DETAILED PROJECT REPORT
ON
SOLAR WATER HEATER
(PALI TEXTILE CLUSTER)

Bureau of Energy Efficiency

Prepared by

Reviewed By

SOLAR WATER HEATER

PALI TEXTILE CLUSTER

BEE, 2010

Detailed Project Report on Solar Water Heater

Textile SME Cluster, Pali, Rajasthan (India)

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Detail Project Report No.: **PAL/TXT/SWH/11**

For more information

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

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List of Abbreviations

- BEE - Bureau of Energy Efficiency
- CERs - Certified Emission Reduction
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- GHG - Green House Gases
- HP - Horse Power
- IRR - Internal Rate of Return
- MoP - Ministry of Power
- MSME - Micro Small and Medium Enterprises
- NPV - Net Present Value
- ROI - Return On Investment
- RPC - Reliance Pet Coke
- SME - Small and Medium Enterprises
- TFH - Thermic Fluid Heater
- SWH - Solar Water 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. Similarly dyeing of cotton requires the cotton fabric to be dyed on Jigger Dyeing Machine requiring hot water at 60°C. Electricity requirement is very low for this process.

Pretreatment and finishing both require hot water. In case of Cotton Dyeing, hot water is required for Jigger Dyeing, Mercerising and also washing (Reduction & Clearance). Presently, hot water is generated by injecting steam to various process machines. However, steam generation requires combustion of fossil fuels. Since the temperature requirement is low which can be very easily supplied by Solar Hot water generator and Pali being favorably placed for harnessing solar power due to only 15 cloudy days in a year, adoption of the proposed technology holds great promise.

The implementation of proposed technology i.e. installation of solar water heater for generation of hot water has potential to save about 10.97 MT RPC per year.

This DPR highlights the details of the study conducted for assessing the potential for installation of solar water heater , 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)	4.50
2	Fuel Saving (RPC)	MT/year	10.976
3	Monetary benefit	₹ (in Lakh)	0.823
4	Debit equity ratio	Ratio	3:1
5	Simple payback period	Month	65
6	NPV	₹ (in Lakh)	0.05
7	IRR	% age	10.35
8	ROI	% age	19.45
9	DSCR	ratio	1.18
10	CO_2 saving	tonne	11
11	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 in Fig. 1 below:

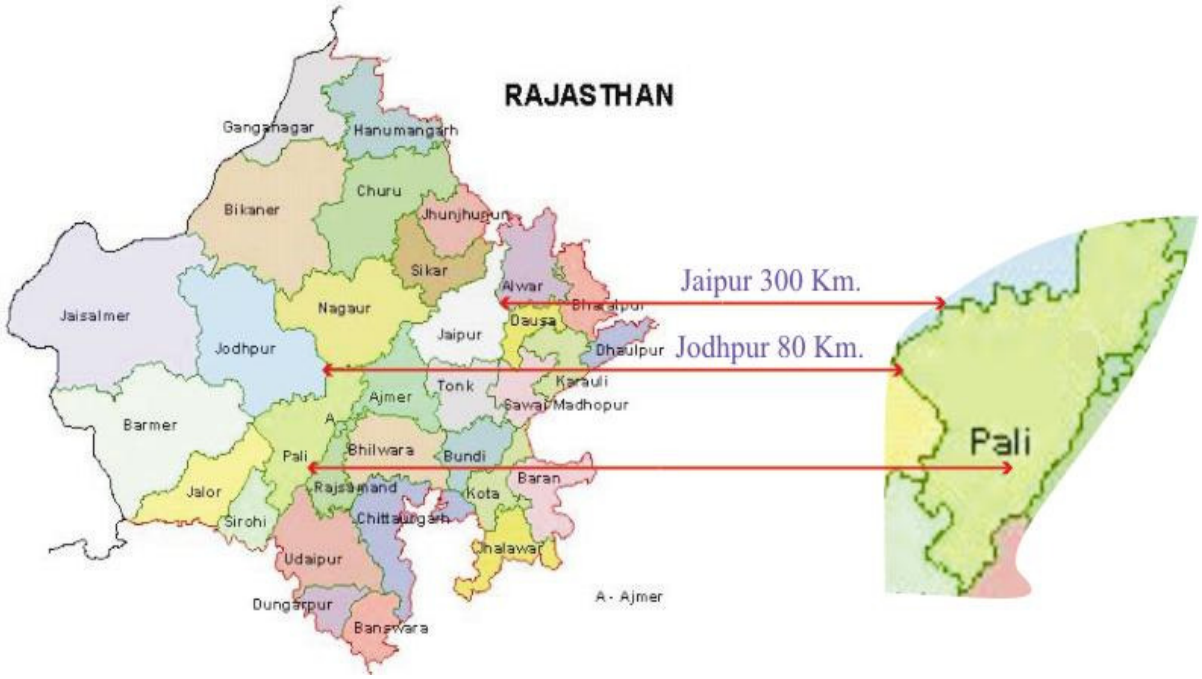


Fig. 1.1 – Pali – Geographical Map

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	27161	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 –

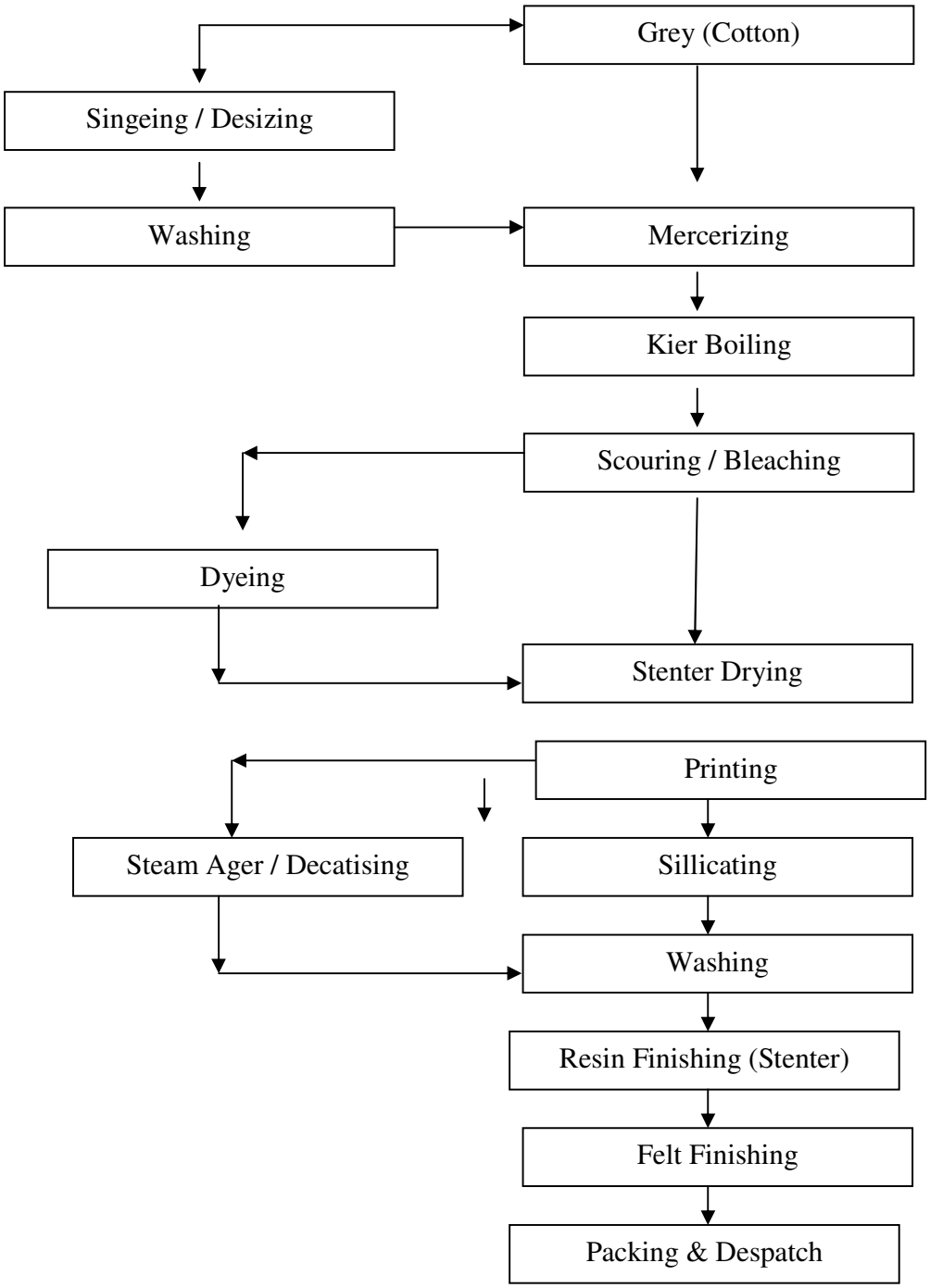


Fig. 1.2 – Process Flow Diagram of Cotton Dyeing and Printing

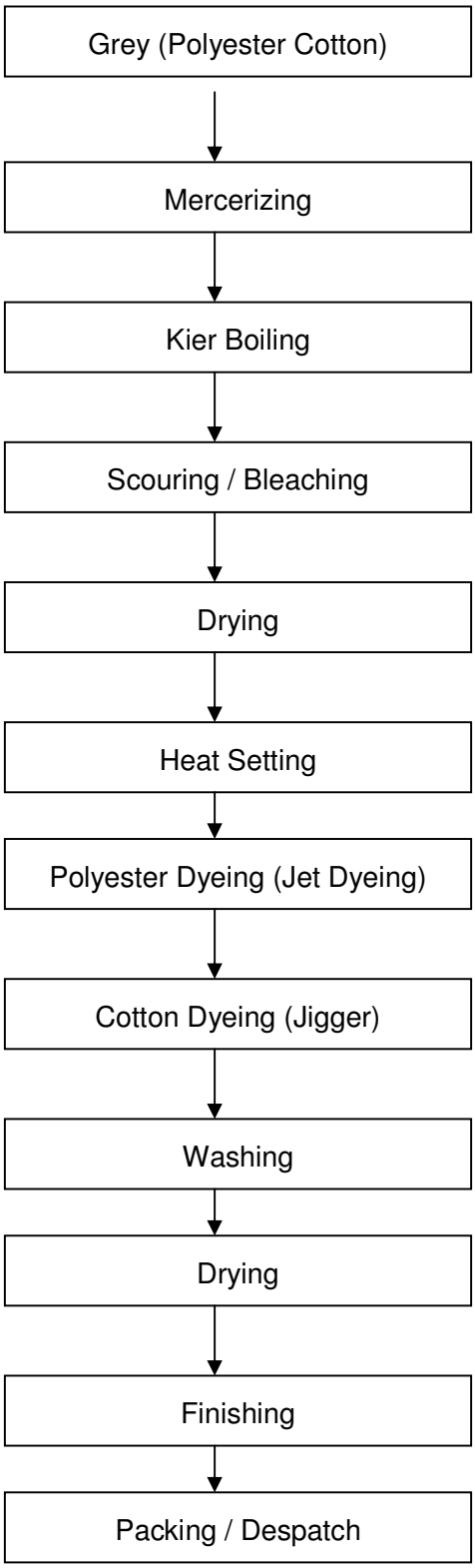


Fig. 1.3 – Process Flow Diagram of Polyester Cotton Dyeing and Finishing

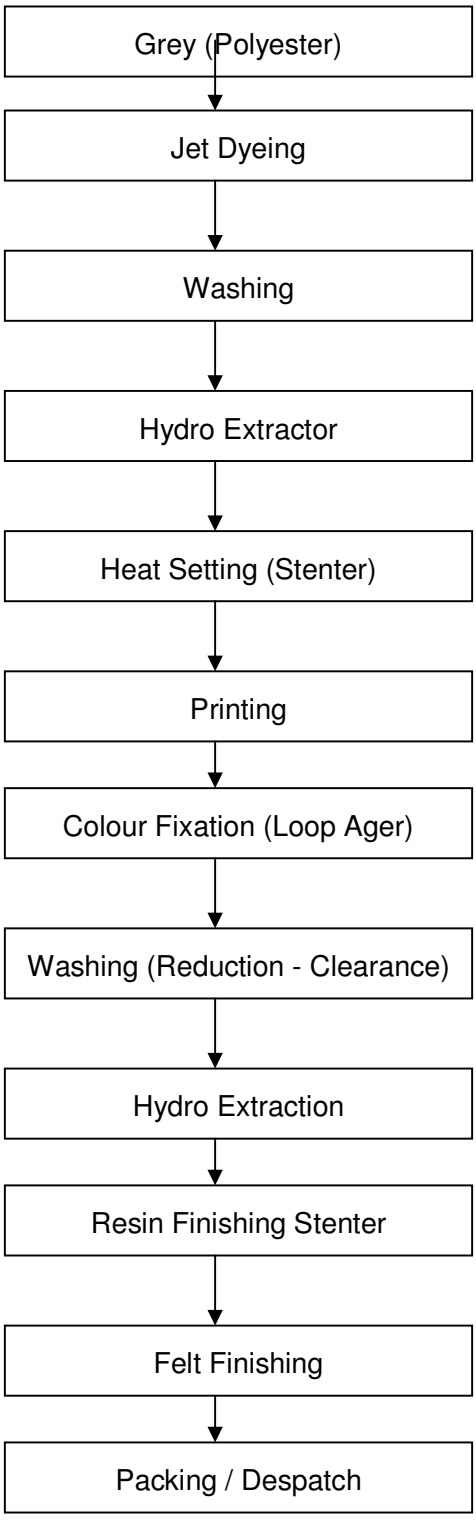


Fig. 1.4 – Process Flow Diagram of Polyester Printing and Finishing

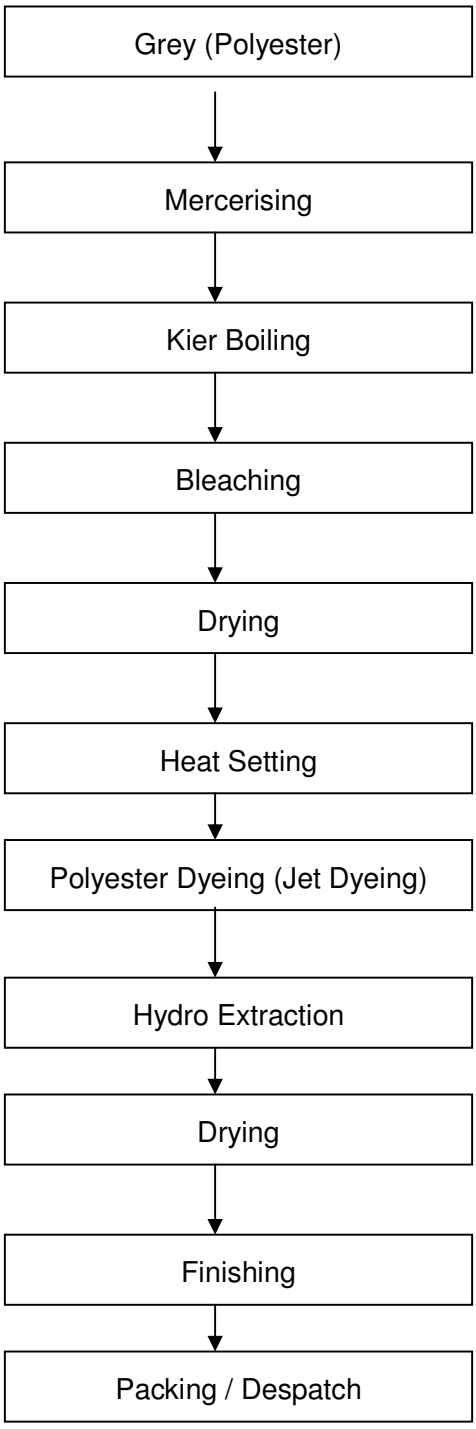


Fig. 1.5 – Process Flow Diagram of Polyester Dyeing and Finishing

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

Hot water is required for Cotton Dyeing in Jigger Dyeing Machine.

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 1.5 to2 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. Also, hot water is required in Kier Boiling but the temperature needed is 130°C.

Presently the requisite temperature of hot water is achieved by either steam injection or by raising hot water through direct heating of the bath. The process is as it is inefficient as process control is not possible in direct heating and also combustion efficiency is very low in this kind of open combustion.

The temperature requirement is ideal for replacement of heat source by solar water heater. Also, geographically and climatically, Pali is very suitably placed to harness Solar Power due to very high solar insolation and also only 15 cloudy days every year.

A typical jigger dyeing machine is depicted in the following photograph:-

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. This method of imparting heat to water for use in Jigger is proposed to be replaced by Solar Water Heater.

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, and Methodology of temperature Control adopted etc. heat required 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:

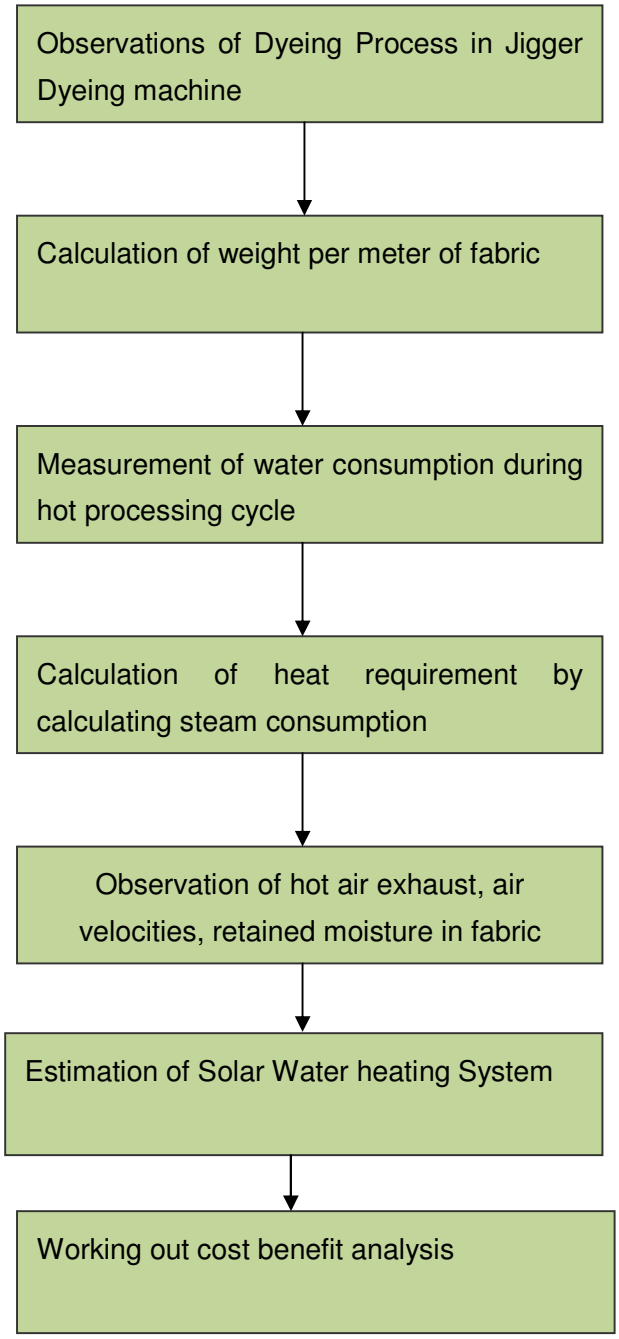


Fig. 1.7 Energy Audit methodologies

1.3.4 Design and operating parameters specification

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.

1.3.5 Operating parameter & efficiency analysis

The operating parameters of jigger dyeing machine are furnished in Table 1.6 below:

Table 1.6 Operating parameters details

S.No.	Parameter	Unit	Details
1	Use of hot water	--	Jigger machine
2	Temperature of hot water required for dyeing	°C	80-96
3	Specific steam consumption	kg/kg of fabric	1.5 – 2.0

1.4 Barriers in adoption of proposed technology/equipment

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

- Kick off Seminar to create awareness
- Energy Audit (Detailed and Preliminary) in over 78 units
- Capability building and involvement of institutional financers, local service providers and also domestic equipment manufacturers.
- Design and distribution of dissemination material containing most of the measures.
- Design and distribution of Cluster Manual containing technology gap assessment and cost benefit analysis of proposed Energy Conservation measures.
- Involvement of Industry Association, Department of Industries and local administration.

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

1.4.1 Technological Barrier

- The proposed technology, being generic in nature, is readily available and is duly supported by Ministry of MNRE by way of subsidy for industrial application.
- Non-availability of technology or aversion to adoption for any other reason does not seem to be the case here as one of the units in Pali is already using the technology.
- Solar Water Heater manufacturers are vigorously marketing the proposed technology and in fact UNDP and GEF also is coming out with advertisement nowadays for popularization of this technology. Being virtually free of maintenance requirements is a big plus.
- 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 mostly in hand process units only. The proposed system is costly and also the payback period is not that attractive. Hence it needs financial sop and also preferential financing. The units in Pali have very healthy financial position. 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. Rs. 10 Lacs investment per machine and cannot be managed from internal resources. The investment is on higher side and would need external financing for adoption.
- 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

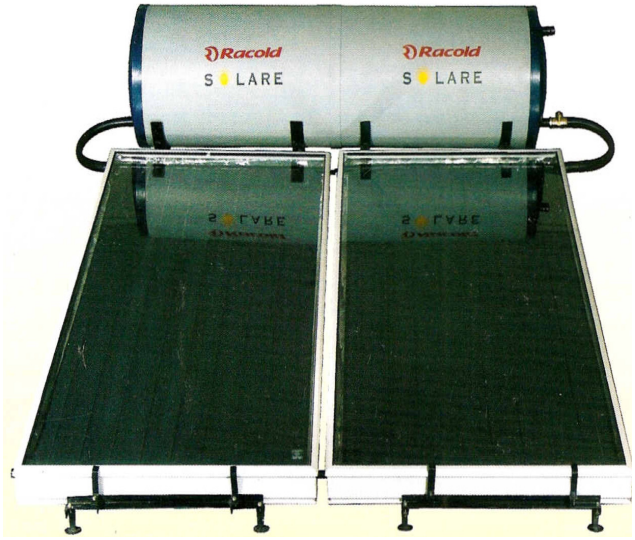
Background

One Jigger Dyeing Machine dyes 450 meters or 36 kg fabric per batch and produces 2.3 batches per day. Thus total production from each Jigger is 82.8 kg per day and steam requirement for every Jigger would be 165.6 kg steam per day.

Description of equipment

Solar water heater comes in modular package having rated capacity in terms of liters of water raised per day to a pre specified temperature. But, the actual output would depend upon the availability of sun and intensity of sunlight. Enterprises cannot work on a standalone solar water heating system and need to have stand bye system to supplement any loss of capacity due to non availability of sun light. The existing system can be retained to serve as stand bye system. However, no. of rainy days (overcast conditions) in Pali is less than 15 days in a year. So the enterprises can use Solar Water heating System as standalone system.

Solar Water Heater system has been gaining in popularity ever since the subsidy on electricity has been reduced or even lifted. The system has come into further focus in terms of acceptability in view of climate Change negotiations, threat of global warming and also promulgation of National Solar Mission.



The vacuum tube type Solar Water heating system gives good operating efficiency and keeps performing at high levels without much of breakdown. Thus the vacuum tube type is preferred over plate type.

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 jigger machine without any modification to existing Machinery.

2.1.3 Superiority over existing equipment

The output of the system would remain more or less same and the adoption would no]t really make much of difference in quality or output.

2.1.4 Availability of equipment

The system can be delivered within 3 to 4 weeks of placement of order through manufacturers all over India.

2.1.5 Source of equipment

Proposed Equipment is available indigenously.

2.1.6 Technical specification of equipment

Technical specification of proposed technology is attached at Annexure 2.

2.1.7 Terms and conditions in sales of equipment

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

2.1.8 Process down time during implementation

The proposed system is independent of existing system and integration would need plumbing work. However, tuning of the system and performance monitoring would take maximum one day.

2.2 Life cycle assessment and risks analysis

The life cycle of the system is more than 25 years. Breakdowns are minimal due to there being no moving parts. General troubles like plumbing problems and insulation deterioration may take place.

2.3 Suitable Unit for Implementation of Proposed Technology

The proposed system can be implemented in over 5000 no. of Jigger Dyeing Machines. Total potential for energy saving would be 54880 MT RPC equivalent 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

Fuel saving to the tune of 10.97 MT RPC is expected to accrue. Details of fuel saving calculation are given at Annexure 6.

3.1.2 Electricity saving

No electricity savings is expected from the proposed system.

3.1.3 Improvement in product quality

The implementation of the proposed system will not really have any worthwhile impact on product quality.

3.1.4 Increase in production

The implementation of the proposed system will not really have any worthwhile impact on productivity.

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 reduce emission from burning of fuel.

3.2 Monetary benefits

The monetary saving arising out of implementation of proposed technology in one Jigger Dyeing would be ₹ 82317/- per year if cost of RPC be taken to be @ ₹ 7500/- per MT RPC.

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

Reduction in emission of CO_2 and release of ash in atmosphere would make the environment less polluted.

3.4.2 Reduction in GHG emission

The equivalent saving in GHG emission for every Jet Dyeing Machine would be 11.48 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 system is about ₹ 4.14 lakh for 3 jigger system (1.305 lacs per 1000 liters less 20% subsidy from MNRE and scaled up to 1.325 Liters) as per the quotation from M/s SOLAR MAXX attached as Annexure 8.

4.1.2 Erection, commissioning and other misc. cost

Erection & commissioning cost is ₹ 0.36 lakh and miscellaneous cost.

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	cost
1	Equipment cost	₹ (in Lakh)	3.71
2	Erection & Commissioning cost	₹ (in Lakh)	0.05
3	Total cost	₹ (in Lakh)	3.76

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost which is. ₹ 0.94 lakh.

4.2.2 Loan amount.

Remaining 75% cost of the proposed project will be taken from the bank which is ₹ 2.92 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 7 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 10 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 ₹ 0.82 lakh per annum.

- The Operation and Maintenance cost is estimated at 1% of cost of total project with 1% increase in every year as escalations.
- Interest on term loan is estimated at 10%.
- Depreciation is provided as per the rates provided in the companies act.

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

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 3.76 lakh and monetary savings due to reduction in Electricity & Fuel consumption is 0.82 lakh hence, the simple payback period works out to be around 54 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 0.05 Lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 10.35%. 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 19.45%.

Table 4.2 Financial indicators of proposed technology

S.No.	*Particular*	*Unit*	*Value*
1	Simple payback period	Months	54
2	NPV	₹ (in lakh)	0.05
3	IRR	% age	10.35
4	ROI	% age	19.45
5	DSCR	ratio	1.18

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	9.05	0.01	19.13	1.12
Realistic	10.35	0.05	19.45	1.18
Optimistic	11.63	0.24	19.73	1.25

4.5 Procurement and Implementation Schedule

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

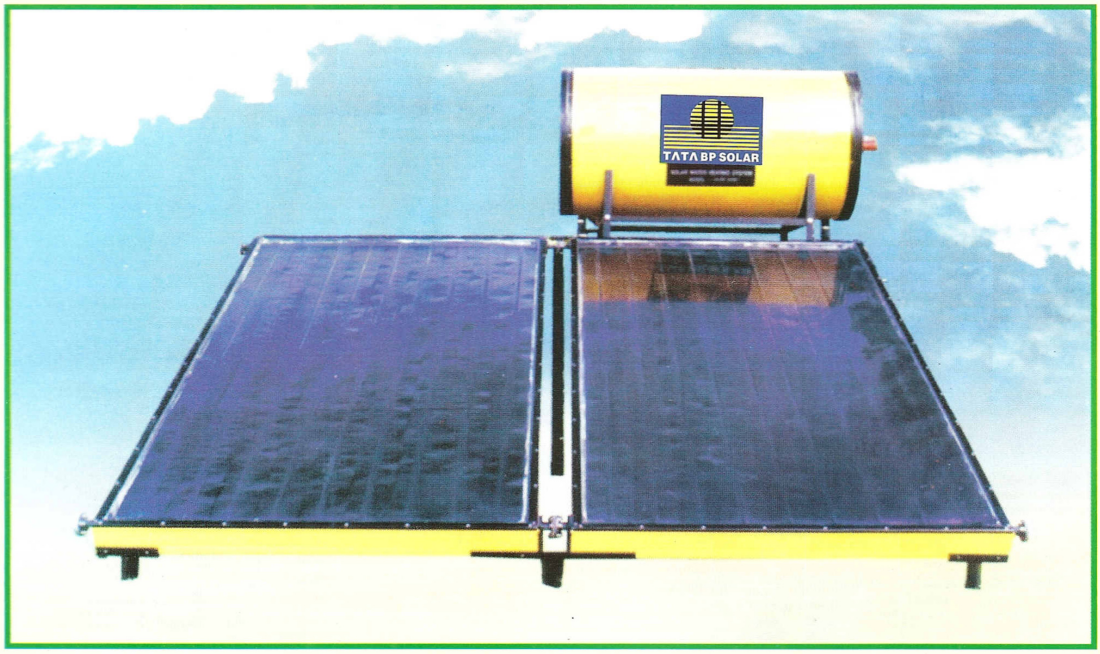
ANNEXURE

Annexure -1: Information Brochure of equipment

TATA BP SOLAR

TATASOL

WATER HEATING TECHNOLOGY



TATA BP Solar India Limited

The power of the sun working for you

Tata BP Solar is a joint venture of TATAs and BP Solar, the world's largest solar company. The company designs, fabricates, installs SPV modules, systems, solar lanterns, street lights, medical refrigerators, water pumps etc. in an array of sizes and power and voltages for specific applications.

Driven by its interest in solar photovoltaics the company has extended its product range to include solar collectors and solar hot water systems. These products are marketed under the **TATASOL** brand name.

The remarkable efficiency of solar water heating ushers in significant benefits to all. Combining the latest in solar technology, **TATASOL** collectors and hot water systems are fabricated entirely according to customer requirements and to acceptable standards. The investment is economically viable and flexible enough to be installed in homes, hotels, hospitals, schools, hostels, industrial centers, farms, dairies, tanneries, textile mills, process industries-in fact wherever large quantities of hot water is needed continuously.

TATASOL collectors is designed for high performance and durability. This collector consists of selectively coated copper sheets known as absorbers which are bonded to copper tubes through which water flows by ultrasound welding. The entire unit is easy to handle and is weather resistant.

Technical Features :

- Seamless, round special copper tubes.
- Plate type copper die formed sheets cover the copper tubes for maximum heat transfer.
- Brass flanges for easy mounting.
- Headers made of extra heavy seamless copper tubing.
- Permanent metal-to metal bonding with high stress resistance.
- All joints are brazed with silver content alloy, free of cadmium and zinc
- Each collector is pressure tested at 300 psi
- The collectors are B.I.S. certified and are I.S.I. marked
- "THE THERMAL PERFORMANCE OF THE COLLECTORS IS ABOVE THE PREVAILING INDUSTRIAL STANDARD" Remarks of Regional Solar Energy Testing Centre, Madurai Kamaraj University.

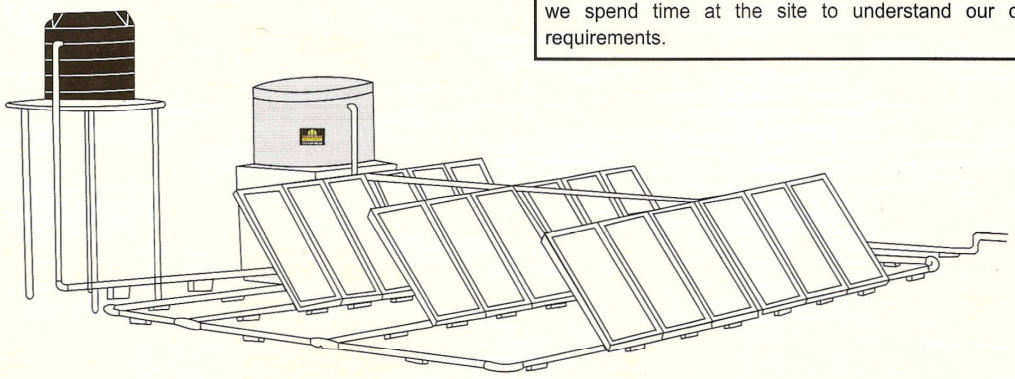
Tata BP Solar India Ltd, Bangalore and Compact Business Service, Jaipur have joined handed to bring to Rajasthan the best collectors in the country integrated into a system design to suit the needs of individual customers. While smaller systems are packaged units of Tata BP Solar India Ltd, 500 LPD and larger systems are manufactured by Compact Business services using Tatasol Collectors.

A new field and new manufacturers appear on the horizon everyday only to disappear as quickly. We in COMPACT BUSINESS SERVICES on the other hand are a firm of engineers who have been in this field since 1984. Since then we have installed SOLAR WATER HEATING SYSTEMS for :

- Residential use as replacement for electric Geysers
- Bathing in Hostels and Temple complexes.
- Bathing washing and cleaning in high class hotels.
- Pantry washing and cooking in Industrial Canteens.
- Maintaining working fluid temperature in Industrial Processes.

We have installed these systems to deliver temperatures of upto 80° C and we have maintained these systems continuously as to ensure that our clients actually save energy year after year.

Some of the systems installed by us are simple thermosyphon type systems while the others have a variety of controls to ensure simplicity of operation while maximising reliability and energy savings. This is possible only because we spend time at the site to understand our clients requirements.



TATA BP SOLAR

TATA BP Solar India Limited
Plot No. 78, Electronic City,
Hosur Road, Bangalore 561 229

For More Information Contact :
Compact Business Services
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Tel : Off. 2216228, 2217896
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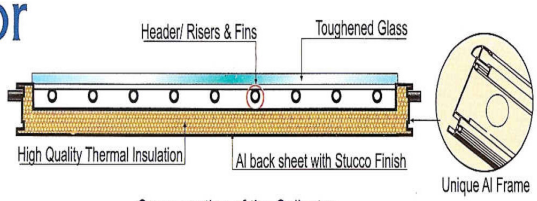
e-mail : solarcbs@datainfosys.net

ENERGY IS LIFE
BEE
CONSERVE IT


Switch on the Sun
Switch on the Sun
Racold
SOLARE
Penta+
Advantage
IS:12933 (PART 1):1992
CM/L-7452979
ISI APPROVED
Saves up to 70%
OF MONTHLY ELECTRICITY BILLS
Duronox
INNER CONTAINER
5* YEAR
PRODUCT GUARANTEE
ISO 9001 : 2000
CERTIFIED COMPANY

Unique Flat-plate Collector

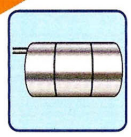
Collector is a vital component of the Solar Water Heater and Racold Solare flat-plate collector is specially designed using the latest Italian technology to offer high heating efficiency and maximum durability.



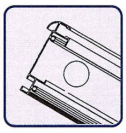
Cross-section of the Collector

- **Water-proof construction**: The collector in Racold Solare is specially designed making it water-proof. This enhances the durability and efficiency, ensuring consistent product performance.
- **Unique Aluminium frame**: Designed for structural strength and to withstand mechanical shocks, ensuring durability.
- **Ultrasonic welding**: Permanent molecular bonding between copper fins and copper tubes results in high heat absorption and better efficiency.
- **Absorber Material**: Headers, risers and fins are made using 99.9 % pure copper with selective black chrome coating.
- **Toughened glass**: Clear toughened glass (4mm thick) can withstand mechanical shock and ensures better transmission of solar energy.
- **Insulation**: Hi-quality thermal insulation at the bottom and side of the panel ensures minimum heat loss.
- **Rugged mounting system**: Powder coated mounting stand with PU finish and sandwich type design ensures durability, while the stainless steel fasteners are corrosion resistant.

Penta+ Advantage



Duronox Inner Container: Specially treated inner container ensures durability and resistance against corrosion. It comes with a 5-year replacement guarantee.



Unique Flat-plate Collector: Specially designed water-proof collector with high structural strength for dependable performance and high durability.

PUF insulation: Hi-density injected PUF insulation ensures best results in every season. PUF with insulation properties twice as effective as any other insulation material helps in maximum heat retention.

High Rated Pressure: Racold Solare are built to withstand high operating pressure (4.5 bar equivalent to 45 mtrs water head).

Rust-proof outer body: The Acrylonitrile-Butadiene Styrene (ABS) material with Polyurethane (PU) painting makes the outer body weather proof, durable and corrosion resistant.

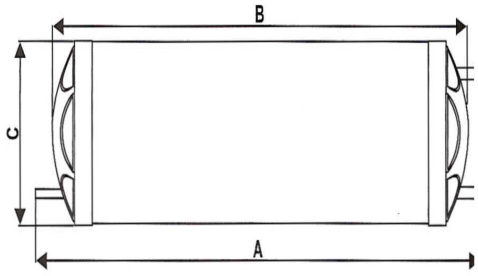
Annexure 2 – Technical specification

Technical Specifications	
Inner Container and Accessories for Solar Water Heater	
Type	Natural Thermosyphon
Capacity	100 L,125 L, 200 L, 250 L, 375 L, 500 L
Inner Container	SS-304L, with special treatment for long life
Insulation	Injected PUF Insulation 45mm thick
Outer Body	Plastic - ABS material with PU coating
Air Release Valve	Italian, 3-in-1
Mounting Stand	PU painted structural steel
Colour	Light grey cylinder with blue caps.

Technical Specifications	
Solar Flat-plate Collector	
Type of Absorber	Selective black chrome with Nickel undercoat
No. of Risers	9
Size of Collector	2091 x 1069 x 100mm
Glass	Toughened, 4mm thick
Frame Material	Extruded aluminium section (7.5 kgs.)
Back Sheet	Aluminium sheet 0.7mm thick with Stucco finish
Insulation	Glasswool and Rockwool
Dry Weight	60 kg

Specifications mentioned above are subject to change without prior notice

Product Dimensions						
Model	100L	125L	200L	250L	375L	500L
"A"	1030	1219	1812	2167	1502	1922
"B"	948	1138	1728	2084	1489	1909
"C"	512	512	512	512	730.5	730.5



Solar Energy for Industrial Process Heat Applications

up to 350°C in Economically Viable Manner using **ARUN**™
for the **FIRST TIME** in **INDIA** by **CLIQUE** and **IIT-Bombay**

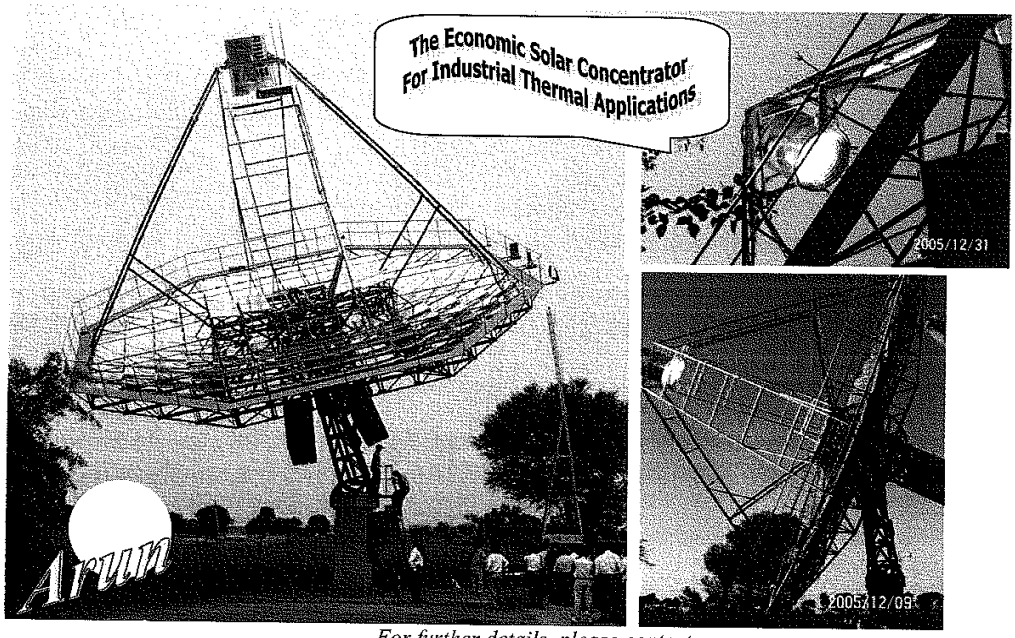
Clique Developments Private Limited, Mumbai with **IIT-Bombay** has developed **ARUN - Solar Thermal Concentrator** that has opened up the possibilities of saving significant proportion of liquid or gaseous fossil fuels or electricity used in **Industrial Process Heat (IPH) Applications** economically.

First time in INDIA: Solar Concentrator System for Industrial Process Heat with
Largest aperture area and highest annual heat generation capacity
Highest operating temperatures and highest stagnation temperatures
Lowest cost to energy output ratio for IPH systems at 150°C or higher
Capacity of day-long energy storage and integration with a wide range of applications

- Nine units of 169 m^2 of **ARUN™** are installed by **Clique Developments Ltd., Mumbai** in the sectors of hospitality, dairy, chemical processing and auto manufacturing for delivering dry saturated steam up to 8 bar(g) (IBR approved system) or pressurized hot water. Before this, 160 m^2 unit of **ARUN™** was designed and installed by **Clique Developments Ltd.** for pasteurisation of milk at **Mahanand Dairy, Latur**. As a result, the dairy does not need to fire the boiler on sunny days.
- The technology is evaluated by IIT-Bombay and performance is continuously monitored since January, 06. It was also tested earlier by 'Regional Test and Technical Back-up Centre' of Ministry of New and Renewable Energy (MNRE) at School of Energy Studies, University of Pune in May, 03.

How to use ARUN™

- For variety of industrial process heat applications at 80 to 350°C in **ON-LINE** or **ADD-ON** mode with the existing boiler or heater for heat supply at any time of the day or night saving fossil fuels or electrical energy whenever the Sun shines. It needs only cleaning of reflectors and no fuel at all !
- **Many ARUN™ dishes** can be installed to increase the heating power capacity.



For further details, please contact

Clique Developments Limited
134-A/B, Government Industrial Estate, Charkop, Kandivali (West), Mumbai 400067, INDIA. Phone: (22) 2860 9011
e-mail: arunsolar@gmail.com website : www.clique.in

Salient features of ARUN™

- Fresnel Paraboloid Solar Concentrating Reflector with specially designed insulated receiver having minimum thermal losses at the point focus and two-axes tracking of the Sun for maximum heat output
- Specially protected glass reflectors for very long trouble-free life without significant loss of reflectivity
- Water, steam, thermic fluid or oils as working fluid, integrable with various industrial thermal processes in on-line or add-on mode, provision of storage system for heat delivery any time of the day or night
- Built-in safety controls with emergency alarm system and user-friendly console
- Completely automatic operation requiring minimum operator intervention and maintenance
- Strict quality controls and performance tested as per the testing procedures developed at IIT-Bombay
- Latest technology with IBR approved steam delivery system that is much more productive based on energy delivery at all temperatures compared to ETC or concentrators like Scheffler cooker, CLFR or parabolic trough
- Field experience of operating 10 dishes
- 100% indigenous technology developed and patented by Clique, an exclusive Engineering Consultancy Group

Technical specifications and performance parameters of ARUN™

Fluids used	Water, steam or thermic fluid
Delivery temperature range	Up to 350°C
Operating wind speed	Up to 10 m/s (36 kmph)
Survival wind speed	Up to 47 m/s (169 kmph)
System life	25 to 30 years

Performance of ARUN™ solar concentrator system	Single dish	A pair of dishes
Aperture area	169 m^2	169 x 2 m^2
Heat delivery rate during day-time*	50 to 90 kW_{th}	100 to 180 kW_{th}
Daily energy delivered for 275 to 300 days per year*	600 to 700 Mcal	1.2 to 1.4 million kcal
Annual operating hours*	2700 to 3000 h/yr	2700 to 3000 h/yr
Annual fuel savings (Furnace Oil or Diesel)*	15 to 20 kL/yr	30 to 40 kL/yr
Aerial unshaded clear space required	18 x 18 x 16 m ht	2 x 25 x 20 x 16 m ht
Foot-print / clear area required on ground / roof	1 x 1 m	2 x 1 x 1 m
Underground Foundation Area if on installed on ground	4 x 4 m	2 x 4 x 4 m
Tracking and control energy	2 kWh/day	4 kWh/day

**The actual performance of the dish depends on solar radiation available and other site conditions*

Where to use ARUN™ for process heat applications up to 350°C

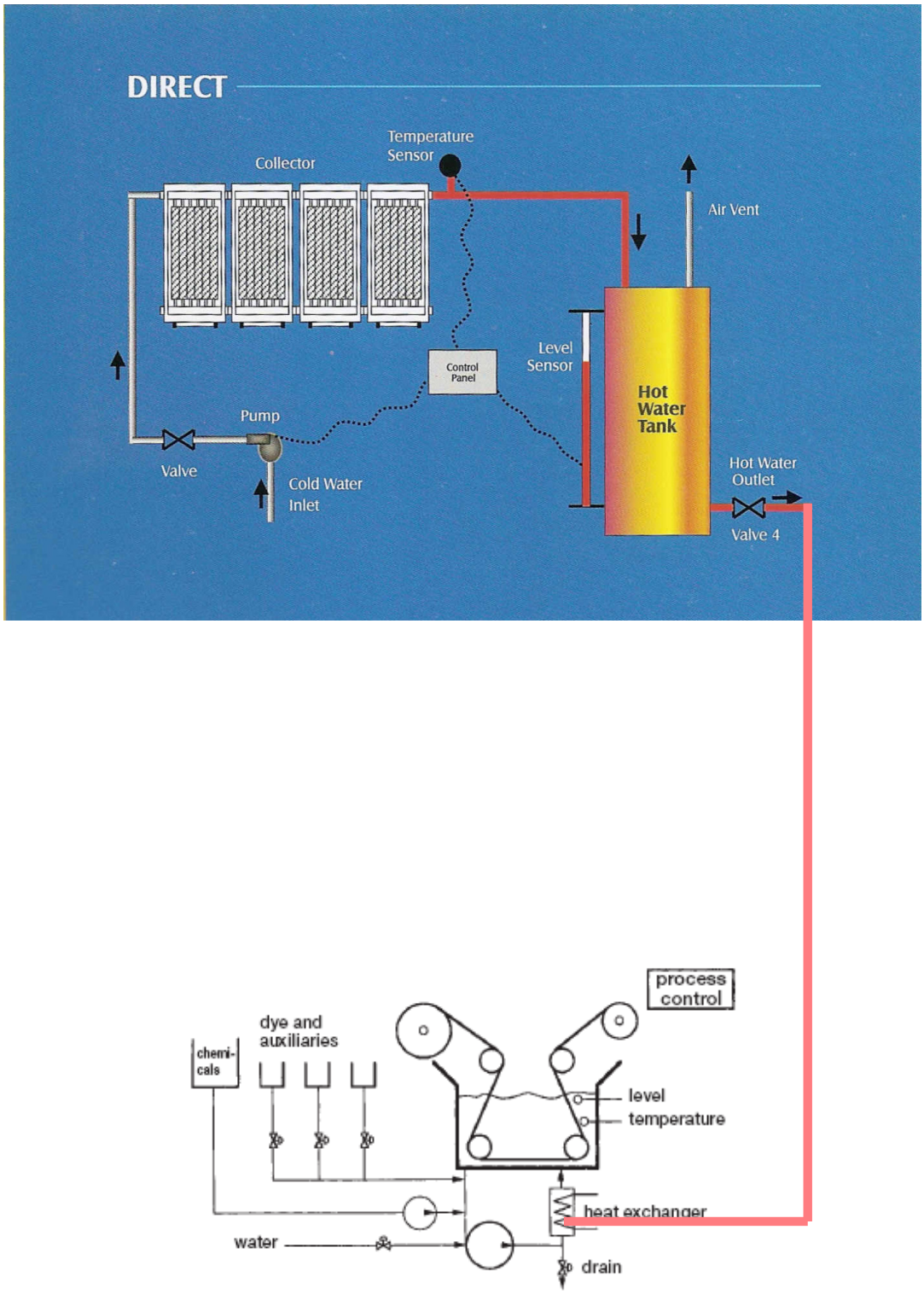
- In **milk processing**, for pasteurisation, cleaning and other thermal processes
- For cleaning and degreasing operations in **automobile industry**
- Heating and maintaining the baths for 7-tank or 9-tank **galvanizing** or **phosphating** processes
- For **thermic fluid heating** in different processing industries, heating of **Furnace Oil** or **LSHS**
- For **boiler** make-up water and feed-water heating as well as steam generation
- In **chemical processing** plants, galvanizing, colours and dyes industries, **pharmaceutical** industries, **textile industry** for cloth processing, **timber industry** for wood seasoning, for **drying** applications like chilli and fruits drying, drying of chemicals, core heating, paint drying, paper drying, drying of herbs
- In **vegetable oil mills** for solvent extraction and distillation, in **agro industries** for food processing, concentration of extracts, bio-mass dehydration, honey processing, herbal processing, in **sugar mills** for sap concentration, biomass dehydration
- In **service industries** like **hospitals, hotels, offices** for cooking, bathing, washing, sterilization
- For space cooling using **Vapour Absorption Refrigeration (VAR)** systems and **air conditioning** systems
- **Cold storage units** for perishable food, marine and horticultural products at remote places
- For **Solar Co-generation** generating power along with process heat, **clean Hydrogen** generation

Economics of ARUN™

- Saves costly fossil fuel for 25 to 30 years with negligible running cost
- Subsidy from MNRE and soft loans available as well as 80% accelerated depreciation
- Positive cash flow right from the first year of the project
- Competitive prices compared to other solar concentrators on energy delivered basis
- Reduces CO_2 emissions to the environment. The Carbon Credits (CERs) can be traded internationally

A WISE INITIATIVE TODAY, FOR ENERGY SECURED TOMORROW

Annexure -3: General arrangement drawing



Annexure -4: Detailed financial analysis

Assumption

Name of the Technology	**SOLAR WATER HEATER**		
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)	3.71	
Civil works, Erection and Commisioning	₹ (in lakh)	0.05	
Other cost	₹ (in lakh)	0.00	
Total Investment	₹ (in lakh)	3.76	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	0.94	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	2.82	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	1.00	Feasibility Study
Annual Escalation	%age	1.00	Feasibility Study
Estimation of Revenue			
Fuel saving(RPC)	Tons/year	10.97	
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	2.82	0.12	2.70	0.33
2	2.70	0.24	2.46	0.26
3	2.46	0.32	2.14	0.23
4	2.14	0.38	1.76	0.20
5	1.76	0.44	1.32	0.16
6	1.32	0.48	0.84	0.11
	0.84	0.56	0.28	0.06
	0.28	0.28	0.00	0.01
		2.82		

WDV Depreciation

₹ (in lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	3.76	0.75
Depreciation	3.01	0.60
WDV	0.75	0.15

Projected Profitability

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Fuel savings	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Total Revenue (A)	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Expenses										
O & M Expenses										
Total Expenses (B)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
PBDIT (A)-(B)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Interest	0.79	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
PBDT	0.33	0.26	0.23	0.20	0.16	0.11	0.06	0.01	-	-
Depreciation	0.46	0.53	0.55	0.58	0.63	0.67	0.72	0.77	0.78	0.78
PBT	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Income tax	0.26	0.33	0.35	0.39	0.43	0.47	0.52	0.57	0.58	0.58
Profit after tax (PAT)	-	-	0.19	0.20	0.21	0.23	0.25	0.26	0.27	0.27

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
rofit before tax	0.26	0.33	0.35	0.39	0.43	0.47	0.52	0.57	0.58	0.58
Add: Book depreciation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Less: WDV depreciation	3.01	0.60	-	-	-	-	-	-	-	-
Taxable profit	(2.55)	(0.08)	0.55	0.58	0.63	0.67	0.72	0.77	0.78	0.78
Income Tax	-	-	0.19	0.20	0.21	0.23	0.25	0.26	0.27	0.27

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Liabilities										
Share Capital (D)	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Reserves & Surplus (E)	0.26	0.59	0.75	0.94	1.15	1.40	1.68	1.99	2.31	2.62
Term Loans (F)	2.70	2.46	2.14	1.76	1.32	0.84	0.28	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	3.90	3.99	3.83	3.64	3.41	3.18	2.90	2.93	3.25	3.56

Assets	1	2	3	4	5	6	7	8	9	10
Gross Fixed Assets	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76
Less Accm. Depreciation	0.20	0.40	0.60	0.79	0.99	1.19	1.39	1.59	1.79	1.99
Net Fixed Assets	3.56	3.36	3.17	2.97	2.77	2.57	2.37	2.17	1.97	1.78
Cash & Bank Balance	0.34	0.62	0.67	0.67	0.64	0.61	0.53	0.76	1.27	1.79
TOTAL ASSETS	3.90	3.99	3.83	3.64	3.41	3.18	2.90	2.93	3.25	3.56
Net Worth	1.20	1.53	1.69	1.88	2.09	2.34	2.62	2.93	3.25	3.56
Debt Equity Ratio	2.87	2.62	2.28	1.87	1.41	0.89	0.30	0.00	0.00	0.00

Projected Cash Flow

₹ (in lakh)

Particulars / Years	0	1	2	3	4	5	6	7	8	9	10
Sources											
Share Capital	0.94	-	-	-	-	-	-	-	-	-	-
Term Loan	2.82										
Profit After tax		0.26	0.33	0.16	0.19	0.21	0.25	0.28	0.31	0.32	0.32
Depreciation		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total Sources	3.76	0.46	0.53	0.36	0.39	0.41	0.44	0.48	0.51	0.52	0.52
Application											
Capital Expenditure	3.76										
Repayment Of Loan	-	0.12	0.24	0.32	0.38	0.44	0.48	0.56	0.28	-	-
Total Application	3.76	0.12	0.24	0.32	0.38	0.44	0.48	0.56	0.28	-	-
Net Surplus	-	0.34	0.29	0.04	0.01	(0.03)	(0.04)	(0.08)	0.23	0.52	0.52
Add: Opening Balance	-	-	0.34	0.62	0.67	0.67	0.64	0.61	0.53	0.76	1.27
Closing Balance	-	0.34	0.62	0.67	0.67	0.64	0.61	0.53	0.76	1.27	1.79

IRR

₹ (in lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		0.26	0.33	0.16	0.19	0.21	0.25	0.28	0.31
Depreciation		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Interest on Term Loan		0.33	0.26	0.23	0.20	0.16	0.11	0.06	0.01
Cash outflow	(3.76)	-	-	-	-	-	-	-	-
Net Cash flow	(3.76)	0.79	0.78	0.60	0.59	0.57	0.55	0.54	0.52
IRR	10.35%								

NPV	0.05

Break Even Point

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Oper. & Maintenance Exp (75%)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Sub Total*(G)*	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Fixed Expenses										
Oper. & Maintenance Exp (25%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Interest on Term Loan	0.33	0.26	0.23	0.20	0.16	0.11	0.06	0.01	0.00	0.00
Depreciation *(H)*	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sub Total (I)	0.54	0.47	0.44	0.41	0.37	0.32	0.27	0.22	0.21	0.21
Sales (J)	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Contribution (K)	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Break Even Point (L= G/I)	67.41%	58.84%	55.73%	51.42%	46.20%	40.20%	33.88%	27.47%	26.36%	26.38%
Cash Break Even {(I)-(H)}	42.41%	33.83%	30.71%	26.39%	21.17%	15.15 %	8.83 %	2.40 %	1.29%	1.30%
Break Even Sales (J)*(L)	0.55	0.48	0.46	0.42	0.38	0.33	0.28	0.23	0.22	0.22

Return on Investment

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Net Profit Before Taxes	0.26	0.33	0.35	0.39	0.43	0.47	0.52	0.57	0.58	0.58	4.49
Net Worth	1.20	1.53	1.69	1.88	2.09	2.34	2.62	2.93	3.25	3.56	23.08
											29.71%

Debt Service Coverage Ratio

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow											
Profit after Tax	0.26	0.33	0.16	0.19	0.21	0.25	0.28	0.31	0.32	0.32	1.99
Depreciation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	1.59
Interest on Term Loan	0.33	0.26	0.23	0.20	0.16	0.11	0.06	0.01	0.00	0.00	1.36
Total (M)	0.79	0.78	0.60	0.59	0.57	0.55	0.54	0.52	0.52	0.52	4.93

DEBT

Interest on Term Loan	0.33	0.26	0.23	0.20	0.16	0.11	0.06	0.01	0.00	0.00	1.36
Repayment of Term Loan	0.12	0.24	0.32	0.38	0.44	0.48	0.56	0.28	0.00	0.00	2.82
Total (N)	0.45	0.50	0.55	0.58	0.60	0.59	0.62	0.29	0.00	0.00	4.18
	1.75	1.57	1.08	1.01	0.95	0.94	0.87	1.80	-	-	1.18
Average DSCR (M/N)	1.18										

Annexure -5: Details of procurement and implementation

Details of shutdown time needed –

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

Typically the shut down time needed to implement the project would be three days. The shutdown would involve mainly the monitoring of the system performance and its optimization for achieving the best performance parameters since the proposed system would be parallel to the existing system and no time is required in hooking up the existing system to the proposed system.

Annexure 6: Detailed equipment assessment report

Calculation of Energy Saving Potential

Solar water heater	
Average ambient temperature	35°C
Water heated	95°C
Quantity of water heated in a day	3000 litre
Total Heat generation avoided per day	180000 kCal/day
Total Heat generation avoided per year	=180000X350 = 63000000 kCal/year
Overall efficiency of boiler (Generation + Distribution)	70 %
Heat input to boiler for serving this load	=63000000/0.7 = 90000000 kCal/Yr
Pet Coke having CV	8200 kCal/kg
Equivalent quantity of Residual Pet Coke	= 90000000/8200 = 10976 kg RPC/Yr
Monetary Equivalent @ Rs. 7500/- per MT	= 10976X7500 = ₹ 82317/- per year
Investment for 3000 Ltr per day capacity solar Water Heater	₹. 4.5 Lakh
Simple Pay Back Period	5.46 years

Annexure -7: Details of equipment service providers

S.No.	*Technology*	*Name of Service Provider*	*Address*	*Contact Person and No.*
1.	Installation of Solar Water HEater	Aksons Solar		Mr. Nitin Sharma
2	Installation of Solar Water HEater	Solar Maxx	ILLUSIONS4REAL - Energy Saving Solutions Web: www.illusions4real.com Telefax: +91 141 220 3535 Mobile: +91 98280 12991 D-104/2 Meera Marg, Bani Park Jaipur 302016, Rajasthan, INDIA	Amit Karnawat
3	Installation of Solar Water HEater	M/s Photon Energy Systems Ltd.	Bhuvan Technique 21 Bhrigu Nagar, Ajmer Road, Jaipur-302021 Telefax: +91 141 2247275 Mob: +91 9460514655 / 9460061897 / 9414056392	

Annexure – 8 Quotation for Proposed Technology

BHUVAN
TECHNIQUE

21 Bhrigu Nagar, Ajmer Road,

Near Gehlot Bunglow, JAIPUR-302019

Telephone: 91 141 2247275 Rajasthan Dealers: **Photon Energy Systems Ltd**

Email: bhuvantech@gmail.com Agents: **SVS Wind Driven Turbo Ventilators**

Solution providers: **Low Energy Lighting(LED also)**

BT-PHOTON/PCRA-Offer 11th Nov 2010

Joint Director,

PCRA, Jaipur

Sub: Evacuated Tube Solar Water Heating Systems

Ref: PHOTON Energy Systems Ltd, Hyderabad

Dear Sir,

This has reference to your requirement for **1000 LPD** Solar Water Heating System. We are pleased to submit our best offer as under:

Sr No	Description/Model	Type	Unit Price in rupees	Qty	Amount
1	**PHOTON Super 1000 LPD** - MIRACLE Inner tank SS304 Tank Outer Tank GI coated Painted **No of Tubes 70 nos**	Evacuated Tube	1,45,500.00	1nos	1,45,500.00
2	**PHOTON Super 500 LPD - MIRACLE** Inner tank SS304 Tank Outer Tank GI coated Painted **No of Tubes 70 nos**	Evacuated Tube	75,500.00	2nos	1,51,000.00

All Tanks are Puff Insulated (preinsulated from factory)

All tubes are 1500 mm in length.

As against routine 60 nos tubes, we have offered 70 tube manifolds for better performance.

Terms & Conditions:-

Price: The Above prices are ex our office

VAT: Extra as applicable at the time of supply – presently Nil.

Payment Terms: 40 % advance at the time of placement of order, 60% on supply of material.

Allied Work: Wherever required Sanitary, Electrical & Civil work will have to be done by you at your cost.

System Installation charge: INCLUDED

Line Insulation & Line extension etc: Extra.

Delivery: System will be delivered with three to four weeks from the date of receipt of your confirmed order along with necessary advance.

Validity: 15 days from the date of the offer.

Thanking you,

Yours faithfully,

For BHUVAN TECHNIQUE

ILLUSIONS4REAL, D-104/2 MEERA MARG, BANI PARK, JAIPUR - 16, RAJASTHAN 0141 220 35 35

!LLUSIONS4REAL

Quotation

To: PCRA, Pali — Date 13.11.2010

Particulars	Quantity	Price
SolarMaxx Solar Water Heating non-pressurized 1000 litres (Parallel connected units: 3x330 litres) - Machine Injected PUF insulated tanks (hot water storage tanks) with foodgrade SS Inner tanks mounted on the top of each unit - Borosilicate Vacuum tubes collectors to minimise scaling - Aluminium reflectors to increase efficiency - Assistant tanks mounted on the top of Hot Water Storage Tanks to ensure adequate water pressure inside each unit - Galvanised Steel stand & frame with anti-corrosion coating to ensure strength & longevity - ZERO use of harmful chemicals, coolants or heat tranfering fluids - Foodgrade SS used in entire inner tank including inner piping - In-built electric power backup in each unit to ensure hot water during over-cast conditions	1	Rs. 1,45,000.00
Summary		Rs. 1,45,000.00
Discount	10%	Rs. 14,500.00
Total		Rs. 1,30,500.00

TIN # 08711765465

Price above valid for one month
All payments in advance in favour of m/s illusions4real
Invoice does not include freight that shall be paid at actuals by the buyer.
Invoice does not include installation & extra material costs, if any, and shall be paid at actuals by buyer.
2 years functional waranty on all features except power back-up element. 1 year waranty on power back-up element.
No waranty on breakage.
Jurisdiction is subject to Jaipur district only.

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

Petroleum conservation Research Association

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

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

Website: www.techsmall.com