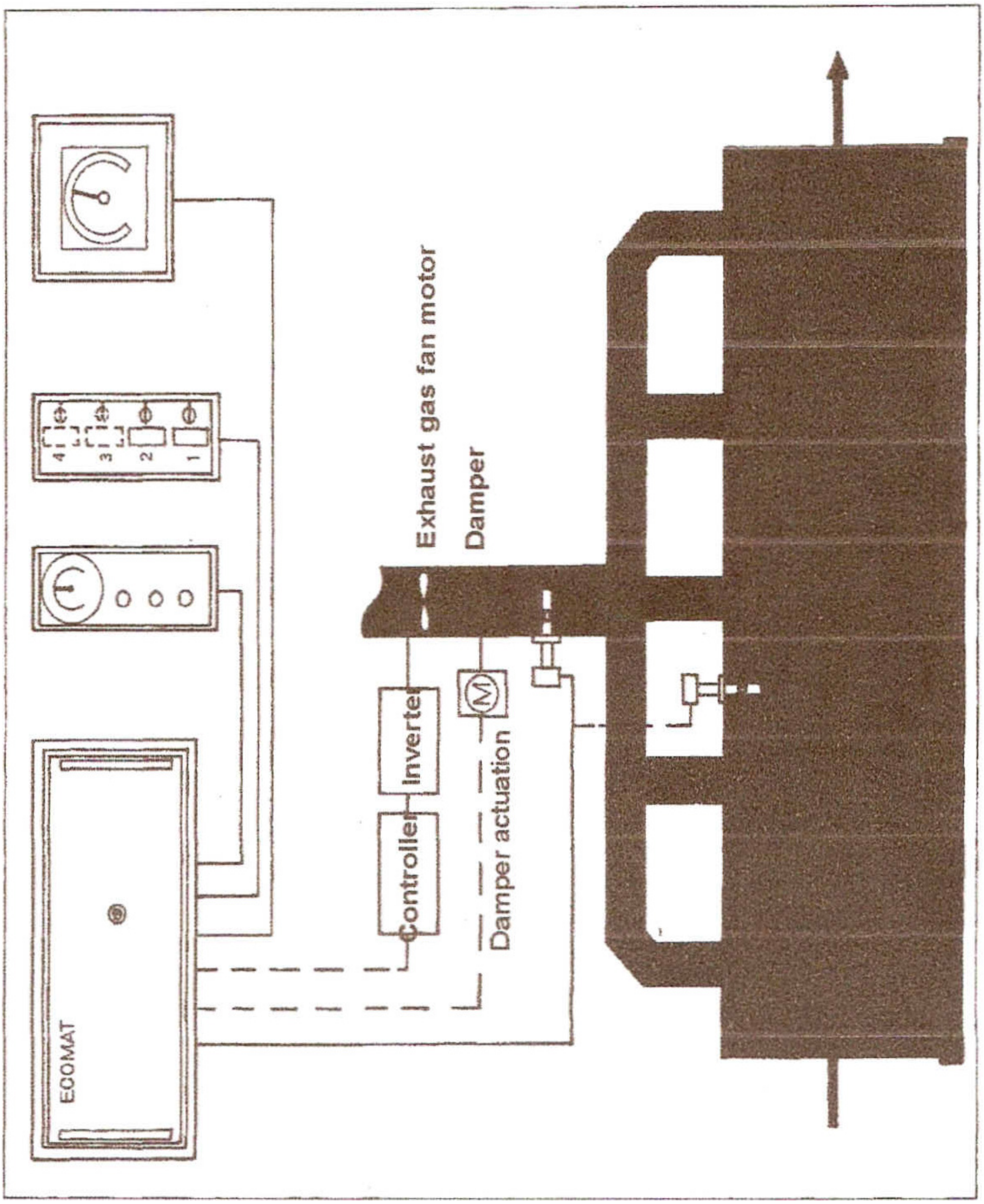
Calculation of Energy Saving from installation of fabric temperature control in stenter

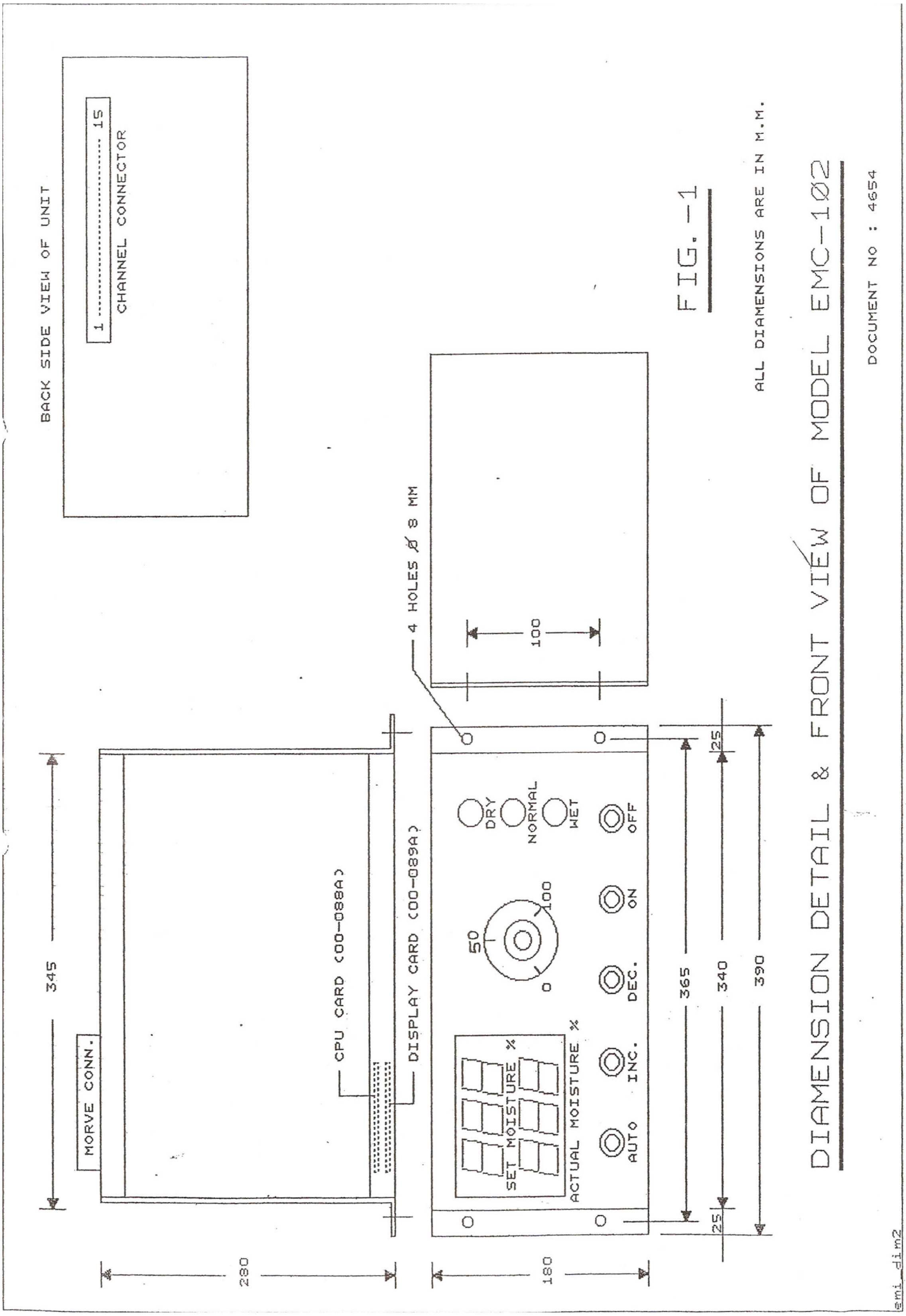
The implementation of Exhaust humidity measurement and control has a potential to save 5 to 30% energy. To be on safer side, only 5% saving has been considered.		
S.No.	**Particular**	**Detail**
1	Total operating hour in a day	24
2	Total operating days in a year	300
3	Present speed of stenter	70 mtr/min
4	Present daily processing of Cloth	100800 mtr
5	Increase in production to control of humidly	5%
6	Additional production per year	1512000 mtr
	Electricity Saving	
7	Electricity load	55 kW
8	Daily Electricity consumption	1320 kWh
9	Specific electricity consumption	0.01 kWh/mtr
10	Annual electricity saving due to increase in production	15120 kWh
11	Cost of electricity	₹ 4.6/kWh
12	Annual Monetary saving due to saving of electricity	₹ 69552
	Fuel Saving (RPC)	
13	Fuel (RPC) consumption per hour	55 kg
14	Fuel consumption per day	1320 kg
15	Specific fuel consumption	0.01 kg/mtr
16	Fuel saving due to increase in production	15.12 MT/year
17	Monetary saving due to fuel saving	₹ 1,13,400
18	Total monetary benefit due to installation of proposed technology	₹ 1,82,952
19	Total investment required	₹ 3,65,000
20	Simple payback period	24 months

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	
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




BACK SIDE VIEW OF UNIT
1 15
CHANNEL CONNECTOR
FIG.-1
ALL DIAMENSIONS ARE IN M.M.
DIAMENSION DETAIL & FRONT VIEW OF MODEL EMC-102
DOCUMENT NO : 4654
4 HOLES Ø 8 MM
100
345
MORVE CONN.
CPU CARD (00-088A)
DISPLAY CARD (00-089A)
DRY
NORMAL
WET
OFF
ON
DEC.
INC.
AUTO
0
50
100
SET MOISTURE %
ACTUAL MOISTURE %
365
340
390
25
25
280
180
emi_dim2

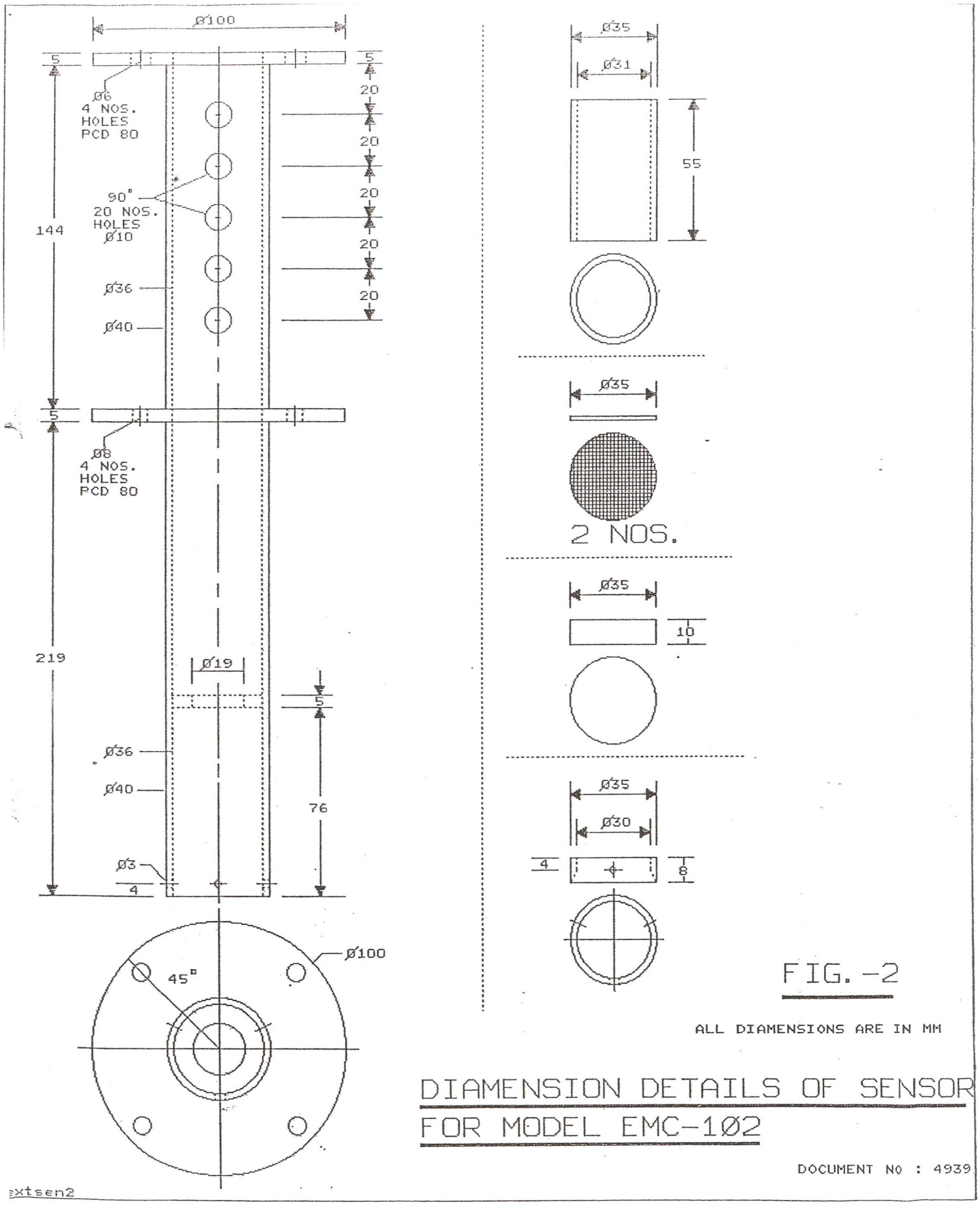


FIG. -2

ALL DIAMENSIONS ARE IN MM

DIAMENSION DETAILS OF SENSOR FOR MODEL EMC-1Ø2

DOCUMENT NO : 4939

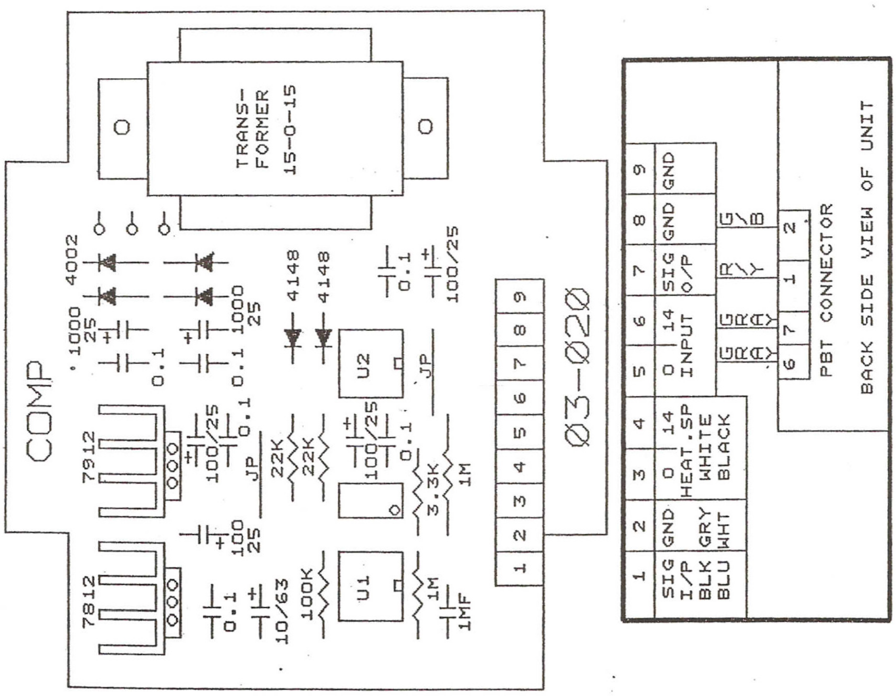


FIG.-3

EXTERNAL CONNECTION DETAILS OF PRE-AMPLIFIER CARD (03-020)
OF MODEL EMC-102

DOCUMENT NO : 5399
13-04-05
03_020C3

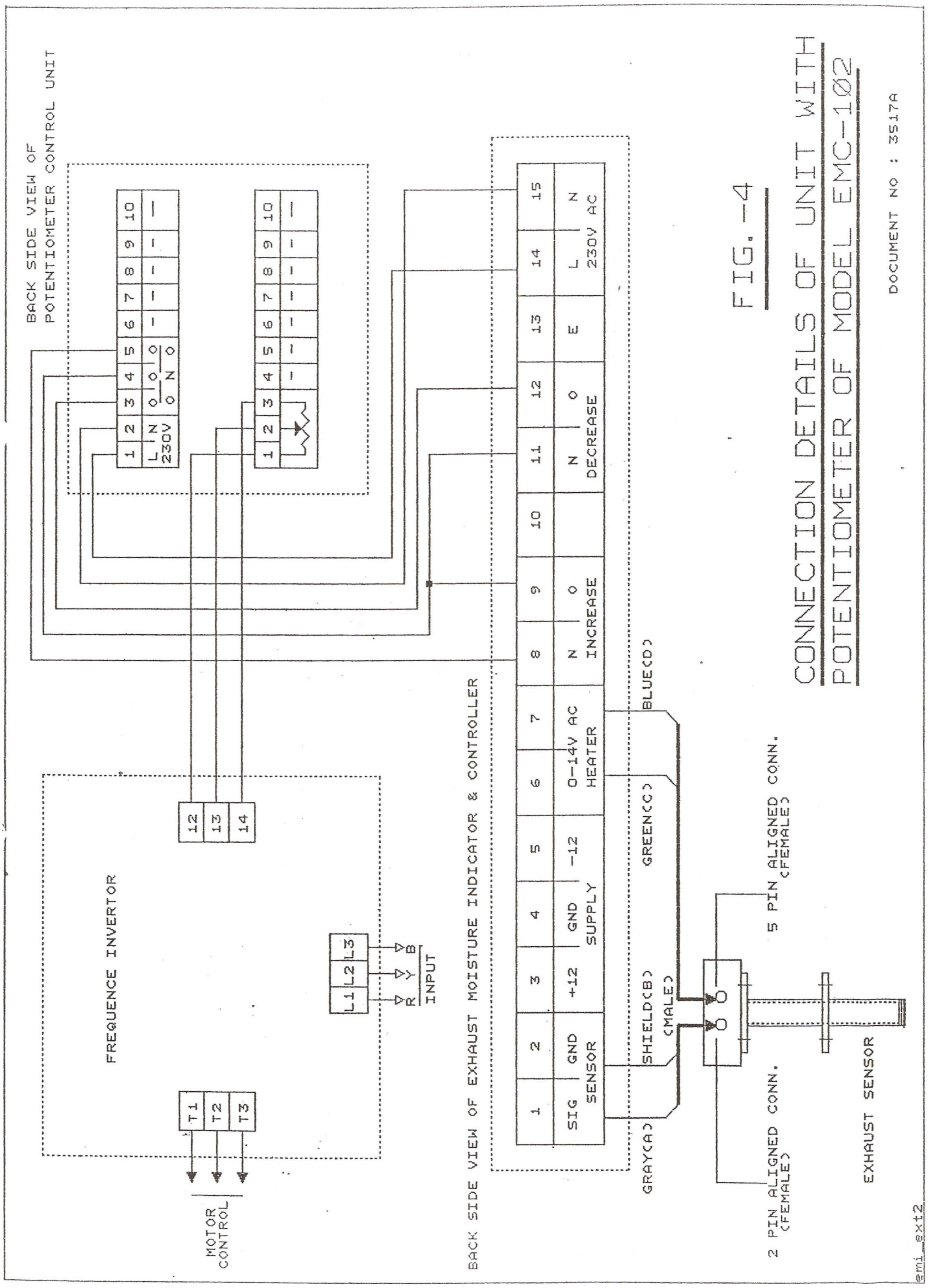


FIG. -4

CONNECTION DETAILS OF UNIT WITH POTENTIOMETER OF MODEL EMC-1Ø2

Annexure – 7 Quotation for Proposed Technology

:2:

DESCRIPTION	PRICE NET EX.WORKS PER UNIT

* Sensor housed in a suitable casing to withstand high air circulation and high temperature with connection and mounting arrangement.

3. INVERTER : Frequency variable power supply for Automatic control of RPM of Blower motor of stenter or Dryer.

4. SERIAL INTERFACE (optional) : For communication with Computer or Programmable Logic controller.

5. SOFTWARE PACKAGE (optional) : For Data Management Information.

PRICE OF :

1. Exhaust Air Moisture Indicator and Controller Model EMC-102 with two relay output and Sensor with Motorized Potentiometer for varying the Speed of Blower fan / inverter. .. **Rs. 85,000/-**

2. Variable frequency power supply to vary RPM of AC Motor. (suitable to operate on 440V A/C 50 c/s, three phase power supply).

* **5 HP** Capacity	**Rs. 31500/-**
* **7.5 HP** ""	**Rs. 42000/-**
* **10 HP** ""	**Rs. 58500/-**

3. Serial Interface for computer .. **Rs. 4950/-**

4. Software Package for data management : Report generation : in Digital and graphical form. **Rs. 49450/-**

(Price of the software includes :
* Travel time of the software engineers
* Travel cost, installation & training
* 2 Months of phone & email / internet assistance from the running test
* After the 1st two month of assistance, The cost for the yearly assistance fee is ....**Rs. 4950/-**

Other terms and conditions as per attached sheet.

SPECIAL NOTE : While placing order please advice :

If your Inverter is with PLC then to control RPM or Speed of AC Main Motor, system with 4 - 20 mA or 0 - 10V output will be required hence while placing order please clarify the details of your output requirement for controlling the RPM or Speed of Main Motor.

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