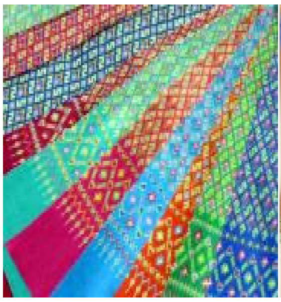
DETAILED PROJECT REPORT
ON
INSTALLATION OF AUTO TEMPERATURE CONTROLLER IN JIGGER DYEING MACHINE
(PALI TEXTILE CLUSTER)







Bureau of Energy Efficiency

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INSTALLATION OF AUTO TEMPERATURE CONTROLLER IN JIGGER DYEING MACHINE

PALI TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Installation of Auto Temperature Controller In Jigger Dyeing Machine

Textile SME Cluster, Pali, Rajasthan (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PAL/TXT/TCJ/12**

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Acknowledgement

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

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

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List of Abbreviations

- BEE - Bureau of Energy Efficiency
- 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

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. Dyeing forms major part of the process and the process along with pretreatment in Polyester fibers is accomplished in Jet Dyeing machine. The electricity consumption of Jigger Dyeing machine in a mill having dyeing and finishing facility is negligible. However, steam consumption is considerable, to the extent of 250 Kg steam per hour during heating cycle.

During Energy Audit, major flaw was observed in process parameter control of Jigger Dyeing Machine causing the heating fuel Consumption increase more than 2 folds. The flaw is mainly connected with non-existence of temperature control device leading to overheating causing waste of useful heat energy and also leading to higher surface heat losses.

Implementation of the proposition would save 20 MT of RPC from the set of 10 jigger machine.

This DPR highlights the details of the study conducted for assessing the potential for installation of Installation of auto temperature control in jigger dyeing machine , 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)	1.2
2	Fuel saving (RPC)	MT/year	20
3	Monetary benefit	₹ (in Lakh)	1.50
4	Debit equity ratio	Ratio	3:1
5	Simple payback period	Month	10
6	NPV	₹ (in Lakh)	4.33
7	IRR	% age	96.44
8	ROI	% age	29.63
9	DSCR	ratio	5.05
10	CO_2 saving (10 set of machine)	MT/year	55
11	Process down time	Days	Nil

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:

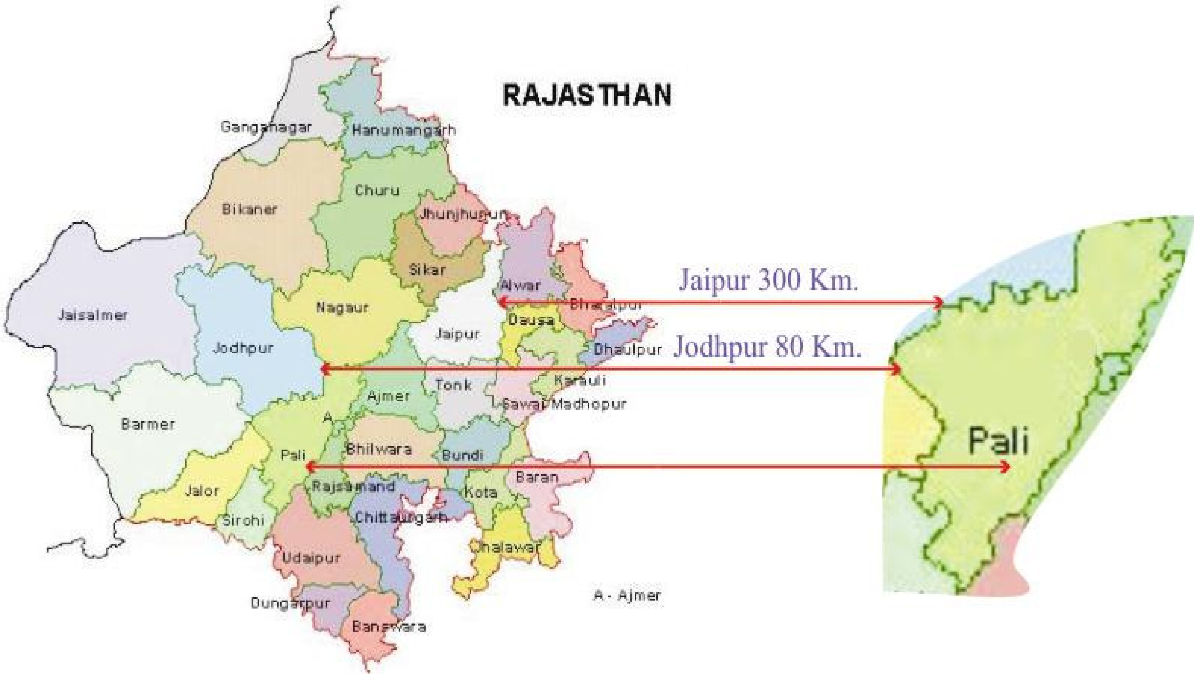


Fig. 1.1 – Pali – Geographical Map

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 are drawn below –

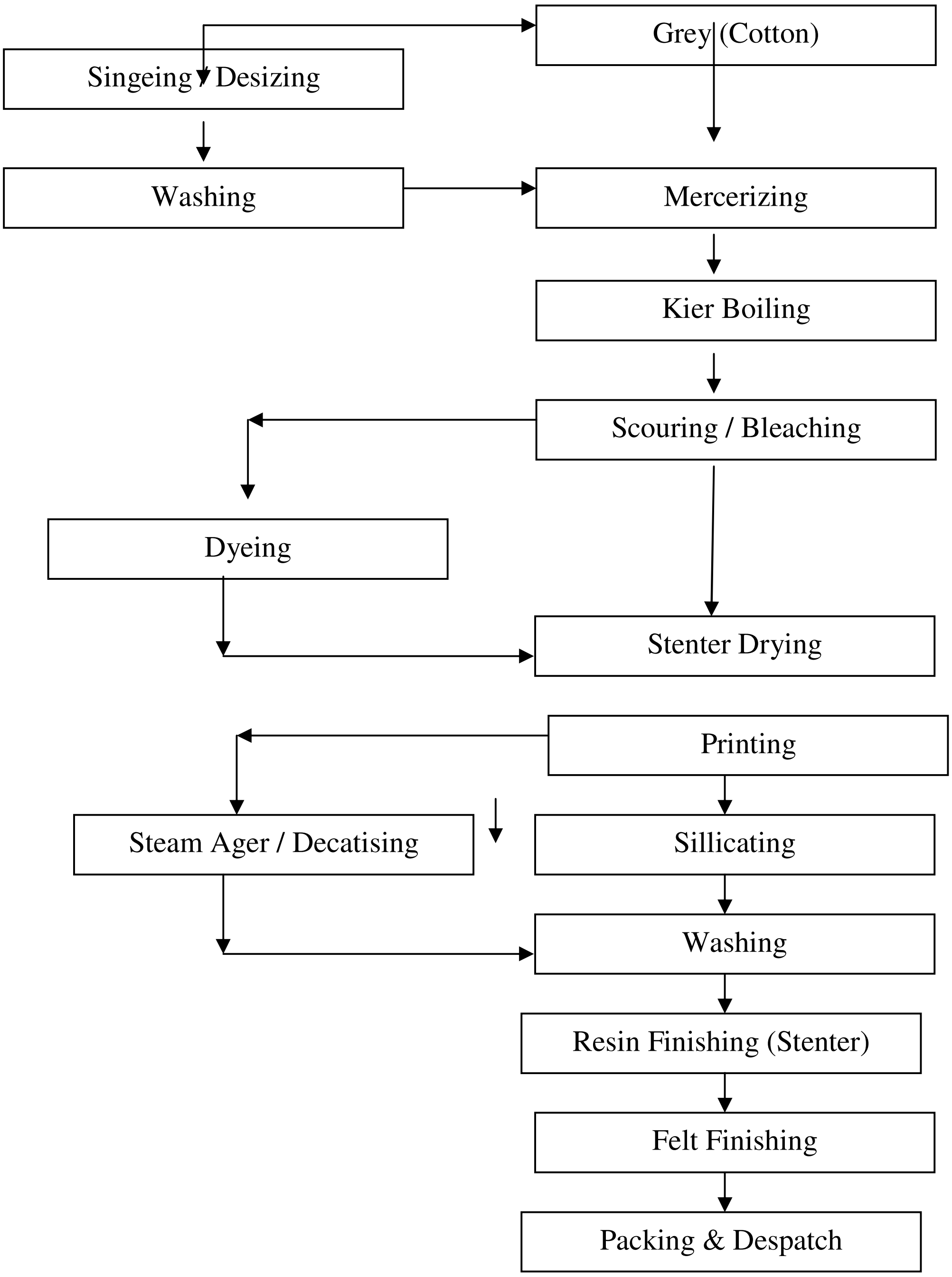


Fig. 1.2 – Process Flow Diagram of Cotton Dyeing and Printing

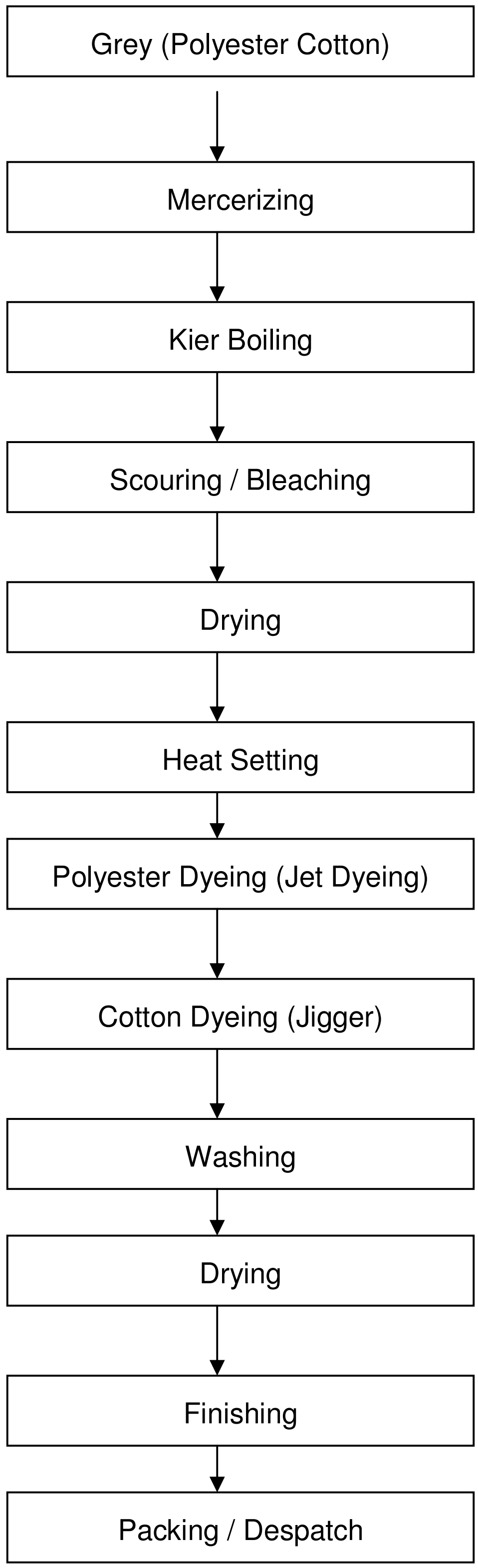


Fig. 1.3 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

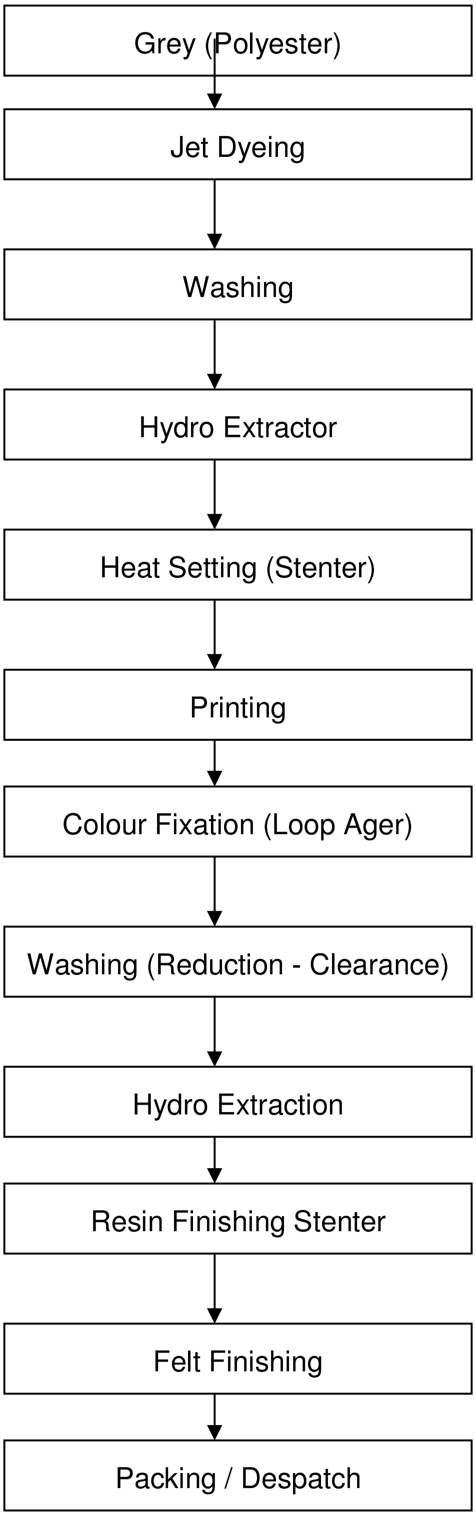


Fig. 1.4 – Process Flow Diagram of Polyester Printing and Finishing

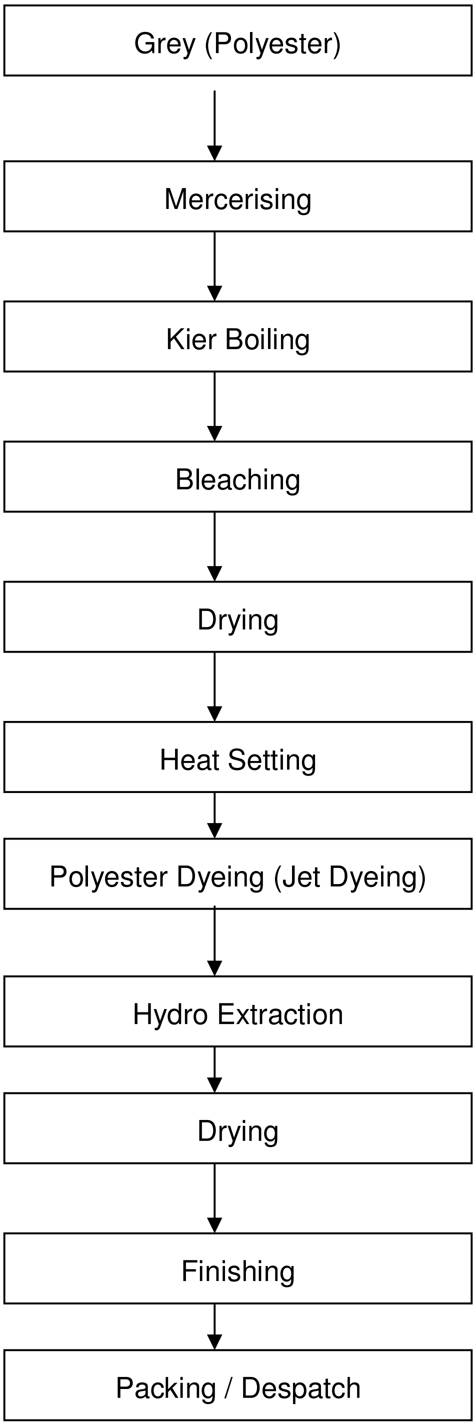


Fig. 1.5 – Process Flow Diagram of Polyester Dyeing and Finishing

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

Jigger Dyeing is the most common method of dyeing cotton fabric and is also traditional method in use for a long time now. The machinery is inexpensive and also very convenient and relatively easier for operators as compared to other machines and hence is very popular.

In jigger dyeing the fabric is dyed by about six repeat passages through a V-shaped stainless steel trough filled with dye liquor. Jiggers are most suitable for medium and heavy weight cotton goods, which can withstand lengthwise tension. The batch size is about 450 m or approximately 50 to 70 kg weight. The lowest liquor to material ratio is about 3 to 5 and highest about 15 to 20.

Heat requirements in the jigger are for raising the liquor temperature for surface heat losses and for evaporation. Different dyes require different levels of temperature, e.g., vat and reactive dues, to 75^{o}C and direct, sulphur and disperse dues require 95 to 100^{o}C. The disperse dyes are applied to polyester fabrics with an auxiliary agent called carrier. The steam consumption depends upon the temperature, duration and the liquor to material ratio. For example, the steam consumption is around 0.5 to 0.6 kg steam per kg of fabric for which dyeing is done for one hour at 75^{o}C with liquor to material ratio of 5. Soaping at boil usually follows all dyeing. The specific steam consumption for this is estimated to be about 1.0 kg steam/kg fabric. An 'after treatment' or treatment after dyeing is carried out in case of direct, disperse and reactive dyes at about 50^{o}C and this accounts for about 0.3 kg steam per kg fabric. Thus, in case of jigger dyeing the specific steam consumption is in the range of 1.5to2 kg/kg fabric.

The process temperature depends upon the kind of Dye used and ranges from 80°C to 96°C. Dye used in Pali textile cluster is predominantly reactive dye and the temperature required is 80°C.

During site visit and also during detailed Energy Audit, it was observed that the temperature of the dye bath in Jigger Dyeing machine was being controlled by opening and closing steam injection valve on the basis of visual estimation. The method was found to be unsatisfactory and general observation was that the operators were keeping the temperature as high as possible so as not to lose on quality.

Jigger Dyeing Machine

Fig. 1.6 – Photograph of jigger dyeing machine

1.3.2 Role in process

Hot water is required for Dye application, Dye fixation, soaping etc in a Jiger Dyeing Machine. The Jigger Dyeing Machine is required for Dyeing of cotton fabric or cotton content of the blended fabric. Dyeing of cotton fabric requires hot water at temperatures 80°C to 96°C depending upon the type of dye used. Presently heat for raising this hot water is drawn from steam raised in boiler or by direct heating and there is no arrangement to measure the temperature leading to general over heating and hence loss of useful heat.

Benchmarking for existing specific energy consumption

As has been described in section 1.3.1, steam requirement in Jigger Dyeing is to the tune of 1.5 to 2 Kg steam per Kg of fabric. However, the actual consumption would depend upon the kind of Dye used, Liquor Ratio, Methodology of temperature Control adopted etc. Energy consumption in Jet Dyeing machine would depend on following mentioned things

- Type of Dye used
- Availability of online dosing of dye or not
- Liquor Ratio
- System for Temperature control installed or not.
- Jigger Type - Closed or Open

1.3.3 Energy audit methodology

The following methodology was adopted to evaluate the performance of Stenters which is shown in Fig. 1.7 below:

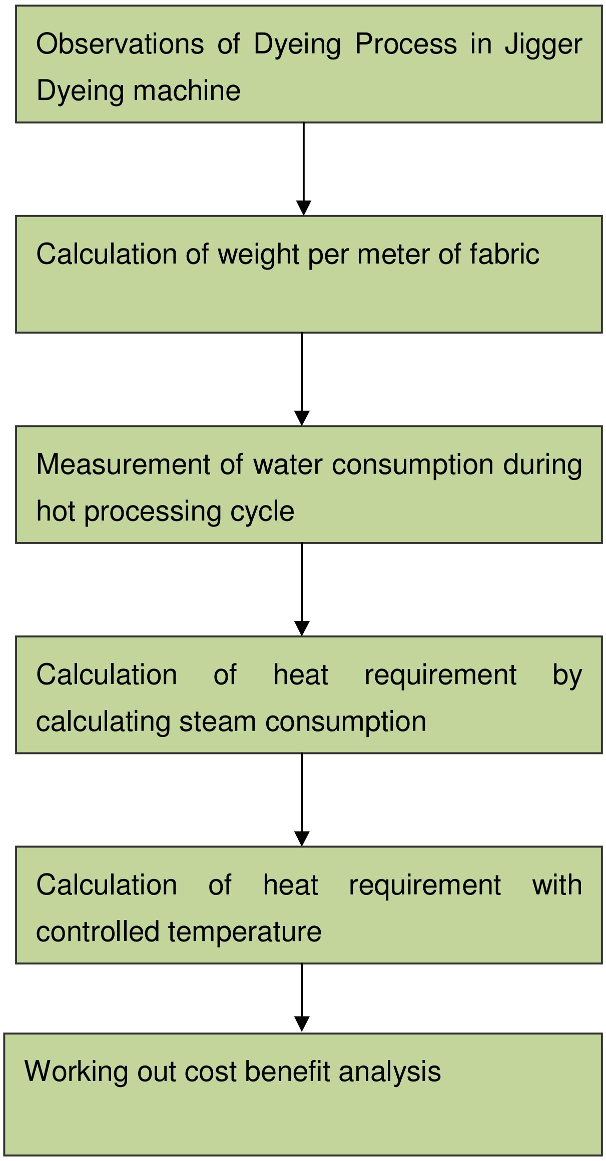


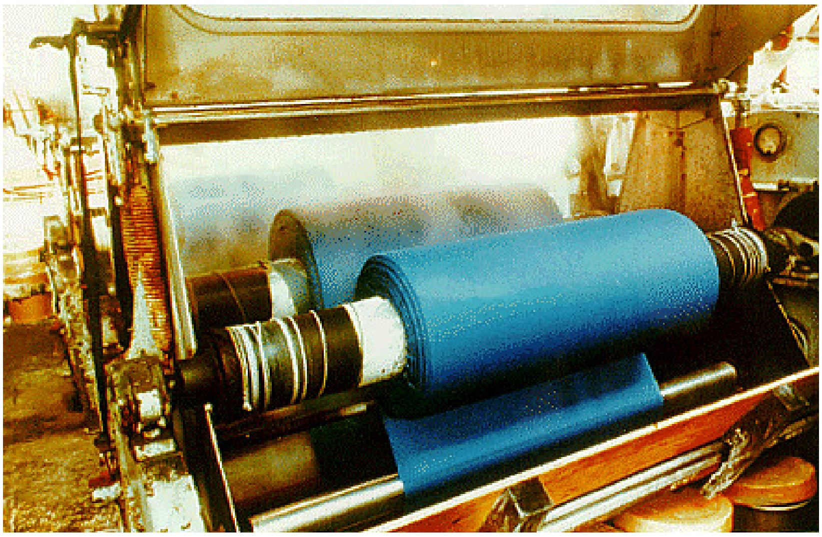
Fig. 1.7 Energy Audit methodologies

1.3.4 Design and operating parameters specification

The requirements of the present dyeing done in Pali are that the fabric should be dyed at a temperature of 80^{o}C. during Energy Audit general over heating was observed and the operating temperature was observed to be more than 96 ^{o}C in all the cases.

1.3.5 Operating parameter & efficiency analysis

Presently, the units are forced to use 16% higher heat energy in Jigger Dyeing Machine due to non provision of a simple mechanism for controlling the flow of steam injection into the Jigger by way of measurement of process parameter. On a population of over 5000 Jigger Dyeing Machine in Pali, the combied saving potential works out to be very high.



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 not readily available as a package due to non use but can be assembled locally as all the components are locally available.
- Non-availability of technology or aversion to adoption for any other reason does not seem to be the case here as at least one unit in Pali is using automatic temperature controller by control of steam injection rate in some other process.
- The local vendors have agreed to assemble the product locally and on presentation of the product in the local market with guaranteed cost benefit analysis, the adoption and replication is certain.
- 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. ₹ 1.0 Lakh investment for a cluster of 10 machine and can as well be managed from internal resources. However, the units have upto 36 Jet Dyeing machines and hence investment of ₹ 3.6 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

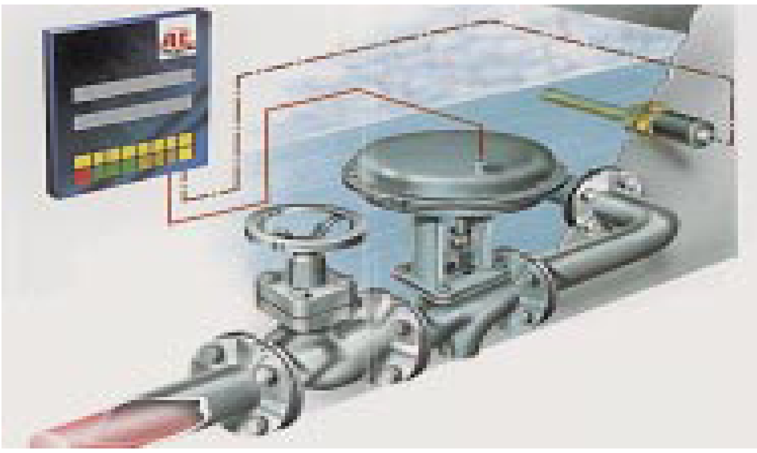
2.1 Detailed description of technology proposed

Background

Most of the Jet Dyeing machines have pumps of larger capacity than actual requirement (suitable upto 500 gm/linear meter fabric). In practical use, nozzle flow is throttled by 50%. Furthermore, the output of pump of the Jet Dyeing Machine is pegged at 3.5 Kg/cm^2 all through the cycle whereas this pressure is required for 55 minutes only in a cycle of 180 minutes.

Description of equipment

The system is not available of the shelf in Pali and for that matter any other textile dyeing and processing cluster. However, systems working on similar process are getting used in other sections like Scouring or even in washing range. The typical arrangement of the system is depicted in the following sketch.



2.1.1 Equipment specification

The equipment will have to be assembled for Jigger Dyeing Application. However, since the control mechanism is simple and almost similar products are being used I other application, some change in material of sensor is required to suit the application.

2.1.2 Suitability over existing equipment

The proposed system can be retrofitted to existing jigger 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 can be got assembled locally within 3 to 4 weeks of placement of order through local manufacturers as well as manufacturers in Ahmedabad.

2.1.5 Source of equipment

The technology needs to be adapted to suit the requirements and initial discussions have yielded positive response from local vendors.

2.1.6 Technical specification of equipment

The proposed equipment is a generic application of control systems readily available and hence technical specification of proposed technology cannot be provided except that it has to maintain temperature of 80°C by ON / OFF control of steam control valve.

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 minimal work and hence no downtime is expected.

2.2 Life cycle assessment and risks analysis

The unit would mainly consist of Relays / Control Cables / Temperature Sensor and Solenoid operated valve. Of all the components, the temperature sensor is likely to remain in contact with corrosive fluids and hence the material has to be corrosion resistant. Also, the solenoid operated valve will have to operate very often and hence it may get choked or may have break down. However, the system is likely to serve for a minimum period of 5 years.

2.3 Suitable Unit for Implementation of Proposed Technology

The proposed system can be implemented in over 2000 no. Jigger Dyeing Machines out of a total of over 5000 such machines presently operating at Pali.

3.0 ECONOMIC BENEFITS FROM PROPOSED EQUIPMENT

3.1 Technical benefit

3.1.1 Fuel saving

Fuel saving to the tune of 2 MT of RPC is possible by implementation of the proposed system in one machine. However, the units in Pali contain multiple Jigger Dyeing Machines and hence the benefit likely to accrue to any single unit would be to the tune of minimum 20 MT RPC worth ₹ 1.5 lakh.

3.1.2 Electricity saving

No saving in electricity is anticipated by implementation of the proposed measure.

3.1.3 Improvement in product quality

The system would ensure precision process control of the dyeing process and hence product quality would certainly improve. The installation of proposed system would help improve reproducibility of shades and at the same type help produce absolute matching of shades. Also the product will have better colour fastness and uniform application of colour. Most important is that the proposed system can help optimize water consumption having indirect bearing on energy consumption.

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

The project would help optimize on consumption of Dyes and would also reduce quantity of Dye in the run off.

3.2 Monetary benefits

The monetary saving arising out of implementation of proposed technology in one Jigger dyeing would be ₹ 15052/- per year and from the set of 10 machine ₹ 150520/- if cost of RPC is taken to be @ ₹ 7500/- per MT.

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

The indirect benefit of implementation of the proposed system would accrue by way of optimization of Dye consumption and also wastage of Dye in run off. This would further reduce load of Effluent Treatment Plant.

3.4.2 Reduction in GHG emission

The equivalent saving in GHG emission for every Jigger Dyeing Machine would be 5.5 MT per year as per UNEP GHG Calculator.

3.4.3 Reduction in other emissions like SO_X

NIL

4.0 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Equipments cost

Cost of the equipment is about 1.0 Lakh (incl. of taxes and cartage for 10 systems) as per the attached quotation.

4.1.2 Erection, commissioning and other misc. cost

Erection & commissioning cost is ₹ 0.2 lakh and miscellaneous cost.

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	cost
1	Equipment cost	₹ (in Lakh)	1.0
2	Erection & Commissioning cost	₹ (in Lakh)	0.20
3	Total cost	₹ (in Lakh)	1.20

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost which is 0.30 lakh.

4.2.2 Loan amount.

Remaining 75% cost of the proposed project will be taken from the bank which is 0.90 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 ₹ 1.50 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 ₹ 1.20 lakh and monetary savings due to reduction in Electricity & Fuel consumption is 1.50 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 ₹ 4.33 Lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 96.44%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 29.63%.

Table 4.2 Financial indicators of proposed technology

S.No.	Particular	Unit	Value
1	Simple payback period	Months	10
2	NPV	₹ (in lakh)	4.33
3	IRR	% age	96.44
4	ROI	% age	29.63
5	DSCR	ratio	5.06

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	91.91	4.06	29.42	4.81
Realistic	96.44	4.33	29.63	5.06
Optimistic	100.95	4.59	29.82	5.30

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

Annexure -1: Information Brochure of equipment

Typical specification of Temmperature Controller programmer is as below -

Types :

- Single Set Point Controller
- Double Set Point Controller
- Multi Set Point Controller
- Multi Channel Controller
- Boiler Temperature Controller
- Temperature Data Monitor – On Line on PC

Output for Controlling :

- RELAY
- SSR
- ANALOG OUTPUT FOR CONTROL ELEMENT

Attributes :

- Single set point controller
- One Set Point with User Band
- One Set Point with Alert Indication
- Two Set Point
- Six Channel Input - Two Set Point
- Signal conditioning check facility
- Automatic cold junction compensation
- Sensor Error - Open detection & display.

Display	• Three & Half Digit 0.3", 0.5", 1.0" • Selectable Dual Display (Actual/Set)
Sensor Input	RTD Pt 100,Thermocouple (J, K, R, S, T Types)
Set Point	Precise Multi turn Port (Advance)
Output	• Relay Output, 1 C/O,2 C/O : 6 AMPS • 'ON' Indication by LED

Range	0 to 1200 ℃
Supply	• 230 V AC • 110 V AC • 50 Hz
Size	• 96*48 mm • 72*72 mm • 96 * 96 mm • 72 * 144 mm • 96*192mm

Typical sketch of the display is as per the above diagram.

Annexure -2: Detailed financial analysis

Assumption

Name of the Technology	AUTO TEMPERATURE CONTROLLER IN JIGGER DYEING MACHINE		
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)	1.00	
Erection and Commisioning	₹ (in lakh)	0.20	
Total Investment	₹ (in lakh)	1.20	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	0.30	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	0.90	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			
Fuel Saving	Tons/Year	20	
Cost	₹/ton	7500	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan

₹ (in lakh)

Years	*Opening Balance*	*Repayment*	*Closing Balance*	*Interest*
1	0.90	0.09	0.81	0.10
2	0.81	0.12	0.69	0.08
3	0.69	0.16	0.53	0.07
4	0.53	0.19	0.34	0.05
5	0.34	0.20	0.14	0.03
6	0.14	0.14	0.00	0.01
		0.90		

WDV Depreciation

₹ (in lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	1.20	0.24
Depreciation	0.96	0.19
WDV	0.24	0.05

Projected Profitability

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Total Revenue (A)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Expenses								
O & M Expenses	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07
Total Expenses (B)	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07
PBDIT (A)-(B)	1.45	1.45	1.45	1.44	1.44	1.44	1.44	1.43
Interest	0.10	0.08	0.07	0.05	0.03	0.01	-	-
PBDT	1.35	1.37	1.38	1.39	1.41	1.43	1.44	1.43
Depreciation	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
PBT	1.28	1.31	1.32	1.33	1.35	1.37	1.37	1.37
Income tax	0.13	0.40	0.47	0.47	0.48	0.49	0.49	0.49
Profit after tax (PAT)	1.15	0.91	0.85	0.86	0.87	0.88	0.88	0.88

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
rofit before tax	1.28	1.31	1.32	1.33	1.35	1.37	1.37	1.37
Add: Book depreciation	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Less: WDV depreciation	0.96	0.19	-	-	-	-	-	-
Taxable profit	0.39	1.18	1.38	1.39	1.41	1.43	1.44	1.43
Income Tax	0.13	0.40	0.47	0.47	0.48	0.49	0.49	0.49

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Reserves & Surplus (E)	1.15	2.06	2.91	3.77	4.63	5.52	6.40	7.28
Term Loans (F)	0.81	0.69	0.53	0.34	0.14	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	2.26	3.05	3.74	4.41	5.07	5.82	6.70	7.58

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Less Accm. Depreciation	0.06	0.13	0.19	0.25	0.32	0.38	0.44	0.51
Net Fixed Assets	1.14	1.07	1.01	0.95	0.88	0.82	0.76	0.69
Cash & Bank Balance	1.13	1.98	2.73	3.46	4.19	5.00	5.94	6.89
TOTAL ASSETS	2.26	3.05	3.74	4.41	5.07	5.82	6.70	7.58
Net Worth	1.45	2.36	3.21	4.07	4.93	5.82	6.70	7.58
Debt Equity Ratio	2.70	2.30	1.77	1.13	0.47	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	0.30	-	-	-	-	-	-	-	-
Term Loan	0.90								
Profit After tax		1.15	0.91	0.85	0.86	0.87	0.88	0.88	0.88
Depreciation		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Total Sources	1.20	1.22	0.97	0.91	0.92	0.93	0.95	0.95	0.95
Application									
Capital Expenditure	1.20								
Repayment Of Loan	-	0.09	0.12	0.16	0.19	0.20	0.14	-	-
Total Application	1.20	0.09	0.12	0.16	0.19	0.20	0.14	-	-
Net Surplus	-	1.13	0.85	0.75	0.73	0.73	0.81	0.95	0.95
Add: Opening Balance	-	-	1.13	1.98	2.73	3.46	4.19	5.00	5.94
Closing Balance	-	1.13	1.98	2.73	3.46	4.19	5.00	5.94	6.89

IRR

₹ (in lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		1.15	0.91	0.85	0.86	0.87	0.88	0.88	0.88
Depreciation		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Interest on Term Loan		0.10	0.08	0.07	0.05	0.03	0.01	-	-
Cash outflow	(1.20)	-	-	-	-	-	-	-	-
Net Cash flow	(1.20)	1.32	1.05	0.98	0.97	0.96	0.95	0.95	0.95
IRR	96.44%								

NPV	4.33

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Sub Total(G)	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Interest on Term Loan	0.10	0.08	0.07	0.05	0.03	0.01	0.00	0.00
Depreciation (H)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Sub Total (I)	0.18	0.15	0.14	0.13	0.11	0.08	0.08	0.08
Sales (J)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Contribution (K)	1.46	1.46	1.46	1.46	1.46	1.45	1.45	1.45
Break Even Point (L= G/I)	12.24%	10.57%	9.77%	8.69%	7.39%	5.83%	5.47%	5.54%
Cash Break Even {(I)-(H)}	7.91%	6.23%	5.43%	4.35%	3.04%	1.47%	1.11%	1.17%
Break Even Sales (J)*(L)	0.18	0.16	0.15	0.13	0.11	0.09	0.08	0.08

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	1.28	1.31	1.32	1.33	1.35	1.37	1.37	1.37	10.70
Net Worth	1.45	2.36	3.21	4.07	4.93	5.82	6.70	7.58	36.12
									29.63%

Debt Service Coverage Ratio

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	1.15	0.91	0.85	0.86	0.87	0.88	0.88	0.88	5.52
Depreciation	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.38
Interest on Term Loan	0.10	0.08	0.07	0.05	0.03	0.01	0.00	0.00	0.33
Total (M)	1.32	1.05	0.98	0.97	0.96	0.95	0.95	0.95	6.23

DEBT

Interest on Term Loan	0.10	0.08	0.07	0.05	0.03	0.01	0.00	0.00	0.33
Repayment of Term Loan	0.09	0.12	0.16	0.19	0.20	0.14	0.00	0.00	0.90
Total (N)	0.19	0.20	0.23	0.24	0.23	0.15	0.00	0.00	1.23
	0.10	0.08	0.07	0.05	0.03	0.01	0.00	0.00	0.33
Average DSCR (M/N)	5.05								

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						

Annexure 4: Detailed equipment assessment report

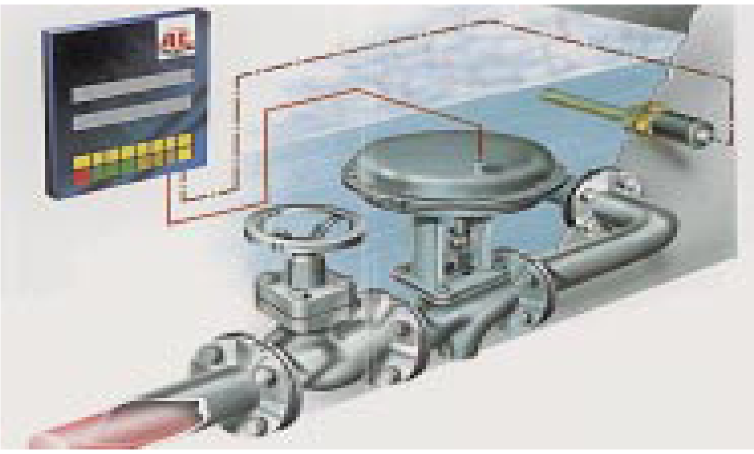
Calculation of Energy Saving Potential

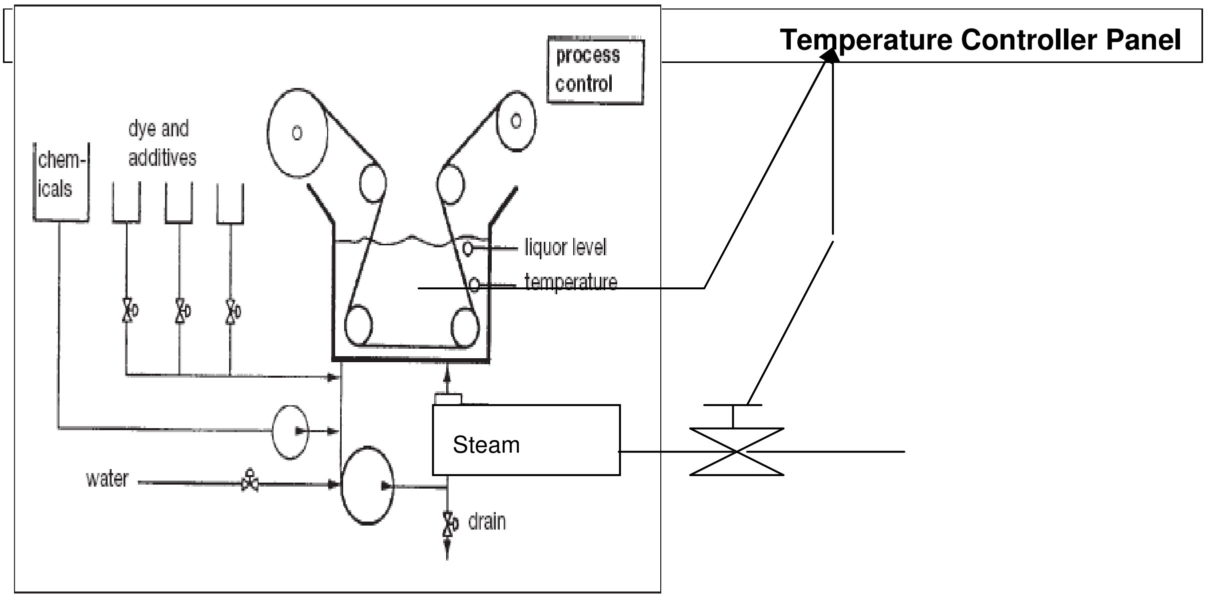
Particulars	Calculations
Temperature observed in Jigger	96^{O}C
Temperature required for hot cycle	80^{O}C
Water consumption per day in hot Dyeing	2400 Litre
Saving of heat per day = MSΔt	2400x1x(96-80) = 38400 kCal/day
Fuel saving per day considering GCV 8200 kCal/kg and Boiler Efficiency 70%	6.69 kg RPC/day
Yearly saving potential from one jigger machine	2.007 MT
Monetary equivalent @ 7500/MT	₹ 15052 /- per year
Cost of Auto Control Steam Valve	₹ 12000/- per year
General Payback period	9.6 months

Annexure -5: Details of equipment service providers

S.No.	Technology	Name of Service Provider	Address	Contact Person and No.
1.	Installation Jigger Temperature Control Mechanism	M/s Vikalp energy Consultants	6/332, Malviya Nagar, Jaipur	Mr. Shrivastava

Annexure – 6 Typical arrangement drawings for proposed system





Annexure – 7 Quotation for Proposed Technology

Vikalp Energy Consultants
(…..Energizing Alternatives)

November 11th, 2010

For
Shri Suman Kumar
Joint Director
PCRA Jaipur

Sub : - Your enquiry for Temperature Control System in Jiggers by Steam Flow Control – Budgetary Quote

Dear Sir,

We are happy to inform that we are in a position to supply such a system, though, it is not readily available off the shelf in the market. The details of the system is as below –

Specification :-

Temperature Sensor – J type with SS Thermowell
½" steam globe Valve with solenoid operation, Normally Closed type
Temperature setting device and controller
Panel, Cables and other miscellaneous items would be beyond the scope.

Price

The cost of the system FOR would be Rs. 10000/- per unit inclusive of taxes and cartage. Consumables and labour charges required for Erection & Commissioning would be Rs. 2000/- per unit over and above the cost of the system. Payment terms would be 40% advance and balance on dispatch of the material.

Supply Schedule

Supply can be made within 3 to 4 weeks of placement of order. Although the system is small and should not be taking this much time. However, the customization of the product on order will take time.

Hope that this serves your purpose.

Yours sincerely
(S.Srivastava)
Proprietor
Vikalp Energy Consultants

6/332, Malviya Nagar, Jaipur
Phone – 0141—2723929, EMail - vikalpenergy@rediffmail.com

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
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Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

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(Under Ministry of Petroleum and Natural Gas)
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