DETAILED PROJECT REPORT
ON
HYBRID SOLAR TRAY DRYER – 200 TRAYS

(AHMEDABAD CHEMICAL CLUSTER)











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HYBRID SOLAR TRAY DRYER – 200 TYAYS

AHMEDABAD CHEMICAL CLUSTER

BEE, 2010

Detailed Project Report on Hybrid Solar Tray Dryer (200 Trays)

Chemical SME Cluster, Ahmedabad, Gujarat (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No. ***AMD/CHM/HSD/12***

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Winrock International India

New Delhi

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List of Abbreviations

MT	Metric Tonne
kWh	kilo Watt Hour
GoI	Government Of India
MoMSME	Ministry of Micro Small and Medium Enterprises
GHG	Green House Gas
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
O&M	Operational & Maintenance
NPV	Net Present Values
ROI	Return on Investment
IRR	Internal Rate Of Return
DSCR	Debt Service Coverage Ratio
PBT	Profit Before Tax
PAT	Profit After Tax
ID	Induced Draft
FD	Forced Draft
HAG	Hot Air Generator
DBT	Dry Bulb Temperature
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Winrock International India is executing BEE-SME program in Ahmedabad chemical Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Ahmedabad chemical cluster is one of the largest chemical clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures / technologies, so as to facilitate maximum replication in other chemical clusters in India.

The main energy forms used in the cluster units are wood. Wood is used as fuel in hot air generator for drying process. The cost incurred in the drying process constitutes major portion in the overall energy cost in majority of chemical industries in Ahmedabad cluster.

Function of tray dryer in chemical industries is to remove moisture from the final product. Hot air from the HAG is forced into the tray dryer chamber by propeller fans, the hot air carries the moisture along and moves away through the chimney. Drying is one of the major energy and time consuming process in the overall manufacturing process of chemicals.

Proposed solar tray dryer system is used as a hybrid system. The sunlight required for the operation of solar tray dryer will not be available over the entire batch. At start, process will work on solar tray dryers assuming 7 – 10 hours of average sunlight in a day, and in the absence of sunlight the process has to be changed over to energy efficient hot air generator mode.

This DPR highlights the details of the study conducted for assessing the potential for replacement of conventional tray dryers by solar tray dryers , 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

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S. No	Particular	Unit	Value
1	Project cost	₹(in Lakh)	13.46
2	Wood saving	tonnes/year	226.10
3	Monetary benefit	₹(in Lakh)	6.04
4	Debit equity ratio	Ratio	3:1
5	Simple payback period	years	2.22
6	NPV	₹(in Lakh)	8.53
7	IRR	% age	27.62
8	ROI	% age	25.72
9	DSCR	Ratio	1.83
10	Process down time	Days	7
11	CO_2 reduction	Tons/year	206

The projected profitability and cash flow statements indicate that the proposed project implementation i.e. solar tray dryers with existing tray dryers 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. Ahmedabad chemical 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 INTRODUCTION

1.1 Brief introduction about Cluster

Ahmedabad city and its surrounding areas have various types of chemical SME units like dyes, dye Intermediates and pigments manufacturing units. All these chemical manufacturing units are located at Vatva, Naroda and Odhav industrial areas. There are about 500 chemical units in Vatva, 60 units in Naroda and 40 units in Odhav. Most of manufacturing units in these areas are in operation from last 10 to 15 years.

Ahmedabad chemical cluster like many other SME clusters, were in a dire state in regard to the energy efficiency and conservation. In almost all units, whether big or small, there had been no conscious efforts to take up energy conservation and energy efficiency measures as a part of day to day operations. In majority of cases, the small scale entrepreneur are not even aware of the measures that could bring down the energy cost, which will automatically have positive bearing on the overall manufacturing cost. Some of the bigger units had experimented with few parameters to improve the energy efficiency in the units, but the results and outcome were confined to them only. All the units in cluster have been operating in traditional conditions and most of the equipments in cluster were procured from the local suppliers, who are fabricating / manufacturing the equipments on basis of their age old expertise / technology.

These units are using various types of raw material such as Sulphuric acid, Hydrochloric acid, Acetylic acid, Chlorine gas, Benzene, Sodium nitrate, Ethylene, Ammonia, Disulphonic-acid, Copper, Chlorine, Ammonia and Potassium sulphate etc, The nature of raw material depends on their final product manufactured in the unit. All these raw materials are being procured from local suppliers/traders or bought from neighboring states. There are various types of chemical products manufacturing in cluster, few of them are DASDA, Alpha & Beta Pigment, Reactive dyes, Acid dyes, and direct dyes. In fact majority of the chemical units in these clusters manufacture two or three different types of chemical related products as per the market requirements.

1.1.1 Existing production process

The main production process used in chemical industry which is followed in the entire cluster with minor changes according to the requirement is shown in Figure 1.1 below:

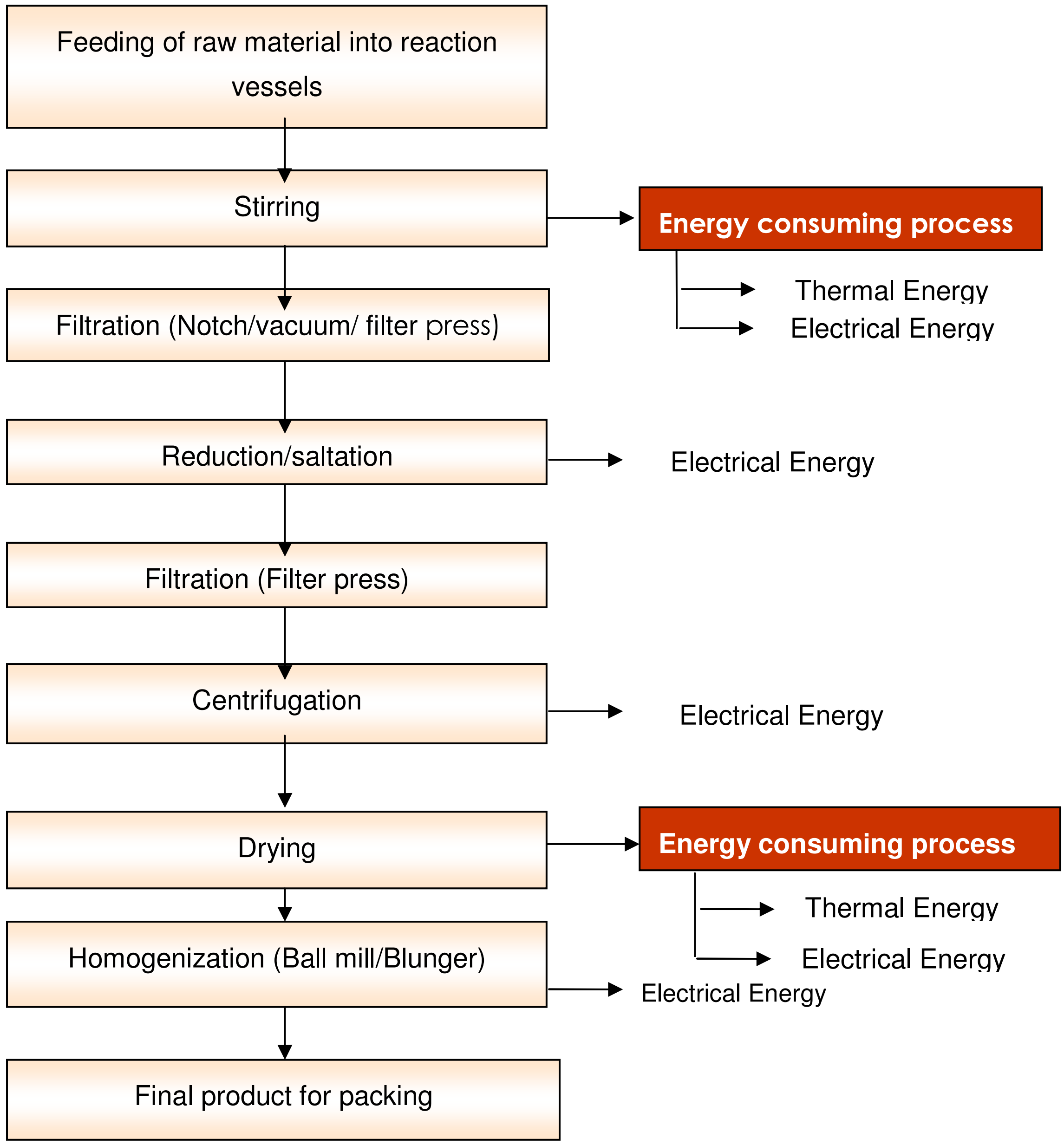

Figure 1.1: Process flow chart

The production process as depicted in the above chart is typical to almost all the chemical units in the Ahmedabad chemical cluster. However, depending on the final product, quality of final product and the attributes of the raw material, the above stated process flow is altered to suit the requirement of the unit.

1.2 Energy Performance in Ahmedabad chemical cluster

Majority of the industries located in Ahmedabad are engaged in manufacturing of different types of chemicals. Different chemical units in the Ahmedabad chemical cluster is using the different types of energy sources including electricity and fuels such as wood, natural gas, biomass & coal depending on technology, process requirement, availability, economic and safety point of view. There are two forms of energy used in manufacturing of chemicals in typical chemical units in Ahmedabad cluster; electrical and thermal energy. Electrical energy is being used in operation of equipment & other electrical utilities and thermal energy is being used in process and drying applications. Energy cost is representing around 10-15 percent of manufacturing cost in a typical manufacturing unit, out of which thermal energy costs around 60 percent of the total energy cost and remaining accounts for electrical energy. In majority of the units in the Ahmedabad chemical cluster wood is used for thermal energy generation due to its easy availability at economical cost.

Annual energy consumption and average production of a typical chemical manufacturing unit are given in Table 1.1 below:

Table 1.1 Annual Energy consumption and production

S.No	Particular	Unit	Value
1	Electricity consumption	kWh	130000
2	Wood consumption	MT	350
3	Production	MT	110

1.2.1 Specific energy consumption

Specific electrical and thermal energy consumption in chemical unit is varying on the final product manufactured in that unit. Specific electrical and thermal energy consumption in a typical chemical is shown in Table 1.2 below:

Table 1.2 Specific energy consumption of a typical unit

S.No.	Particular	Unit	Value
1	Electricity	kWh/kg of product	1.2
2	Fuel	Kg of wood/kg of product	3.0

1.3 Identification of existing technology/ equipment

1.3.1 Description of equipment

During Energy use and technology audit studies in various chemical industries in Ahmedabad Chemical cluster, it was observed that most of the Chemical units are using inefficient tray dryers for drying the final product and it is found that the efficiencies of the existing tray dryer is low. Performances of various tray dryers in Ahmedabad Chemical units are evaluated and analyzed the quantum of various losses in tray dryer systems were analyzed.

Figure1.2 Tray dryers operations at a chemical industry

From energy use and technology gap audit studies in various chemical units of Ahmedabad chemical cluster, the following were observed/ identified:

- Energy efficiency improvement opportunities
- Environment and safety improvement of workers
- Design flaws in the conventional tray dryers
- Operational & maintenance practices in conventional tray dryers

1.3.2 Technical gap in conventional tray dryer

Technology gaps/design flaws in conventional tray dryers system are identified and described below in detail:

- ***Location of Inlet and Exhaust Locations in Tray Dryers:***

Location of hot air inlet and exhaust air outlet in tray dryers will affects the heat transfer between wet cake and hot air. Selection of hot air inlet and exhaust air outlet should be such that the hot air should complete one full cycle in tray dryer for effective utilization of hot air.

- ***Partition Between Fans in Tray Dryers:***

In conventional tray dryer system there is no partition between two fans. If the speeds of the two fans are different, there is a possibility that air velocity of two fans can oppose each other this will reduce the effective air handling capacity of tray dryer. Sometimes this is reducing the 5-10% effective air flow in tray dryer.

- ***Insulation of Tray Dryer:***

From technology studies it was observed that in conventional tray dryer system there is no insulation on tray dryers. It is recommended to use ceramic wool as insulating material, to reduce the radiation heat losses in tray dryer system were observed as 3-5%.

- ***Volume of Air in Between Two Trays:***

From technology studies it was observed that air velocity between two trays is less, it will lead to poor heat transfer efficiency and increased drying time. Due to different quantity of air between different trays in tray dryer affect the quality of product.

- ***Spacing Between Trays in Tray Dryers:***

Due to non uniform spacing between the trays, quality of final product being affected and drying time is increased.

- ***Air Circulation Fans:***

Conventional tray dryer systems being used as propeller fans for air circulation in tray dryer, which have poor efficiency, compared to axial flow fans. Propeller fans have 20% lower efficiency than axial flow fans.

- ***Gaps Between Bottom & Top Portions of Trays With Respect to Tray Dryer:***

This causes less resistance to air flow in tray dryer compared to resistance in between trays, it automatically reduces the heat transfer efficiency between hot air and wet cake.

1.3.3 Specification of existing system

Detailed technical specification of existing system is presented in Table 1.3 below:

Table 1.3 Specification of existing tray dryers

S. No.	Details	Units	Value
1	Number of trays	Nos.	200
2	Tray dimensions	in	32” X 16” X 1.25”
3	Overall dimensions	mm	3950 X 1950 X 2100
4	Number of fans	Nos.	4
5	Number of doors	Nos.	2
6	Number of racks and placement of racks	Nos.	4
7	Rating of motor fans	HP	1
8	Motor Speed	RPM	1440
9	Type of draught system	--	forced
10	Power supply	--	AC,3phase, 415V, 50Hz, 4wire
11	Type of drying	--	Air heater dryer
12	Type of insulation of doors	--	Mineral wool
13	Thickness of insulation	mm	50
14	Type of insulation of cabinet	--	Mineral wool
15	Thickness of insulation	mm	65

1.3.4 Role in the process

Function of tray dryer in chemical industries is to remove moisture from the final product. Hot air from the HAG is forced into the tray dryer chamber by propeller fans, the hot air carries the moisture along and moves away through the chimney. Drying is one of the major energy and time consuming process in the overall manufacturing process of chemicals. Apart from the energy and time, final product quality will depend on quality of drying

1.3.5 Need for up gradation of existing equipment

From the above sections it is clear that drying cost is one of the major costs in the overall production process of chemicals, in typical chemical industry which comes out to be ₹ 3/kg, this is approximately 30% of overall energy cost. Apart from the energy cost, drying time is one of the major time consuming area in overall production process of chemicals, in typical chemical industry this would be around 48 -52 hours.

The existing installed conventional tray dryer takes 48 hours for processing one batch. There are lot of design flaws in the existing system those are; uneven spacing between the trays, poor efficiency of propeller fans, no partition between the fans and lots of air leakages in the system. All these things lead to increase in drying time, this will lead to increase in energy consumption in tray dryer.

Advantages of replacing the conventional tray dryer with solar tray dryer are:

- Complete elimination of HAG and hence Reduction in wood consumption
- Improved productivity
- Improved working environment
- Faster drying, it leads to energy savings
- Improves the efficiency of the unit
- Reduction of deforestation and GHGs emissions

1.4 Baseline energy consumption of existing equipment

Energy consumption in tray dryer would depend on below mentioned things:

- Moisture content in the product.
- Volume of air / fan capacity.
- Design of the tray dryer
- Operational & maintenance practices
- Contents of wood

Energy use and technology audit studies were conducted in various units of Ahmedabad chemical cluster to establish the baseline energy consumption of tray dryer and the reports of same are attached in Annexure 1.

1.4.1 Design and operating parameters

Major operating parameters to improve tray dryers performance are:

- Number of plates
- Gap between the plates
- Insulation system
- Reducing the resistance in draught system

Moisture content in inlet feed materials is 0.43 kg of moisture per kg of bone product. Average drying time for tray dryer in typical chemical industry in Ahmedabad chemical cluster is varying from 48 to 52 hrs. Further, complete design and operating parameters are presented at Annexure 1.

1.4.2 Specific fuel consumption in existing system

Based upon energy audit carried out in various units of the cluster, it were found that efficiency of existing tray dryers is very low about 5.9% and with this efficiency average wood consumption in 200 trays for drying one batch is 1728 kg.

1.4.3 Energy audit methodology

Following methodology was used for assessing the performance of existing tray dryers which is depicted below:

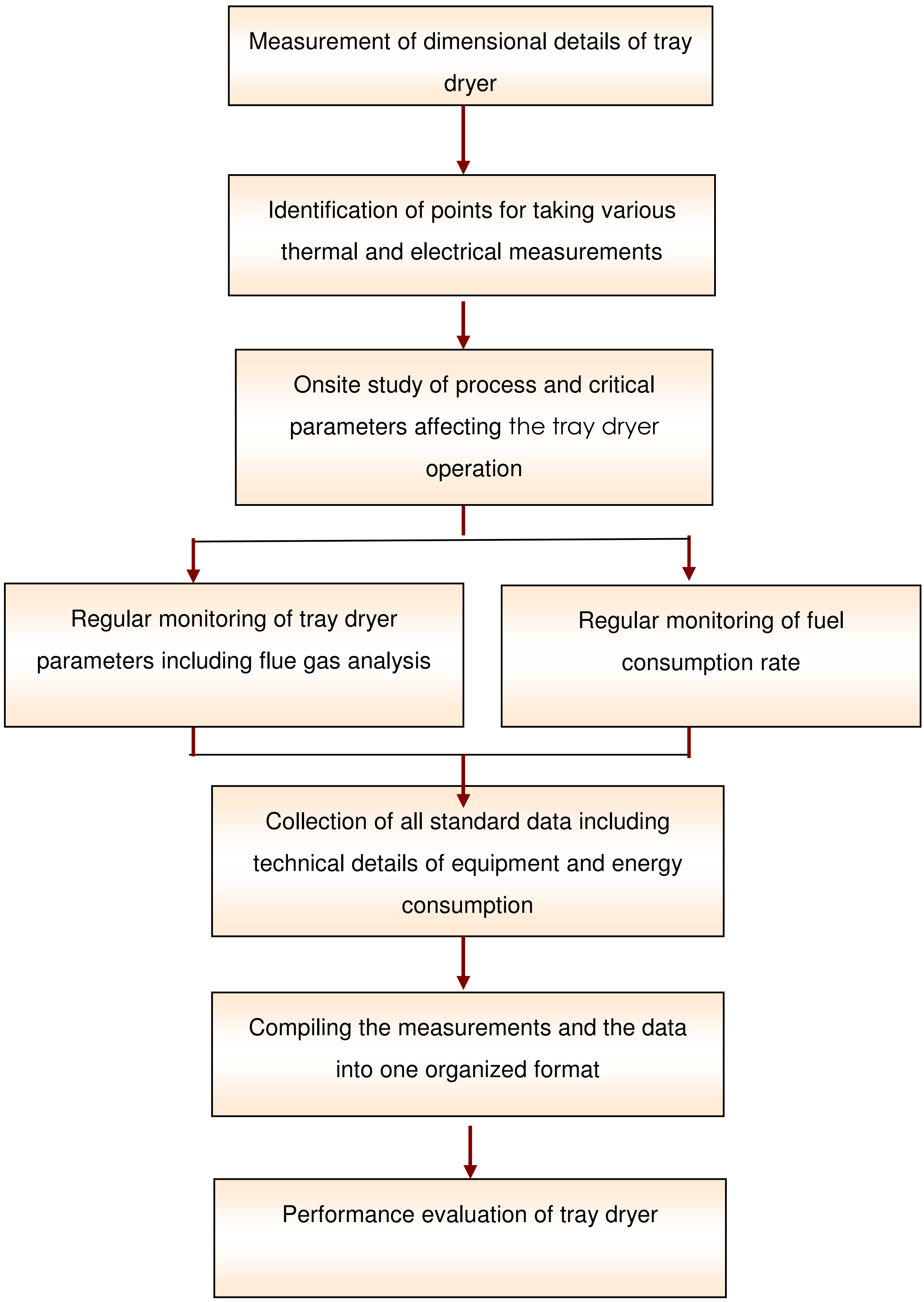

Figure1.3: Energy audit methodology

1.5 Barriers in adoption of proposed technology/equipment

The processes to do with technology and innovations in SMEs are different from those that take place in the context of the large firm. Technology in the SME sector has an increasingly complex or combinative characters as most of the SMEs units of the cluster are regarded for their labour intensive nature and the capability to work with local resources. In the past, SME entrepreneurs have laid more stress on technology to reduce the initial cost of plant & machineries. Major barriers in up-gradation of technology in the cluster are non availability of appropriate technology; distrust on technology supplier, lack of information/ awareness about the energy efficient technologies / equipments / processes among SMEs, which prevents them from adopting the same. Further non availability of skilled manpower and exorbitant cost of new technologies are perceived as barriers. Details of the other barriers in the implementation of energy efficient technologies/equipments in the Ahmedabad chemical cluster are given in the sections below:

1.5.1 Technological Barrier

Majority of the Chemical units entrepreneurs in Ahmedabad chemical cluster do not have any in-depth technical expertise and knowledge on energy efficiency, and are dependent on local technology suppliers or service companies, which normally also rely on established and commonly used technology. The lack of technical know-how made it also impossible for the chemical unit owners to identify the most effective technical measures.

One of the main barriers that prevented implementation of energy efficiency measures/technology up gradation projects in the Ahmedabad Chemical cluster are lack of awareness and information on the energy efficiency & energy efficient technologies. Most of chemical units in Ahmedabad chemical cluster have been established several years ago when energy efficiency was not important issue for the operation of a plant and therefore operating with outdated technology and low end technologies. Since around 15-20 years same technologies in various processes/utilities are continuing in most of the chemical industries in Ahmedabad Chemical cluster.

Core business of the SME owners is focused on uninterrupted production of the plant by conducting necessary repair work at lowest costs, than on investing in new technology. From the point of view of the operators the direct effect on income from a constant or increased production is much more important for the economic viability of the plant, than benefits in form of future savings due to efficiency measures. Maintaining the equipment requires additional efforts, organizational capacity and technical know-how not related to the core business, all together resulting in additional costs. Therefore, even if they were aware of the benefits many chemical unit owners are shied away from such measures or investments. This short term view is strongly influenced by uncertainties described under the barrier of limited financial resources. Investments in replacing single still operational equipment are therefore seen as a rather unnecessary expenditure, and short-term planning has higher priority than sustainable long-term issues.

As the majority of the Entrepreneurs in cluster are not aware of the energy losses in the plant, there may be a strong feeling that the energy efficiency initiatives in manufacturing facility can have a cascading or domino effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced / retrofitted equipment falls below design values.

There is a strong feeling in the owners, that energy efficiency initiatives is a challenge to take the risk of such as business interruption due to production loss against the drive to save energy. These are however can be overcome by motivating them to attend the awareness programs and detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

1.5.2 Financial Barrier

Significant amount of investment is not commonly seen in SME industry sectors in India. Further, from the business perspective for any industry owner, it is more viable, assured and convenient to invest on project expansion for improving the production capacity or quality, rather than make piecemeal investment in retrofit and replace options for energy savings. Investment returns on large capacity addition or technology adoption shows up prominently in terms of savings and helps in benchmarking operations. Further, there is a strong feeling among the industry owners that, energy conservation-initiatives of replacement and retrofit nature is not a common practice as it involves large capital investment against low returns. In view of this and given the limited financial strength of the chemical units it is clear that the industry owners would not have taken up the risks and invest in energy efficiency measures.

1.5.3 Skilled manpower

The non-availability of the skilled manpower in the area of energy efficiency and conservation is one of the major barriers in the Ahmedabad chemical cluster. Though, the skilled manpower is available in the cluster, they are not aware of the energy conservation and efficiency and its importance, their prime responsibility is to ensure zero down time and uninterrupted production as per the targets set by the management.

2 IMPLEMENTATION OF PROPOSED TECHNOLOGY

2.1 Description of proposed equipment

Proposed solar tray dryer system is used as a hybrid system. The sunlight required for the operation of solar tray dryer will not be available over the entire batch. At start, process will work on solar tray dryers assuming 7 – 10 hours of average sunlight in a day, and in the absence of sunlight the process has to be changed over to energy efficient hot air generator mode. The changeover of solar mode to Energy efficient hot air generator mode is an automatic process, controlled and monitored by digital controllers. These controllers will not only guide the changeover of the process but will also monitor the process parameters to retain the properties of the product.

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Proposed energy efficient solar tray dryer operates on the force draught system, the uniform air circulation within the dryers is carried out by four nos. of high efficiency multi blade type fans driven by 1HP TEFC electric motor. Air inlet and outlet dampers are provided on the top roof of the cabinet. Solar energy is used to heat the air by installing a solar heating panel. Hot air is then drawn into the dryer unit. The cabinet is double walled with 50 mm thick mineral wool in between as insulation. The trolley is fitted with 2 nos. of castor wheel and 2 nos. fixed wheel for the easy movement. A digital control panel for accurate temperature control is provided

2.1.1 Comparison of conventional tray dryers with solar tray dryers

Technical, economic, Environmental, safety aspects of conventional tray dryers and solar tray dryers are compared on life cycle of equipment, same is presented in Table 2.1 below:

Table 2.1 Comparison of conventional and proposed tray dryers

S. No	Details	Conventional Tray Dryer	Solar Tray Dryer
1	Drying time	More	Less
2	Load on HAG	More	Less
3	Environment pollution	High (*partial combustion & more fuel consumption*)	Less
4	Safety of workers	Poor	Good
5	Maintenance	High	Low
6	Operational cost	High	Low
7	Heat losses	High	Low
8	Draught system	Forced	Forced
9	System insulation	Not insulated	Insulated
10	Temperature monitoring & control	No	Yes
11	Radiation losses	More	Less
12	Heat transfer between hot gasses and wet cake	Less; Heat transfer efficiency is less due to non uniform spacing b/w the trays	More (Three path flue gas); heat transfer efficiency is more

From the above table it is clear that solar tray dryer has significant advantages in Energy, Environmental, Economic & safety aspects. It is justifiable to install solar tray dryer in place of conventional tray dryer.

2.1.2 Equipment specification

Complete information about the new equipment along with specification is placed at Annexure 7.

2.1.3 Suitability over existing system

The proposed equipment is completely replaced the existing system and suitable with the existing process.

2.1.4 Superiority over existing system

The new system has digital control panel and better insulation system and use solar energy as a heat source than existing system and hence would yield better result in productivity.

2.1.5 Technical specifications

Design specifications of proposed energy efficient solar tray dryers are presented in Table 2.2 below:

Table 2.2 Technical specifications

S.No	Details	Units	Value
1	Name of equipment	NA	Energy efficient Solar tray dryers
2	Model	NA	AHD-192
3	Heat input to dryer	kCal/hr	30,000
4	No. of trays	No.	200
5	No. of fans	No.	4
6	Motor ratings of fans	H.P	1
7	No. of doors	No.	2
8	No. of racks	NA	4
9	Size of trays	inches	32" X 16" X 1.25"
10	Overall dimensions	mm	3950 X 1950 X 2100
11	Electric supply	NA	AC 3 phase, 415V, 50 Hz, 4wiT
12	Type of dryer	NA	Solar heater dryer

Scope of supply under the model of AHD 192 solar tray dryers is placed at Annexure 7.

2.1.6 Availability of proposed equipment

The technology identified for implementation is available locally and are indigenously produced. The technology/ equipments will be procured from local equipment suppliers. The proposed equipment is locally manufactured by well known vendor of the Ahmedabad chemical cluster.

The technology identified is available in the state of Gujarat (Ahmedabad) and implemented successfully in few units in cluster. The investment required for implementation of the identified measures has good financial returns hence the proposed measure is technically and financially viable.

2.1.7 Equipment providers

Technology/service provider selected for implementation of the proposed energy efficiency project is having about 40 years of experience in implementation of energy efficiency projects. This technology/service provider is having in house R&D team to develop the new products, which are energy & eco friendly. Recommended supplier has the trust in cluster on products developed by them. Details of equipment suppliers are furnished in Annexure 6.

2.1.8 Terms and conditions in sales of Energy efficient Hybrid Solar Tray Dryers

The technology/service provider will provide performance guarantee for the products supplied and warranty for a period of one year for any manufacturing defects. The terms of sales from the proposed supplier is given at Annexure 7.

2.2 Process down time during implementation

The process down time for the replacement of conventional tray dryer with energy efficient Hybrid Solar Tray Dryer will take one week. The implementation can be taken up during weekly holiday, or other holidays, so that the process down time can be reduced.

2.3 Suitable unit for proposed equipment

From our observations on energy use and technology audit studies it was analyzed that proposed energy efficient Hybrid Solar Tray Dryer is suitable for industries having the tray dryer capacity of 200 trays.

3 ECONOMIC BENEFITS OF ENERGY EFFICIENT HYBRID SOLAR TRAY DRYERS

Energy use and technology audit studies were conducted in various units in the Ahmedabad Chemical cluster, and evaluated performance of existing tray dryer, technical gaps in existing tray dryer and analyzed energy, economic, environmental and social advantages of energy efficient Hybrid Solar Tray Dryer over conventional tray dryer and same are presented in below sections.

3.1 Energy & monetary benefits

3.1.1 Fuel Saving

From Energy use and technology audit studies it was observed that drying operation in tray dryer depends on the number of trays, moisture content in the product and temperature of hot air entering the tray dryer system. The changeover of technology from conventional tray dryer to hybrid system will eliminate the usage of wood consumption. Total wood saving for processing one batch would be 1370.27 kg. For total production of 165 batches per annum it works out to be 226.10 tons per annum.

3.1.2 Electrciity saving

Project implementation will not save electricity while its implementation will increase electricity consumption of about 14770.80 kWh per year.

3.1.2 Monetary benefit

Annual monetary savings of implementation of energy efficient Hybrid Solar Tray Dryers in place of conventional tray dryers is thus ₹ 6.04 lakh per annum. Details of monetary saving calculation are furnished at Annexure 3.

3.2 Environmental benefits

3.2.1 Reduction of deforestation

Most of units of the cluster are using the non renewable wood for hot air generation; by installing the proposed energy efficient Hybrid Solar Tray Dryers in place of conventional tray dryers will eliminate consumption of non renewable wood, which will automatically reduce the deforestation.

3.2.2 GHG emission reductions

Energy consumption of proposed energy efficient Hybrid Solar Tray Dryer is nil as compared to less conventional tray dryer; it automatically leads to reduction of GHGs emissions by implementing proposed energy efficiency Hybrid Solar Tray Dryer in place of conventional tray dryer. Reduction of GHGs emissions leads to improved environment and better compliance with environmental regulations.

3.2.3 CDMability of the project

The proposed project saves about 224 tonne of wood per year for one tray dryer. This roughly corresponds to 206 tonnes of CO2 emission reduction or 207 CERs. Suppose at the cluster level 200 units apply this technology then the total savings would be about 41400 CERs per annum which can be a suitably sized small scale CDM project.

3.3 Social benefits

3.3.1 Impact on working environment

Replacement of conventional tray dryers with Hybrid Solar Tray Dryers will reduce skin temperature, heat losses & temperature control of tray dryer, all those things will improves the working condition & safety of workers near to tray dryer.

3.3.2 Impact on manpower skills

Proposed energy efficient Hybrid Solar Tray Dryer components were procured from other companies and also generate employment during installation and commissioning. As training will be provided by equipment suppliers will improve the technical skills of manpower required for operation of the equipment.

3.3.3 Impact on wages/emoluments

The awareness created amongst worker and training imparted during implementation of the energy efficient technology project is expected to indirectly increase the wages of the workers as it improves their technical skills of operation and maintenance of equipments. Further, the remuneration will improve in the market or in other companies for the work force.

3.4 Other benefits (If any)

3.4.1 Productivity improvements

The improved design of Hybrid Solar Tray Dryer will improve the drying air temperature; this automatically reduces drying time of chemicals. It was observed that drying is one of major time consuming area, drying time reduction in chemical manufacturing unit will improves productivity of chemical units in Ahmadabad chemical cluster.

3.4.2 Quality improvements

Most of the chemicals manufactured by the Ahmedabad chemical cluster units are temperature sensitive. As inbuilt design of automatic temperature control system in energy efficient Hybrid Solar Tray Dryers controls the temperature of hot air in tray dryers, this will automatically improve the quality of material produced.

3.4.3 Easy operation& maintenance

In energy efficient Hybrid Solar Tray Dryer are designed such way that easy access to regular operational and maintenance in Hybrid Solar Tray Dryer.

4 ECONOMICS & IMPLEMENTATION OF HYBRID SOLAR TRAY DRYERS

4.1 Cost of project implementation

4.1.1 Equipment cost

Technical and financial quotations of proposed energy efficient Hybrid Solar Tray Dryers are collected from reputed vendors. Cost of energy efficient Hybrid Solar Tray Dryers having capacity of 200 trays or 30,000 kCal per hrs is ₹ 12.13 lakh (₹ 4.40 lakh+ ₹ 7.00 lakh+ ₹ 365*200 trays) only as per the quotation provided at Annexure-7.

4.1.2 Other cost

Erection & commissioning cost is ₹ 1.21 lakh and contingencies cost comes out to be ₹ 0.12. Details of project cost are furnished in Table 4.1 below:

Table 4.1 Details of proposed equipment installation cost

S.No	Particular	Unit	Value
1	Equipment cost	₹ (in Lakh)	12.13
2	Erection & Commissioning cost	₹ (in Lakh)	1.21
3	Other misc. cost	₹ (in Lakh)	0.12
4	Total cost	₹ (in Lakh)	13.46

4.2 Arrangement of funds

Proposed financing for the replacement of conventional tray dryers with energy efficient Hybrid Solar Tray Dryers is made considering a debt equity ratio of 3:1, which is normally allowed by financial institutions for financing energy efficiency projects. On the basis of debt equity ratio of 3:1 the promoter's contribution works out to 25% of the project cost and the balance would be term loan from the Bank / FIs.

4.2.1 Entrepreneurs contribution

Total cost (Equipment and erection& commissioning) of project works out to be ₹ 13.46 lakh. Out of which entrepreneur's contribution is 25%, which work out to be ₹ 3.37 lakh.

4.2.2 Loan amount

75% of the project cost would be available as term loan from the banks/financial institutions, which works out to be ₹ 10.10 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, being period, with in which the entire term loan would be repaid. The financials have been worked out on the basis of certain realistic assumptions, which are outlined below

- The project is expected to achieve monetary savings of ₹ 6.04 lakh per annum,
- The operational and Maintenance cost is estimated at 4% of cost of fixed assets with 5% increase every year to take care of escalations.
- The erection and commissioning charges is estimated at 10% of the total project cost for the plant and machinery
- Interest on term loan is estimated at 10%. The tenure of the loan is considered 5 years and repayment starts after 6 months from the first date of disbursement of loan in 60 monthly installments.
- Depreciation is provided as per the rates provided in the companies Act.
- Income tax provision is made as per IT Act 1961.
- Based on the above assumptions, profitability and cash flow statements have been prepared.

4.3.2 Simple payback period

Simple payback period of replacing conventional tray dryers with energy efficient Hybrid Solar Tray Dryers is 2.22 year.

4.3.3 Net Preset Value (NPV)

The Net present value of the investment on project is at @10.00% interest works out to ₹ 8.53 lakh.

4.3.4 Internal rate of return (IRR)

After tax Internal Rate of Return of the project is works out to be 27.62%. 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 25.72%.

Details of all the financial parameters for the replacement of conventional tray dryers with energy efficient Hybrid Solar Tray Dryers are presented in Table 4.2 below:

Table 4.2 Financial parameters of energy efficient Hybrid Solar Tray Dryers

S. No	Parameter	Unit	Value
1	Simple payback period	Years	2.22
2	NPV	₹ in lakh	8.53
3	IRR	%age	27.62
4	ROI	%age	25.72
5	DSCR	Ratio	1.83

4.4 Sensitivity analysis

In different situation fuel saving may increase or decrease on the basis of this scenario a sensitivity analysis in realistic, pessimistic and optimistic scenario has been carried out which is as under:

- Fuel saving increased by 5%
- Fuel saving decreased by 5%

Table 4.3 Sensitivity analysis

Particulars	IRR	NPV in lakh	ROI	DSCR
Normal	27.62%	8.53	25.72%	1.83
5% increase in fuel savings	30.11%	9.83	26.01%	1.93
5% decrease in fuel savings	25.09%	7.23	25.40%	1.72

Assuming all provision and resource input would remain same during sensitivity analysis.

4.5 Procurement and implementation schedule

Total time required for implementation of proposed project is about 13 weeks from the date of financial closure. Detailed procurement and implementation schedules are furnished at Annexure 6.

ANNEXURE

Annexure-1 Energy audit reports of conventional tray dryers

Energy Audit Report of Tray Dryer Report at Unit-1:

Tray dryer is the one of the major energy consuming equipments in production process of chemicals in Unit-1. Detailed Performance assessment of the tray dryer at Unit-1 is presented in the tables below.

S. No	Details	Units	Value
1	Heat input required to the tray dryers	kCal/hr	30000
2	Number of trays	Nos.	200
3	Tray dimensions	in	32" X 16" X 1.25"
4	Overall dimensions	mm	3950 X 1950 X 2100
5	Number of fans	Nos.	4
6	Number of doors	Nos.	2
7	Number of racks and placement of racks	Nos.	4
8	Rating of motor fans	HP	1
9	Motor Speed	RPM	1440

Efficiency of tray dryer was evaluated by following method:

Dryer efficiency = $[w*(m_{in} - m_{out})*\{(T_{out}-T_{in})*Cp_{(w)} + L_e\}] / H_{in}$

Where,

W = wt. of material at output of dryer on dry basis kg/batch

m_{in} and m_{out} = moisture content in feed material and output material expressed in kg moisture/ kg of bone dry product.

T_{in} and T_{out} = temperature of the material being dried at dryer inlet and dryer outlet.

L_e = Latent heat of evaporation of water at the exhaust temperature of dryer in KJ/Kg

H_{in} = Thermal energy input rate to dryer in KJ/batch

This method requires measuring of a number of operational parameters of the tray dryer.

Application of tray dryer	***Tray dryer, which is used to remove moisture***	
Fuel input to tray dryer	Hot air from HAG	
wt. of feed material @ 4kg/tray	kg/batch	800
Material temperature @inlet	^oC	92
Material temperature @outlet	^oC	59.5
Moisture content in feed @inlet	Kg of moisture/kg of bone dry product	0.43
Moisture content in feed @outlet	Kg of moisture/kg of bone dry product	0.03
Drying time in conventional tray dryer	Hr/batch	48
Drying time in energy efficient tray dryer	Hr/batch	30
Wood consumption in HAG	Kg/hr	36
Specific heat of water $Cp_{(w)}$	KJ/kg K	4.18
Thermal energy input to dryer in existing system	KJ/batch	19511539
Latent heat of evaporation of water@ exhaust	KJ/Kg	2278
Efficiency of the existing system	% age	5.9

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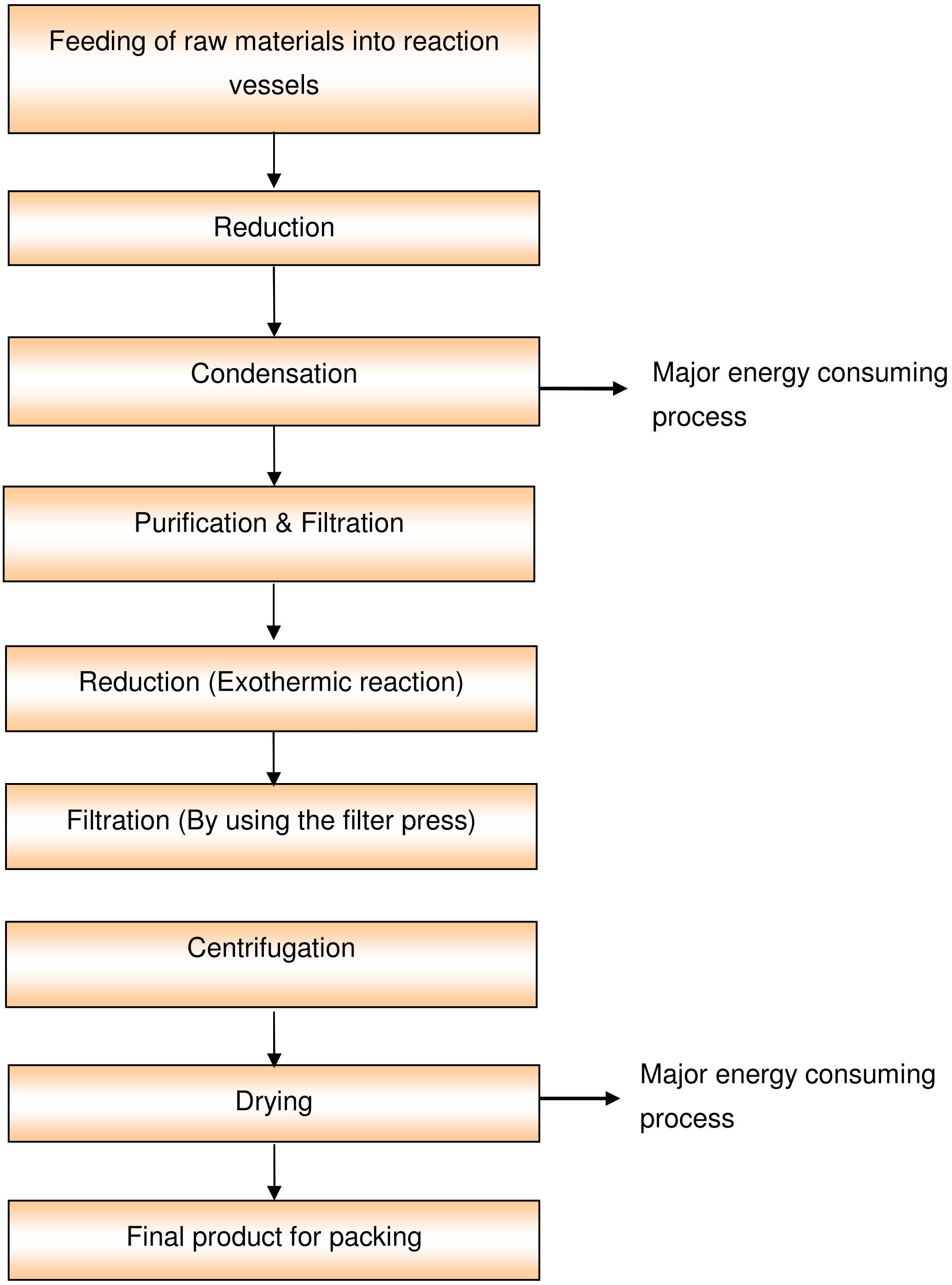
Annexure 2 Process flow diagram

Process flow diagram of chemical industry in Ahmedabad Chemical cluster is furnished in figure below



Annexure-3 Detailed technical assessment report

Most of the chemical industries in Ahmedabad chemical cluster are in unorganized sector with low engineering, limited technology innovation and poor R&D base as well as low level of human resource on knowledge of technology, operational skill etc. This sector also faces deficiencies such as the lack of access to technology and technology sharing and the inadequacies of strong organizational structure, professional attitude etc.

Comprehensive Study conducted at various chemical units in Ahmedabad Chemical cluster to assess the technology gap in different processes and utilities. Following technical gaps are observed during our study:

- The state of art of technology of the unit for some of the equipments installed is poor as compared to technologies available in market. There are various technological gaps were identified in chemical units as under and these may be due to lack awareness on the technologies available, quantum of energy loss and its monetary benefit, lack of awareness among the workforce etc.
- There is a tremendous need for this cluster to modernize/upgrade its technology and adopt energy efficient technologies in some of their operational areas. Further, the management based on discussions, are interested in improve the efficiency of the plant by adopting this type of technology instead of going for retrofit options in the existing equipments.

The various factors which influence the management towards implementation of energy efficiency and energy conservation projects in chemical units in Ahmedabad Chemical cluster are:

- Energy efficiency and energy conservation is a low cost investment option which reduces energy consumption
- Low capital investment
- The energy efficiency improvement will enhance the plant management to be competitive in local and global markets by reducing production cost
- To conserve depleting fossil fuels
- The energy efficiency and conservation reduces GHG emissions because of low carbon dioxide and particulate emissions
- Energy efficiency and conservation is a viable strategy to meet future energy needs of the expanding plans in the industry
- The return on investment is attractive with lower pay back periods.

Parameter	Unit	Value
Drying time in Conventional tray dryer for processing one batch	hrs	48
Drying time in Energy efficient tray dryers for processing one batch	hrs	30
Wood consumption in existing 200 tray dryers	Kg/hr	36
Efficiency of existing tray dryers	% age	5.9
Specific fuel consumption in existing tray dryers (200 tray)	Kg/batch	1728
Efficiency of new tray dryers	% age	9.5
Specific fuel consumption in new energy efficient tray dryers	kg/hr	22.36
Total solar dryer operation time in one batch	Hrs	14
Total hot air generator operation time in one batch	Hrs	16
Wood saving due to use of Hybrid Solar Tray Dryer	Kg/batch	1370.27
Total nos. of batch in a year	Batches	165
Total fuel saving	Tone/year	226.10
Total connected load	HP	4
Total electricity consumption	kWh/year	14470.8
Cost of wood	₹/tonne	3000
Cost of electricity	₹/kWh	5
Net annual monetary savings	₹ in lakh	6.04
Cost of implementation	₹ in lakh	13.46
Simple payback period	Years	2.22

Annexure-4 Detailed cash flow evaluations

Name of the Technology	Energy Efficient Hybrid Solar Tray Dryers		
Rated Capacity	200 trays		
Details	**Unit**	**Value**	**Basis**
Installed Capacity	Trays	200	
No of batch	Batches	165	
Time required for one batch	Hrs.	30	
Proposed Investment			
Cost of plant & Machinery	₹(in lakh)	12.13	Feasibility Study
Erection & Commissioning (10% of plant machinery)	₹(in lakh)	1.21	Feasibility Study
Investment without IDC	₹(in lakh)	0.12	Feasibility Study
Total Investment	₹(in lakh)	13.46	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹(in lakh)	3.37	Feasibility Study
Loan Funds (Term Loan)	₹(in lakh)	10.10	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	%	5.00	Feasibility Study
Estimation of Revenue			
Wood savings	Tonne/Annum	226.10	-
Cost	₹/tons	3000	
Electricity cost	₹/Annum	73854	
St. line Depreciation	%	5.28	Indian Companies Act
IT Depreciation	%	80.00	Income Tax Rules
Income Tax	%	33.99	Income Tax Act 2008-09

Estimation of Interest on term loan ***₹(in lakh)***

Years	Opening Balance	Repayment	Closing Balance	Interest
1	10.10	0.72	9.38	1.17
2	9.38	1.56	7.82	0.87
3	7.82	1.80	6.02	0.70
4	6.02	2.20	3.82	0.51
5	3.82	2.48	1.34	0.27
6	1.34	1.34	-0.01	0.04
		10.10		

WDV Depreciation ***₹(in lakh)***

Particulars / years	1	2
Plant and Machinery		
Cost	13.46	2.69
Depreciation	10.77	2.15
WDV	2.69	0.54

Projected Profitability ***₹ (in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Revenue through Savings								
Fuel savings	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04
Total Revenue (A)	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04
Expenses								
O & M Expenses	0.54	0.57	0.59	0.62	0.65	0.69	0.72	0.76
Total Expenses (B)	0.54	0.57	0.59	0.62	0.65	0.69	0.72	0.76
PBDIT (A)-(B)	5.51	5.48	5.45	5.42	5.39	5.36	5.32	5.29
Interest	1.17	0.87	0.70	0.51	0.27	0.04	-	-
PBDT	4.34	4.61	4.75	4.91	5.12	5.32	5.32	5.29
Depreciation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
PBT	3.63	3.90	4.04	4.20	4.41	4.61	4.61	4.58
Income tax	-	0.83	1.61	1.67	1.74	1.81	1.81	1.80
Profit after tax (PAT)	3.63	3.06	2.43	2.53	2.67	2.80	2.80	2.78

Computation of Tax **₹ (in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit before tax	3.63	3.90	4.04	4.20	4.41	4.61	4.61	4.58
Add: Book depreciation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Less: WDV depreciation	10.77	2.15	-	-	-	-	-	-
Taxable profit	(6.43)	2.45	4.75	4.91	5.12	5.32	5.32	5.29
Income Tax	-	0.83	1.61	1.67	1.74	1.81	1.81	1.80

Projected Balance Sheet

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Liabilities								
Share Capital (D)	3.37	3.37	3.37	3.37	3.37	3.37	3.37	3.37
Reserves & Surplus (E)	3.63	6.69	9.12	11.65	14.32	17.12	19.92	22.70
Term Loans (F)	9.38	7.82	6.02	3.82	1.34	-0.01	-0.01	-0.01
TOTAL LIABILITIES (D)+(E)+(F)	16.37	17.87	18.50	18.83	19.02	20.48	23.28	26.06
Assets								
Gross Fixed Assets	13.46	13.46	13.46	13.46	13.46	13.46	13.46	13.46
Less : Accm.depreciation	0.71	1.42	2.13	2.84	3.55	4.26	4.97	5.69
Net Fixed Assets	12.75	12.04	11.33	10.62	9.91	9.20	8.49	7.77
Cash & Bank Balance	3.62	5.83	7.17	8.21	9.11	11.28	14.80	18.29
TOTAL ASSETS	16.37	17.87	18.50	18.83	19.02	20.48	23.28	26.06
Net Worth	6.99	10.06	12.48	15.02	17.68	20.48	23.29	26.06
Debt Equity Ratio	2.79	2.32	1.79	1.13	0.40	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	3.37	-	-	-	-	-	-	-	-
Term Loan	10.10								
Profit After tax		3.63	3.06	2.43	2.53	2.67	2.80	2.80	2.78
Depreciation		0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Total Sources	13.46	4.34	3.77	3.14	3.24	3.38	3.51	3.51	3.49
Application									
Capital Expenditure	13.46								
Repayment of loan	-	0.72	1.56	1.80	2.20	2.48	1.34	-	-
Total Application	13.46	0.72	1.56	1.80	2.20	2.48	1.34	-	-
Net Surplus	-	3.62	2.21	1.34	1.04	0.90	2.17	3.51	3.49
Add: Opening balance	-	-	3.62	5.83	7.17	8.21	9.11	11.28	14.80
Closing balance	-	3.62	5.83	7.17	8.21	9.11	11.28	14.80	18.29

IRR **₹ (in lakh)**

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		3.63	3.06	2.43	2.53	2.67	2.80	2.80	2.78
Depreciation		0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Interest on Term Loan		1.17	0.87	0.70	0.51	0.27	0.04	-	-
Cash outflow	(13.46)	-	-	-	-	-	-	-	-
Net Cash flow	(13.46)	5.51	4.64	3.84	3.75	3.65	3.55	3.51	3.49
IRR	27.62%								

NPV	8.53

Break Even Point

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.57
Sub Total*(G)*	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.57
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.13	0.14	0.15	0.16	0.16	0.17	0.18	0.19
Interest on Term Loan	1.17	0.87	0.70	0.51	0.27	0.04	0.00	0.00
Depreciation *(H)*	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Sub Total (I)	2.01	1.72	1.56	1.37	1.15	0.92	0.89	0.90
Sales (J)	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04
Contribution (K)	5.64	5.62	5.60	5.58	5.55	5.53	5.50	5.48
Break Even Point (L= G/I)	35.66%	30.65%	27.84%	24.65%	20.63%	16.68%	16.19%	16.44%
Cash Break Even {(I)-(H)}	23.06%	18.00%	15.14%	11.90%	7.84%	3.82%	3.28%	3.46%
Break Even Sales (J)*(L)	2.16	1.85	1.68	1.49	1.25	1.01	0.98	0.99

Return on Investment **₹ (in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	3.63	3.90	4.04	4.20	4.41	4.61	4.61	4.58	33.97
Net Worth	6.99	10.06	12.48	15.02	17.68	20.48	23.29	26.06	132.07
									25.72%

Debt Service Coverage Ratio ***₹ (in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	3.63	3.06	2.43	2.53	2.67	2.80	2.80	2.78	17.12
Depreciation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	4.26
Interest on Term Loan	1.17	0.87	0.70	0.51	0.27	0.04	0.00	0.00	3.56
Total (M)	5.51	4.64	3.84	3.75	3.65	3.55	3.51	3.49	24.94

DEBT

Interest on Term Loan	1.17	0.87	0.70	0.51	0.27	0.04	0.00	0.00	3.56
Repayment of Term Loan	0.72	1.56	1.80	2.20	2.48	1.34	0.00	0.00	10.10
Total (N)	1.89	2.43	2.50	2.71	2.75	1.38	0.00	0.00	13.66
Average DSCR (M/N)	1.83								

Annexure-5 Details of procurement and implementation plan

Procurement and implementation schedule of Hybrid Solar Tray Dryers in place of conventional tray dryers are presented below:

Activity	***Weeks***												
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***
Energy data reconfirmation	■												
Technical discussion & finalization	■	■											
Collection of vendor quotes			■										
Order placement				■									
Material receipt				■	■	■	■	■	■	■			
Installation & Commissioning											■		
Measurement of savings											■	■	
Certification of savings													■

Annexure-6 Details of equipment and service providers

Name of company	***Aero Therm Systems Pvt Ltd***
Name of contact person	Narendra Vadher
Address of company	Plot No: 1517; Phase III; GIDC, Vatva, Ahmedabad
Contact no & Fax no	079-5834987,5890158 &079-5834987
Contact email ids	vadher@ad1.vsnl.net.in
Company website	www.aerothermsystem.com

Name of company	***Energy Machine***
Name of contact person	Mr. Sharad Amin
Address of company	444, G.I.D.C., Phase IV Vithal Udhyog nagar Anand, Gujarat-388 121
Contact no	+(91)-(2692)-232662/ 236210/ 2323309
Fax no	+(91)-(2692)-233472/ 236478
Contact email -id	hem444@gmail.com, bapuamin@gmail.com

Name of company	***Double Ace Engineers***
Name of contact person	Mr. M. B. Gupta
Address of company	1/ 3, Sidhartha Nagar 3rd, Next To Oshiwara Bridge, S., Bridge, S.V. Road, Goregaon (West)
Contact no	+(91)-(22)-26762288/ +(91)-(2525)-270878
Fax no	+(91)-(22)-26762288
Contact email-id	dblace@mtnl.net.in, doubleace2008@gmail.com

Annexure 7 Quotations of energy efficient Hybrid Solar Tray Dryers

EMAIL MSG.: GREEN-06 18TH OCTOBER, 2010

SPECIFICATION AND SCOPE OF SUPPLY

EQUIPMENT		:	TRAY DRYER	
MODEL		:	**AHD – 96**	**AHD-192**
DIMENSIONS	L	:	1930 MM	3950 MM
	W	:	1100 MM	1950 MM
	H	:	2100 MM	2100 MM
HEATING MEDIA		:	HOT AIR GENERATOR	
HEATING INPUT		:	15,000 KCAL/HR OR SOLAR HEATING	30,000 KCAL/HR
POWER SUPPLY		:	AC 3 PHASE 415 V 4 WIRE	

GENERAL DESCRIPTION

CABINET : CABINET OF THE DRYER WILL BE OF 100/200 TRAYS CAPACITY, MADE FROM MS ANGLE FRAME OF DOUBLE WALL CONSTRUCTION LINED INTERNALLY WITH **18 SWG MS** SHEET AND EXTERNALLY **18 SWG MS** SHEET. THE CAVITY FORMED IN BETWEEN DOUBLE WALL WILL BE PROPERLY INSULATED WITH 65 MM THICK MINERAL WOOL TO PREVENT HEAT LOSSES FROM DRYER.

DOORS : HEAVY DUTY AIRTIGHT HINGED DOORS MADE FROM **16 SWG MS** SHEET BACKED BY 50 MM MINERAL WOOL ON THE INNER SIDE AND BALL CATCH LOCKING ARRANGEMENT TOGETHER WITH 40 MM ASBESTOS GASKET ROPE ENSURE VERY STURDY CONSTRUCTION OF THE DRYER.

AIR CIRCULATION : THE UNIFORM AIR CIRCULATION WITHIN THE DRYER WILL BE CARRIED BY **TWO/FOUR NOS.** OF MULTY BLADE TYPE **MS** FABRICATED FAN MOUNTED ON EXTERNALLY ON BALL BEARING PEDESTAL AND DRIVEN BY 1 HP TEFC ELECTRIC MOTOR. AIR INLET AND OUTLET DAMPERS ARE PROVIDED ON THE TOP ROOF OF THE DRYER CABINET.

TROLLEYS : THE STRUCTURE FOR THE HEAVY DUTY TROLLEYS WILL BE MADE FROM 40 MM **MS ANGLE** AND HORIZONTAL SUPPORT WILL BE OF 25 MM **MS ANGLE**. THE DESIGN OF TROLLEY WILL BE GOOD ENOUGH FOR THE PROPER HOT AIR CIRCULATION. THE TROLLEY WILL BE FITTED WITH 2 NOS. CASTOR WHEEL AND 2 NOS. FIXED WHEEL FOR THE EASY MOVEMENT.

EMAIL MSG.: GREEN-06 18TH OCTOBER, 2010

SPECIFICATION AND SCOPE OF SUPPLY

ELECTRICALS	:	**TWO / FOUR NOS. 1 HP X 1440 RPM** TEFC ELECTRIC MOTORS WITH SET OF PULLEYS AND VEE BELTS DRIVE ARRANGEMENT WILL BE PROVIDED. MAKE : CROMPTON/ABB/KIRLOSKER/ROTOMOTIVE
CONTROL PANEL	:	PRE WIRED CONTROL PANEL WILL BE CONSISTING OF **DIGITAL TEMP. INDICATOR CONTROLLER**, CONTACTOR FOR MOTORS/HEATERS, OVER CURRENT RELAY, FUSES, INDICATING LAMP, PUSH BUTTONS, MAIN ISOLATOR SWITCH ETC.
PAINTING	:	THE DRYER WILL BE SPRAY PAINTED WITH TWO COATS OF HIGH TEMPERATURE RESISTANCE ALUMINUM PAINT AND THE OUTSIDE CABINET HAVE ONE COAT OF REDOXIDE BACKED BY HAMMER TONE FINISHED PAINT.
PRICE	**:**	**RS. 3,10,000-00 EACH UNIT WITHOUT TRAYS. (TRAY DRYER MODEL: AHD-96)** **RS. 4,40,000-00 EACH UNIT WITHOUT TRAYS. (TRAY DRYER MODEL: AHD-192)**
OPTIONAL ACCESSORIES	:	FOLLOWING ACCESSORIES CAN BE PROVIDED AT AN EXTRA COST.
SOLAR HEATING	:	SOLAR HEATING PANEL SUITABLE TO GENERATE 30,000 KCAL/HR HEAT.
PRICE	**:**	**RS. 7,00,000-00 EACH.**
SOLAR HEATING	:	SOLAR HEATING PANEL SUITABLE TO GENERATE 15,000 KCAL/HR HEAT.
PRICE	**:**	**RS. 3,75,000-00 EACH.**
TRAYS	:	MADE FROM **18 SWG ALUMINUM** SHEET SIZE : 32" X 16" X 1.25" QTY REQUIRED : 200 NOS.
PRICE	**:**	**RS. 365-00 EACH.**

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