MANUAL ON ENERGY CONSERVATION MEASURES IN OIL MILL CLUSTER ALWAR

ENERGY IS LIFE
BEE
CONSERVE IT

Bureau of Energy Efficiency (BEE)

Ministry of Power, Government of India

Prepared By

CII
Confederation of Indian Industry
Since 1895

CII-AVANTHA
Centre for Competitiveness for SMEs

MANUAL ON ENERGY CONSERVATION MEASURES IN OIL MILL INDUSTRY

Based on findings of BEE's SME Program for Alwar Oil Mill Cluster

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ABBREVIATIONS

MSME	Micro Small and Medium Enterprises
SMEs	Small and Medium Enterprises
GOI	Government of India
BEE	Bureau of Energy Efficiency
EE	Energy Efficiency
IRR	Internal Rate of Return
DPRs	Detailed Project Reports
tpa	Tonnes Per Annum
MTOE	Metric Tonnes of Oil Equivalent
mkCal	Million Kilo Calories
kW	Kilo Watt
hp	Horsepower
kWh	Kilo Watt Hour
SDA	State Designated Agency
GHGs	Green House Gasses
LSPs	Local Service Providers

CHAPTER 1

ABOUT BEE SME PROGRAM

Worldwide the Micro, Small and Medium Enterprises (MSMEs) have been accepted as engines of economic growth to promote and accelerate equitable development. The major advantage of this sector is its enormous employment potential at significantly low capital involvement. This can be established from the simple fact that the MSMEs constitute over 90% of total enterprises in most economies and are credited with generating the highest rates of employment growth and also account for a major share of industrial production and exports. In Indian context, MSMEs play a pivotal role in the overall industrial economy. In recent years the sector has consistently registered higher growth rate as compared to the overall industrial sector. With its agility and dynamism, the sector has shown admirable innovativeness and adaptability to survive the recent economic downturn and recession.

As per available statistics (the 4th Census of MSME Sector), this sector employs an estimated 59.7 million persons spread over 26.1 million enterprises. It is estimated that in terms of value, MSMEs have a 40% share in total industrial output at a huge volume of producing over 8,000 value-added products. At the same time, MSMEs contribute nearly 35% share in Direct Export and 45% share in the Overall Export from the country. SMEs exist in almost all-major sectors in the Indian industry such as Food Processing, Agricultural Inputs, Chemicals & Pharmaceuticals, Electrical & Electronics, Medical & Surgical Equipment, Textiles and Garments, Gems and Jewellery, Leather and Leather Goods, Meat Products, Bioengineering, Sports goods, Plastics Products, Computer Software etc.

However, despite the significant contributions made to towards various aspects of the nation's socio-economic scenario, this sector too faces several critical issues that require immediate attention. One such factor that falls in the ambit of this publication is the prevalence of age old technologies across the sectors and inherent inefficiencies associated with resource utilization, including, energy. The National Mission for Enhanced Energy Efficiency in Industry under the National Action Plan for Climate Change (released by Government of India on June 30, 2008) has emphasized the need for improving Energy Efficiency (EE) in the manufacturing sector. A number of sector-specific studies have also unanimously confirmed that energy intensity in the industry can be reduced with the widespread adoption of proven and commercially available technologies which will improve EE and produce global benefits from reduced Green House Gasses (GHGs) emissions.

As a result of increasing awareness towards efficient usage of energy and other resources, there has been a visible reduction in energy intensity in comprehensive Indian industrial sector. However, focusing the observation on the MSME sector reveals that the energy intensity per unit of production is much higher than that of the organized large scale sector. Since energy cost is significant contributor to the overall production cost of SMEs due to high and rising energy costs in current scenarios, it is required to increase the Energy Efficiency (EE) levels in order to ensure the sustenance of SMEs. One of the ways to reduce the inefficiencies is by replacing the conventional/old/obsolete technology with feasible and adaptable energy efficient technologies. This would not only contribute towards reduction in production cost, but would also improve the quality and productivity of MSME products. However, while knowing the way out, there are still numerous barriers (as listed below) and market failures that have prevented widespread adoption of new energy efficient technologies.

Key barriers in promotion and adoption of EE technologies in Indian SME sector:

- Lack of awareness and capability on the part of SMEs to take up energy conservation activities
- Lack of scientific approach on monitoring and verification of performance assessment of installed equipments and utilities.
- Non availability of benchmark data for various equipments/process
- Low credibility of the service providers such as equipment suppliers and their technologies
- The SME owners are more concerned on production and quality rather than energy efficiency and conservation
- The key technical personnel employed in the SME units are based on their past experience in similar industries rather than technically qualified personnel and hence, they are not aware of the latest technologies or measures which improve energy efficiency
- Lower priority to invest in improving efficiency than in expansion (this may be due to lack of knowledge on cost benefit)

Majority of SMEs are typically run by entrepreneurs and are leanly staffed with trained technical and managerial persons to deploy and capture energy efficiency practice to reduce manufacturing cost and increase competitive edge. Therefore, it will be useful to build energy efficiency awareness in the SMEs by funding/subsidizing need based

studies in large number units in the SMEs and giving energy conservation recommendations including short term energy conservation opportunities, retrofit/replacement options and technology up-gradation opportunities.

In this context, the Bureau of Energy Efficiency (BEE) has laid adequate emphasis on the SME sector as presented in the Working Group on Power for 11th Five-Year Plan (2007-2012)-Sub-Group 5. Consequently, the Bureau has initiated the Energy Efficiency Improvement program in 25 SME clusters in India.

1.1 PROJECT OBJECTIVES

The BEE SME Program is aimed to improve Energy Efficiency in SME sector by technological interventions in the various clusters of India. The EE in SMEs is intended to be enhanced by helping these industries in the 25 energy intensive SME clusters of India by:

- Technology interventions
- Sustaining the steps for successful implementation of EE measures and projects in clusters
- Capacity building for improved financial planning for SME entrepreneurs.

The program also aims at creating a platform for

- Dissemination of the best practices and the best available technologies available in the market for energy efficiency and conservation,
- To create awareness in the clusters, and
- To demonstration the new technology interventions/ projects to stimulate adoption of similar technology/projects in the clusters.

The BEE SME program has been designed in such a way so as to address the specific needs of the industries in the SME sector for EE improvement and to overcome the common barriers in way of implementation of EE technologies in cluster through knowledge sharing, capacity building and development of innovative financing mechanisms. Major activities in the BEE SME program are listed below:

- Energy use and technology studies
- Capacity building of stake holders in cluster for building EE projects
- Implementation of energy efficiency measures

- Facilitation of Innovative financing mechanisms for implementation of energy efficiency projects

The brief objective of each of these activities is presented below:

1. Energy Use and Technology Analysis:-

An in-depth assessment of the various production processes, energy consumption pattern, technology employed and possible energy conservation potential and operational practices in cluster by means of conducting detailed energy audits and technological gap assessment studies in a cluster is presented herewith. The energy audit study includes analysis of the overall energy consumption pattern, study of production process, identification of energy intensive steps/sub-processes and associated technology gap assessment for the individual units. The study also focuses on identifying the Best Operating Practices and the EE measures already implemented in the units.

2. Capacity building of stakeholders

The aim of this activity is capacity building of the enrolled LSPs to equip them with the capability to carry on the implementation of the EE technology projects in cluster on a sustainable basis. The needs of the LSPs will be identified as a preparatory exercise to this activity, as to what they expect from the BEE Program in terms of technical and managerial capacity building.

3. Implementation of EE measures

To implement the EE and technology up-gradation projects in the clusters, technology specific Detailed Project Reports (DPRs) for five different technologies for three scales of operation will be prepared. The DPRs will primarily address the following:

- Comparison of existing technology with feasible and available EE technology
- Energy, economic, environmental & social benefits of proposed technology as compared to conventional technology
- Details of technology and service providers of proposed technology
- Availability of proposed technology in local market
- Action plan for implementation of identified energy conservation measures

- Detailed financial feasibility analysis of proposed technology

4. Facilitation of innovative financing mechanisms

Research and develop innovative and effective financing mechanisms for easy financing of EE measures in the SME units in the cluster. The easy financing involves following three aspects:

- Ease in financing procedure
- Availability of finance on comparatively easy terms and relaxed interest rates
- Compatibility and availing various other Central/ State Governments' incentive schemes like CLCSS, TUFF etc.

1.2 EXPECTED PROJECT OUTCOME

The outcome of BEE-SME Program will be a assessment of total energy usage, preparedness of the cluster to undertake further action and a list of units where further action is recommended along with filled in data collection formats. Expected project outcome of BEE SME program in clusters are:

Energy Use and Technology Analysis

The outcome of the activity will include identification of the EE measures, potential of renewable energy usage, fuel switching, feasibility analysis of various options, and cost benefit analysis of various energy conservation measures including evaluation of financial returns in form of payback period, IRR and cash flows. The cost liability of each measure, including the capital and operational cost will also be indicated.

The identified EE measures will be categorized as per the following types:

- Simple housekeeping measures/ low cost measures
- Capital intensive technologies requiring major investment.

The sources of technology for each of the suitable low cost and high cost measures, including international suppliers as well as local service providers (LSPs)/ technology suppliers, in required numbers shall be identified. It is envisaged to create a knowledge bank of detailed company profile and CVs of key personnel of these technology sources. The knowledge bank will also include the capability statements of each of these sources.

The EE measures identified in the energy audit study will be prioritized as per their energy saving potential and financial feasibility. The inventorization survey would establish details like the cluster location, details of units, production capacity, technologies employed, product range, energy conservation potential along with possible identified EE measures and respective technology suppliers.

The specific outcomes of this activity will be as follows:

- Determination of energy usage and energy consumption pattern
- Identification of EE measures for the units in cluster
- Development and preparation of case studies for already implemented EE measures and Best Operating Practices in the units
- Evaluation of technical & financial feasibility of EE measures in terms of payback period, IRR and cash flows.
- Enlisting of Local Service Providers(LSPs) for capacity building & training including creation of knowledge bank of such technology suppliers
- Capacity building modules for LSPs
- Development and preparation of cluster manuals consisting of cluster details and EE measures identified in cluster.

Implementation of EE measures

The aim of this activity is development and finalization of bankable DPRs for each of the EE projects which would presented before the SME units for facilitation of institutional financing for undertaking the EE projects in their respective units.

The activity will ensure that there is close match between the proposed EE projects and the specific expertise of the Local Service Providers (LSPs). These DPRs will be prepared for EE, renewable energy, fuel switching and other possible proposed measures during course of previous activities. Each DPR will include the technology assessment, financial assessment, economic assessment and sustainability assessment of the EE project for which it has been developed. The technology assessment will include the details of the design of equipment/ technology along with the calculation of energy savings. The design details of the technology for EE project will include detailed engineering drawing for the most commonly prevalent operational scale, required civil and structural work,

system modification and included instrumentation and various line diagrams.

The LSPs will be required to report the progress of the implementation of each such project to BEE PMC. Such implementation activities can be undertaken by the LSPs either solely or as a group of several LSPs.

Capacity Building of LSP's and Bankers

The outcome of this activity would be training and capacity building of LSPs so as to equip them with necessary capacity to undertake the implementation of proposed EE projects as per the DPRs. Various training programs, training modules and literature are proposed to be used for the said activity. However, first it is important to ascertain the needs of the LSPs engaged, as in what they expect from the program in terms of technical and managerial capacity building. Another outcome of this activity will be enhanced capacity of banking officers in the lead banks in the cluster for technological and financial feasibility analysis of EE projects that are proposed by the SME units in the cluster. This activity is intended to help bankers in understanding the importance of financing energy efficiency projects, type and size of projects and ways and means to tap huge potential in this area. Different financing models would be explained through the case studies to expose the bankers on the financial viability of energy efficiency projects and how it would expand their own business in today's competitive environment.

Concluding workshop

The outcome of this activity will be the assessment of the impact of the project as well as development of a roadmap for future activities. The workshop will be conducted for the representatives of the local industrial units, industry associations, LSPs and other stakeholders so that the experiences gained during the course of project activities including implementation activities of EE project can be shared. All the stakeholders in the project will share their experience relating to projects undertaken by them as per their respective roles. Effort from industrial units as well as LSPs to quantify energy savings thus achieved would be encouraged. This would lead to development of a roadmap for implementing similar programs in other clusters with greater efficiency and reach.

1.3 PROJECT DURATION

Activity	Time
Energy use & technology audit	January to April 2010
Capacity Building	Oct 2010
Introductory Service Providers Workshop	Oct 2010
Information Dissemination Workshop	Oct 2010
Implementation of EE Measures	December 2010
Preparation of DPRs	April to October 2010
Capacity building of local service providers	November 2010
Facilitation of Innovative Financing	December 2010
Financing EE	December 2010
Capacity Building of Bankers	December 2010
Concluding Service Providers Workshop	December 2010

1.4 IDENTIFIED CLUSTER UNDER THE PROGRAMME

25 most energy intensive MSME clusters across different end use sectors have been identified to implement the BEE SME program for EE improvement. The details of industrial sector and identified cluster are provided in Table 1.1 below:

Table 1.1: ***List of clusters identified for BEE SME Program***

S. No.	Cluster Name	Location
1.	Oil Milling	Alwar; Rajasthan
2.	Machine Tools	Bangalore; Karnataka
3.	Ice Making	Bhimavaram; Andhra Pradesh
4.	Oil	Bhubaneswar; Orissa
5.	Sea food processing	Kochi, Kerala
6.	Refractories	East &West Godavari, Andhra Pradesh
7.	Rice Milling	Ganjam, Orissa
8.	Dairy	Gujarat
9.	Galvanizing	Howrah, West Bengal
10.	Oil& Aluminum	Jagadhari, Haryana
11.	Limestone	Jodhpur, Rajasthan
12.	Tea processing	Jorhat, Assam
13.	Foundry	Batala, Jalandhar & Ludhiana, Punjab
14.	Paper	Muzzafarnagar, Uttar Pradesh
15.	Sponge iron	Orissa
16.	Chemicals& Dyes	Vapi, Gujarat
17.	Brick	Varanasi, Uttar Pradesh
18.	Rice Milling	Vellore, Tamil Nadu
19.	Chemical	Ahmedabad, Gujarat
20.	Oil	Alwar, Gujarat
21.	Textile	Pali, Rajasthan
22.	Textile	Surat, Gujarat
23.	Tiles	Morbi, Gujarat
24.	Textile	Solapur, Maharashtra
25.	Rice Milling	Warangal, Andhra Pradesh

As a part of BEE SME program, one of cluster identified is Alwar, Oil Mills cluster. It was proposed to carry out energy use and technology audit studies in around 50 units in Alwar Oil Mill Cluster covering all types and sizes of the industries to understand/give valuable insight into the process of developing energy efficiency solutions relevant to the SME industries in the Alwar, Oil Mill Cluster.

CHAPTER 2

ALWAR OIL MILLS CLUSTER SCENARIO

2.1 OVERVIEW OF SME CLUSTER

There are approximately 50 units in Alwar-Oil Mill Cluster which are engaged in oil extraction, units are spread across Alwar and Sawaimadhopur. The units in Alwar and Khairthal are in operation since last 10 –15 yrs whereas in Sawai Madhavpur the units are running since 1970 / 1980.

Approx 30 units are in Alwar & approx 20 units in Sawai Madhopur, both the locations produce by & large mustard oil – refined as well as Kolhu. Mustard is grown where rainfall intensity is low and water availability is also low. Although mustard seeds and powder do not contain allyl isothiocyanate, it is formed when the seeds came in contact with water and the essential oil is formed when a glycoside decomposes due to enzymatic action. The units in the cluster are using their own technology and the process is mechanised. The units are in operation in the general shift only except for some units which are running for 12 hours. Power availability is a major issue, in some areas its there for only 10 hours whereas in certain areas its there for 14-16 hours. The worst affected areas are Gangapur, Kherda. Majority of the units are having LT connection through the grid.

The raw materials used are Mustard seed & the other additives are Mahua, Arandi, and Guava. The raw material is sourced from local mandi as it's the crop grown in deserts. The labour is easily available and no skilled labour employed, the process to a great extent mechanized. Locations of plants are in Industrial areas Alwar, MIA, Khairthal, Tijara, Malgodam Road, Gangapur, Kherda, Gandhi Chowk.

2.1.1 CLUSTER BACKGROUND

Edible oil and cake is produced by crushing oil seeds in kolhu and expellers. Units in clusters are using their own technology and process is mechanized. Bureau of Energy Efficiency (BEE), Government of India with Confederation of Indian Industry (CII) has taken up initiative to enhance the energy efficiency in oil mill units across Alwar and Sawaimadhopur, Rajasthan through BEE-CII Alwar Oil Mill SME Cluster Program. The objective of project is to accelerate the adoption of energy efficiency and technological improvement through knowledge sharing, capacity building and development of initiatives financing mechanism.

2.1.2 PRODUCT MANUFACTURED

Type of Oil Produced:-

1) Kacchi Ghani Oil (from Kolhu)
2) Pakki Ghani Oil (from Expeller)

2.1.3 CLASSIFICATION OF UNITS

Broadly units are classified with respect to production capacity.

1) Large Scale Units
2) Medium Scale Units
3) Small Scale Units

Large Scale Units

These are units which are having large number of Kolhus and Expellers as well as seed cracker whose production capacity lies above 120 MT.

Medium Scale Units

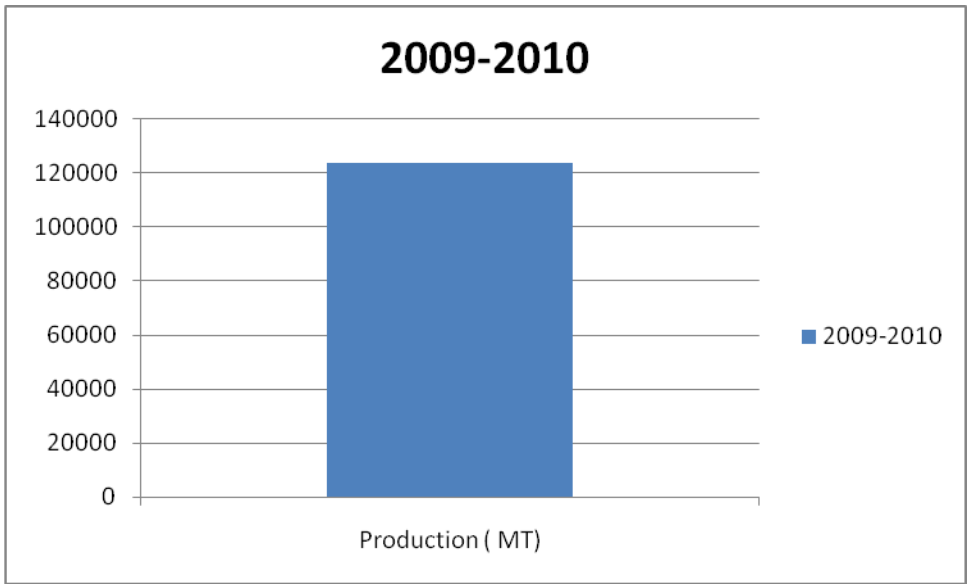
These are units which are having some number of Kolhus and Expellers whose production capacity lies in range of 50 MT to 120 MT. Most of the units of Alwar and Sawaimadhopur lie in this range of production.

Small Scale Units

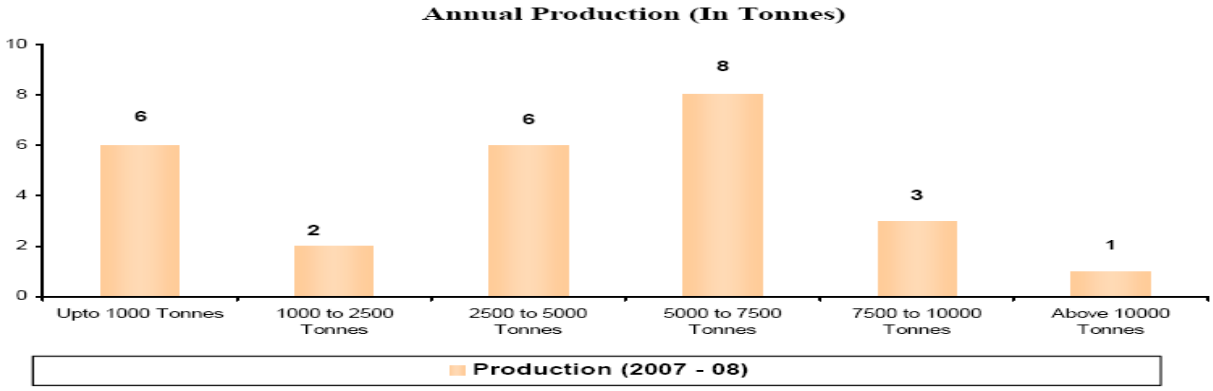
These are units which are either having some number of Kolhus or some numbers of Expellers. Infect some of the units are having only one or two expellers whose production capacity lies below 50 MT. Most of the units of khairthal and Gangapur lie in this range of production.

2.1.4 PRODUCTION CAPACITY

The collective production capacity of oil units of Alwar and Sawaimadhopur is around 124000 MT / annum of oil.



➢ **PRODUCTION**



2.1.5 RAW MATERIALS USED

The raw material used is Mustard seed & the other additives are Mahua, Arandi and Guava. Raw Seed contains almost 40% of oil in it.

The raw material is sourced from local mandi as it's the crop grown in deserts. Mustard is grown where rainfall intensity is low and water availability is also low. Although mustard seeds and powder do not contain allyl isothiocyanate, it is formed when the

seeds came in contact with water and the essential oil is formed when a glycoside decomposes due to enzymatic action.

	DM, %	CP, %	Fat, %	TDN, %	NEm, Mcal/lb	NEg, Mcal/lb
Mustard meal, mechanical extraction	93	34.5	5.5	73	.76	.48

Abbreviations: DM = dry matter; CP = crude protein; TDN = total digestible nutrients; NEm = net energy for maintenance; NEg = net energy for gain

2.2 ENERGY SITUATION IN THE CLUSTER

Energy used for oil extraction is electricity. In Alwar and Sawaimadhopur region there is shortage of power and that leads to less production of oil. Because of the power shortage some of the very small scale units of cluster are planning to shut their plant.

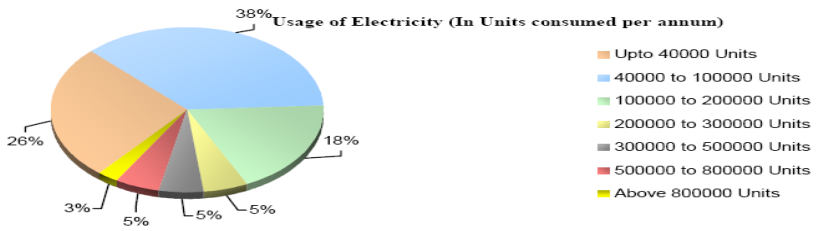
2.2.1 TYPES OF FUEL (FOSSILS, BIOMASS, WASTE, BYPRODUCTS, ETC)

In some of the units in cluster Diesel is being used to run Diesel Generator, at time of power cut. Cost of Diesel is Rs. 32/ Lit.

In some of the unit's wood, bhusi or any type of available waste is used in boiler. Boiler runs mainly in winter for steam requirement to soften cake in expeller. There is no fixed cost for fuel to boiler.

2.2.2 FUELS AND ELECTRICITY CONSUMPTION

- USAGE OF ELECTRICITY (IN UNITS CONSUMED PER ANNUM)



Electrical energy consumption in Alwar and Sawaimadhopur units lies in range of around 186 Lakhs kWh for processing of 1240000 Quintal of Mustard Seed.

2.2.3 SPECIFIC ENERGY CONSUMPTION

Oil units in Alwar & Sawaimadhopur regions are having Specific Energy Consumption in range of 10-15 kWh/Quinal of mustard seed processed.

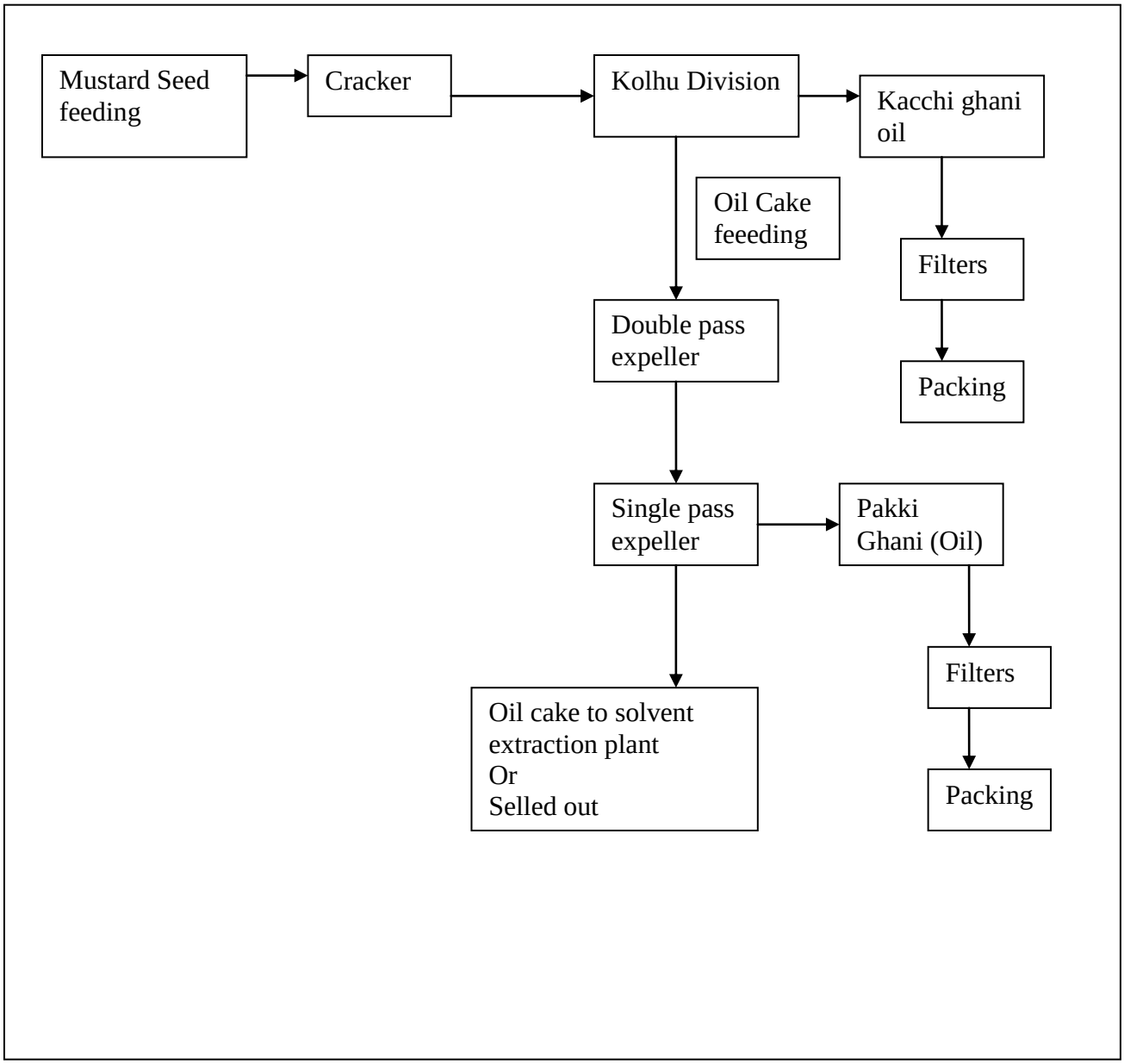
2.3 MANUFACTURING PROCESS/TECHNOLOGY OVERVIEW IN A TYPICAL UNIT

Raw material used for oil production is mustard, which is purchased from Local mandi of Alwar and Sawaimadhopur. To extract oil from raw mustard seed, it is first passed through Kolhu and the waste (oil cake) from the kolhu is then passed through Expeller which extracts more oil from the same oil cake. Remaining oil cake is then processed in solvent extraction plant or sold out in market. Filtered oil goes to oil filling plant where oil is filled in bottles as per requirement and finally packed in cartoon to send at required places across India.

2.3.1 PROCESS TECHNOLOGY

Technology used for process involve expellers (Double pass & Single pass), Kolhus run by motors instead of any animal. Single motors run many kolhus, which are connected on same shaft by belts. After extracting oil from machines, it is sent for filtration to fine filter cloth.

2.3.2 PROCESS FLOW DIAGRAM



S. No	Machine used for Oil Extraction	% of Oil extraction
1	Kolhu	15
2	Expeller	20
3	Solvent extraction unit	5

2.4 CURRENT POLICIES AND INITIATIVES OF LOCAL BODY

Some of the good policies being initiated by local body or oil mill association are as follows:

- Association people involve themselves in increasing energy efficiency of plant.
- Shares the good practices for plant and benefits achieved
- Workers safety
- Regular maintenance of kolhu

2.5 ISSUES RELATED TO ENERGY USAGE AND CONSERVATION AND BARRIER IN TECHNOLOGY UP GRADATION

The processes to do with technology and innovations in SMEs are different from those that take place in large firm context. Technology in the SME sector has an increasingly complex or combinative character, most of the SMEs units in cluster are regarded for their labour intensive and the capability work with local resources. In the past, SME entrepreneurs have given less emphasis to technology in order to reduce initial cost of plant /machinery. Major barriers in up-gradation of technology in the cluster are:

- Lack of awareness on energy efficiency
- Lack of organizational commitment
- Narrow focus on energy
- Not clear about their existing level of operations and efficiency, due to lack of instrumentation & non availability of energy consumption data
- Limited manpower
- Cost of energy conservation options
- Orthodox mind set of entrepreneurs
- Non availability of clean fuels

Details of the other barriers in the implementation of energy efficient technologies / equipments in the Alwar Oil Mill cluster are presented in below sections:

2.5.1 TECHNOLOGICAL BARRIER

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

Most of Oil Mill units in Alwar Oil cluster have been established several years ago when energy efficiency was not important issue for the operation of a plant. They are operating with outdated technology and low end technologies.

As 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 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 Oil Mill unit entrepreneurs that, energy efficiency initiatives are difficult and they do not wish to take the risks such as business interruption due to production loss vis-a-vis the drive to save energy. These can however be overcome by motivating them to attend the awareness programs and use the 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.

2.5.2 FINANCIAL BARRIER

Significant amount of investment is not commonly seen in most of Alwar Oil industries. 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, 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 entrepreneurs from Oil units in Alwar, they would not take the risks to invest in energy efficiency measures.

2.5.3 MANPOWER

Skilled workers are locally available to operate machines available in Alwar. However, there is hardly any engineer employed in these enterprises and the production process remains traditional. This is one of the lacunae of the Alwar Oil Mill cluster.

Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness among workforce. These programs should be organized with equipment suppliers.

CHAPTER 3

ENERGY USE AND TECHNOLOGY ASSESSMENT IN CLUSTER

Energy Audit team have assessed the energy productivity of unit through a detailed study and discussed the various energy issues.

3.1 METHODOLOGY ADOPTED FOR ENERGY USE & TECHNOLOGY AUDIT STUDIES

A well planned methodology was adopted to execute the energy use and technology audit studies and to achieve the desired project objectives. Major steps which were followed during the energy use & technology studies of the project are mentioned below:

- Data Collection
- Measurements
- Analysis
- Technical discussion
- Conclusion

The primary objective of the energy audits is to quantify the existing electricity consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operating practices. Pre-planned methodology was followed to conduct the energy audits. The following sections describe details of methodology adopted in energy use and technology audits in Alwar Oil cluster.

At site team has collected all relevant information related to energy with respect to production. At all required places measurement being taken with involvement of plant people. Analysis of all the data captured being done and then on basis of measurement discussion was held on with plant.

3.1.1.1 PRE ENERGY AUDIT ACTIVITIES

The association provides a platform for development of mutual understanding among the industries and discussion relating to common problems and identification of viable solution. Therefore, as a first step for making inroads in the cluster, the association and its office bearers were approached. Detailed discussions with the association were held on apprising the association about the objective of the project, tentative schedule of the activities being undertaken and expected project outcome.

The office bearers of associations were apprised about benefits of the project for the industries and cluster. The association took up the task of dissemination of all this

information among their respective member units. The outcome of this activity was introduction of project concept to the association and later on to the industry. This helped in identifying progressive and interested entrepreneurs in the cluster.

Energy Audit team have assessed the energy productivity of unit through a study and discussed the various energy issues. At first energy audit team have taken plant round to have feel of plant and to understand plant team expectation through energy audit. Plant management assigned one technical person as coordinator, who has given all kind of details of energy and in his presence data measurement being taken. Finally at end of audit, there was discussion with all plant team regarding findings of energy saving in plant.

3.1.1.2 PRELIMINARY ENERGY STUDY

17 Preliminary energy audit studies are conducted in Alwar Oil cluster. Methodology followed in preliminary energy audit study is presented below:

- Collection of past energy consumption details and energy bill
- List out major energy consuming areas of the plant
- Existing technology of various processes and utilities (latest or old, local or reputed company make etc)
- Identification of the areas for special attention for low cost measures with quick payback period
- Understanding the detailed process with energy and material balance
- Establish specific energy consumption, if possible for the each typical equipment/process
- Identify the areas for detailed energy audit study and measurements required

Preliminary energy study being done to plant which are having capacity of less than 50 MT. some of plants are having one or two expellers, whose power measurement being done. On basis of power study suggestions being discussed with plant team. Similarly lighting study was conducted at plant which is also having good potential for energy savings.

3.1.1.3 DETAILED ENERGY STUDY

Detailed energy study being done at plants which are having capacity more than 50 MT. For detailed energy study every expellers and kolhus power measurement was taken and with respect to measured data, suggestion is given to plant people. Energy Audit team has satisfied the plant expectation, after discussing the energy saving findings in their plant. 26 Detailed energy audit studies are conducted in Alwar Oil cluster. The methodology followed in detailed energy audit study is presented below:

- Collection of past energy consumption details and energy bill

- Listing of major energy consuming areas of the plant
- Identifying existing technology of various processes and utilities (latest or old, crude or efficient, local or reputed company make etc)
- Status of instruments installed in the plant and necessary instrumentation required for the detailed study
- Identification of the areas for special attention for low cost measures with quick payback period
- Understanding the detailed process with energy and material balance
- Monitoring & measuring of different parameters of various equipment / machines to evaluate performance
- Collection of operational data from various measuring instruments / gauges installed in the plant
- Compilation of design data/name plate details of various equipment from design manuals and brochures
- Discussions with concerned plant personnel to take note of operating practices and shop-floor practices being followed in the plant and to identify specific problem areas and bottlenecks if any with respect to energy consumption
- Critical analysis of data collected and parameters monitored
- Identification of energy wastage areas and quantification of energy losses
- Identification of suitable energy conservation measures for reducing energy consumption

3.2 OBSERVATIONS MADE DURING THE ENERGY USE AND TECHNOLOGY STUDIES CARRIED OUT IN THE CLUSTER

Energy audit team made lots of observations during visits, that includes oil manufacturing process, technology or equipment employed, energy availability, utility energy consumption and many more which are listed below.

3.2.1 MANUFACTURING PROCESS AND TECHNOLOGY/ EQUIPMENT EMPLOYED

Manufacturing process involve extraction of oil from mustard seed. Raw material used for oil production is mustard, which is purchased from Local Mandi of Alwar and Sawaimadhopur.

To get oil from raw mustard seed, it is first passed through Kolhu and the waste (oil cake) from the kolhu is then passed through Expeller which extracts more oil from the same oil cake. Remaining oil cake is processed in solvent extraction plant or sold out in market.

Seed passes through various processes of crushing so oil is extracted. After extracting oil from machines, it is sent for filtration to fine filter cloth. Filtered oil goes to oil filling plant where oil is filled in bottles as per requirement and finally packed in cartoon to send

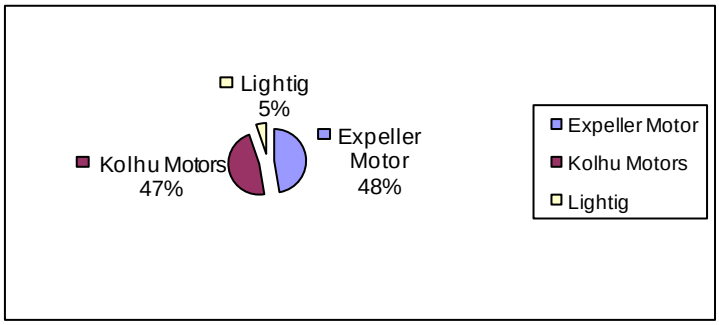
at required places across India.

Equipment employed:

1) Seed Cracker
2) Kolhu
3) Expeller
4) Oil filter
5) Bottling machine
6) Oil filling machine
7) Packing machine

3.2.2 ENERGY CONSUMPTION PROFILE AND AVAILABILITY

Energy consumption profile varies from starting to end of process. Highest energy consuming equipments are kolhus and double pass expellers. As far as energy consumption profile is concerned its pattern remains same as process continues.



3.2.3 CAPACITY UTILIZATION FACTOR

Capacity utilisation factor can be divided into two parts:

1) Machine capacity utilization factor
2) Plant capacity utilization factor

As far as Machine capacity utilization is concerned, it varies. Some of the machines run only for 7 hrs in a day to produce oil, while some runs for 20 hrs in day. Plant utilization factor varies well enough because some of the plant runs only for 6 hrs in a day while some runs for 24 hrs. It varies because of demand variation in market or availability of mustard seed in market.

3.2.4 HOUSEKEEPING PRACTICES

There is good enough space in housekeeping for both raw mustard seed and mustard oil. Raw mustard seed are having large godown for keeping mustard seed bag each of

85 kg. Godown size varies as per plant size. It is good practice of keeping raw seed in good condition such as good day light utilization, systematic arrangement of bags, good material management etc. Plant people store the required raw material for running of plant.

Plant people also have given good housekeeping practice for mustard oil in packed cartoons. These cartoons are packed according to requirement and dispatched accordingly.

3.2.5 AVAILABILITY OF DATA INFORMATION

A majority of the units in Alwar cluster do not have any instrumentation or data monitoring systems to monitor various operational parameters in processes/equipments/utilities. Few instruments are installed in some of the units in the cluster for monitoring of operational parameters in their units. Accuracy of readings from these instruments is also poor.

Most of entrepreneurs in Alwar Oil cluster are not interested in sharing the energy consumption data, due to various reasons. Very few entrepreneurs share their energy consumption against production data in the respective months/annum.

Plant people based on their experience shared the oil extraction from each machines. Energy audit team had taken all the required data to analyze so that specific energy consumption of plant can be reduced. Some of the plant maintains the data which is required for oil quality, that are % of oil content in seed, % of moisture content in seed

Plant people show a good co-operation during energy study, which made smooth running of project.

3.3 TECHNOLOGY GAP ANALYSIS

Oil Mill units in unorganized sector has these characteristics; low engineering, limited technology innovation, poor R&D base, low level of human resource on knowledge of technology and operational skill etc. This sector also faces deficiencies such as the lack of access to technology, technology sharing, lack of strong organizational structure, professional attitude etc. Majority of Oil units in Alwar Oil cluster are using low end technologies in their processes and utilities. The performance of those processes/equipments is poor as compared to the technologies available in the market. There are various technological gaps which were identified in units as under:

- Lack awareness on the technologies available
- Lack of awareness on quantum of energy loss and its monetary benefit
- Lack of awareness among the workforce etc.

There is a tremendous need for this industry to modernize/upgrade its technology and

adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the some of the progressive managements, they are interested in improve the efficiency their units by replacing the conventional technology with energy efficient technologies in market.

From technology audit studies conducted in Alwar Oil cluster, below mentioned areas were identified for technology up gradations; those are:

- Conventional Expeller Motors
- Conventional Kolhus

As far as technology is concerned, most of the units are running traditionally. Almost all units are using old / re-winded motors, old expellers and exhaust fans which are not new technological equipments. All equipments are having high energy consumption. There are various reasons of not having technology up-gradation in oil mill units and they are as follows:

- Remote location
- Unskilled labour
- Lack of awareness
- Stringent with same process flow

3.3.1 TECHNOLOGY UP-GRADATION

There is various new technologies available for above said equipments which are not only energy efficient but also having good productivity. Technology up gradation can be done in every equipments and utilities which are installed. All the equipments which are installed are very old such as, almost all the motors are re-winded many times, old expellers, kolhus. Instead of using these old expellers, Energy Efficient Expellers are available. In similar manner now natural wind eco-ventilators are available in market which easily can replace large numbers of exhaust fans. Energy efficient lamps are available in market which is very competitive with other incandescent lamps. For utilizing day light now transparent sheets are available in market which can reduce the operating hours of lamps. For street lights, new lamps are available in market which not only saves energy but also gives good lux level.

Equipments	Old Technologies	New Technologies	Saving Potential
Expellers	60 HP motor on 48” x 8”	50 HP motor on 48” x 8”	15 %
Gear box		Tested alloy steel. Induction and oil quenching hardness to gears for long life	Longer life

Kolhu			
HPSV lamps	250 W	FTL of (24 x 4) W	60%
HPSV lamps	150 W	FTL of (14 X 4) W	60%
DG	Idle running	Battry back up	50%

Usage	Old Equipments	New Equipments	Saving Potential
Removal of hot and humid air	Exhaust fan (1-2 hp)	Eco Ventilator	100%
Day Light utilisation	Incandensate lamps etc.	Translucent sheets	100% for day time
Kolhu			

3.3.2 PROCESS UP-GRADATION

For up-gradation of process; plant people can go for solvent extraction facility, to extract almost complete oil from mustard seed. To up-grade process of smaller units, they can go for oil filling division in canes and directly can sell in market. Some of the units are not having seed cracker, which leads to more power consumption of kolhu as well as lead to adulteration of oil. Bottling manufacturing and Jar manufacturing units can be installed to have less dependency on other units.

3.4 ENERGY CONSERVATION MEASURES IDENTIFIED

Complete process of oil manufacturing is studied and energy audit team has discussed the various energy saving projects with plant team. There are various energy saving projects which involve processing of raw mustard seed cracker, kolhu motors, Expeller motors, Exhaust system, Lighting system, Power back up system which are discussed with plant people and convinced them about new technologies which are available in market.

3.4.1 PROPOSAL FOR ENERGY CONSERVATION INCLUDING TECHNOLOGY UP GRADATION

Various energy conservation proposals are identified for Oil Mill units in Alwar Oil Mill cluster. Details of identified energy conservation proposals along with its cost benefit analysis and issues in implementation of each proposal are presented in following sections.

1. Installation of Eco Ventilator in Place of Exhaust Fan
2. Replace Re-winded Motors by Energy Efficient Motor
3. Replace 40 W Light by T5, 28 W Light
4. Provide Translucent Sheets in the Cleaning Section Area and avoid Artificial Light

during Day Time

5. Optimize lighting voltage to 210 V by installing voltage stabilizer
6. Replace 250 W HPSV lamps by 24 X 4 W
7. Replace 150 W HPSV lamps by 14 X 4 W
8. Installation of APFC to maintain unity power factor
9. Replace 500 W halogen lamps by 85 W CFL
10. Optimize idle running of Diesel Generator
11. Insulate DG exhaust pipe
12. Changeover from slip ring induction motor to squirrel cage

A) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR -

INSTALLATION OF ECO VENTILATORS IN PLACE OF EXHAUST FANS

Background

Oil fumes creates a lot of problem in working area of plant, so exhaust fans are used but that uses electricity for fumes removal. If we place an eco ventilator then we can save lot of electricity. It was observed that air circulators are continuously ON during the shift. Plant temperature was 30oC while oil fumes in the plant were very high. High oil fumes create sweating and itching in eye which gives requirement of starting air circulation.

Installation of Eco Ventilators will increase number of air changes and will reduce the oil fumes and hot air in the plant.

Operating principle of eco ventilator:-

A natural air ventilator works on natural movement of wind by utilizing the velocity energy of wind to induce air flow by centrifugal action. Centrifugal force on ventilator is caused by spinning of blades that create a low pressure region, which attracts and throws out the hot air allowing it to be replaced by fresh and cool air from outside with the help of spinning vanes that creates a region of low pressure. The Fly Wheel Effect of the Rotor cage helps to use stored energy to provide continue ventilation, even-when, the breeze stops the ventilator to spin. Ecovent's suction process works on slowest velocity of wind as well, therby ventillating the heat and moisture at all wind speed – even when there is no wind, the flywheel affects the rotor cage uses the stored energy to constantly remove the unwanted air, giving rise to ventilation.

3.4.1.2 Benefits of Implementing Installation of Eco Ventilators in place of Exhaust Fans;

Advantages:-

- No Electricity charges
- No Maintenance costs

- Propelled natural wind
- Hot air directly exhausted through ventilator
- Improved working condition
- Increases productivity
- Whether and storm proof
- High temperature alloy material
- Easy to install
- Eco friendly and economical

3.4.1.3 Life cycle analysis for Implementing Installation of Eco Ventilators in place of Exhaust Fans

Calculation

Installed eco ventilators save the power consumption of exhaust fans. Although these exhaust fans are having low power consumption that is in range of 1-1.5 kW, but these exhaust fans are required in large quantity. So cumulatively it saves lot of electrical energy.

Equipment	Power Consumption
Exhaust fan	0.75 kW
Eco Ventilator	Nil

Comparison of energy consumption between Exhaust fan and Eco ventilator

Saving	0.75 kW
Running Hours	7000 hrs/year
Energy Saving	= 0.75 kW/fan x 7000 hrs/yr X Rs. 4.8 / kWh = **Rs. 0.25 Lakh/ year/fan**

As far as life of eco ventilator is concerned, they are not having any power driven equipments, so it last for very long time.

3.4.1.4 Cost of implementing proposal of Installation of Eco Ventilators in place of Exhaust Fans

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of eco ventilators lies in range of Rs. 3500 - 4000 per Eco ventilator. Some of the units are not having facility to install eco ventilator, because of their RCC roof structure. Other than that plants can install eco ventilator to have good working condition as well as to reduce energy consumption. Kolhu division will require more numbers of eco ventilators than Expeller division, since kolhu gives more oil fumes at working area. Total cost of implementation of eco ventilators for all the units in Alwar and Sawaimadhopur is approx. Rs. 2.34 Lakhs.

3.4.1.5 Monetary Saving from implementing proposal of Installation of Eco Ventilators in place of Exhaust Fans

Installation of eco ventilators are gives a good energy saving potential and so money saving. As already said most of the units can install eco ventilators, it will lead to shut off all the exhaust fans. In almost all the units exhaust fan runs continuously which lead to increase in energy consumption of units. Eco ventilator will save approx 2.2 Lakhs kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of eco ventilators will be approx. Rs. 10.91 Lakhs.

3.4.1.6 Simple payback period of implementing proposal of Installation of Eco Ventilators in place of Exhaust Fans

Installation of Eco Ventilators in place of Exhaust Fans has very lucrative payback of only Three Months

$$\text{Payback (Months)} = \frac{\text{Investment x 12}}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Installation of Eco Ventilators in place of Exhaust Fans

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal does not require much capital for implementation, so could be implemented at first priority. It is advisable to use eco ventilators and at that time do not run the exhaust fan, since it nullifies the effects of pressure difference. Small issues may arise from labor side is because of psychological effects of not using exhaust fans. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to remove hot and humid oil fumes from plant with no electricity consumption and that is use of eco ventilators. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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Mr. Tarun Vijay

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M B House Stadium Road

Ahmedabad

07926405563/26461314

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B) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF RE-WINDED MOTORS BY ENERGY EFFICIENT MOTORS

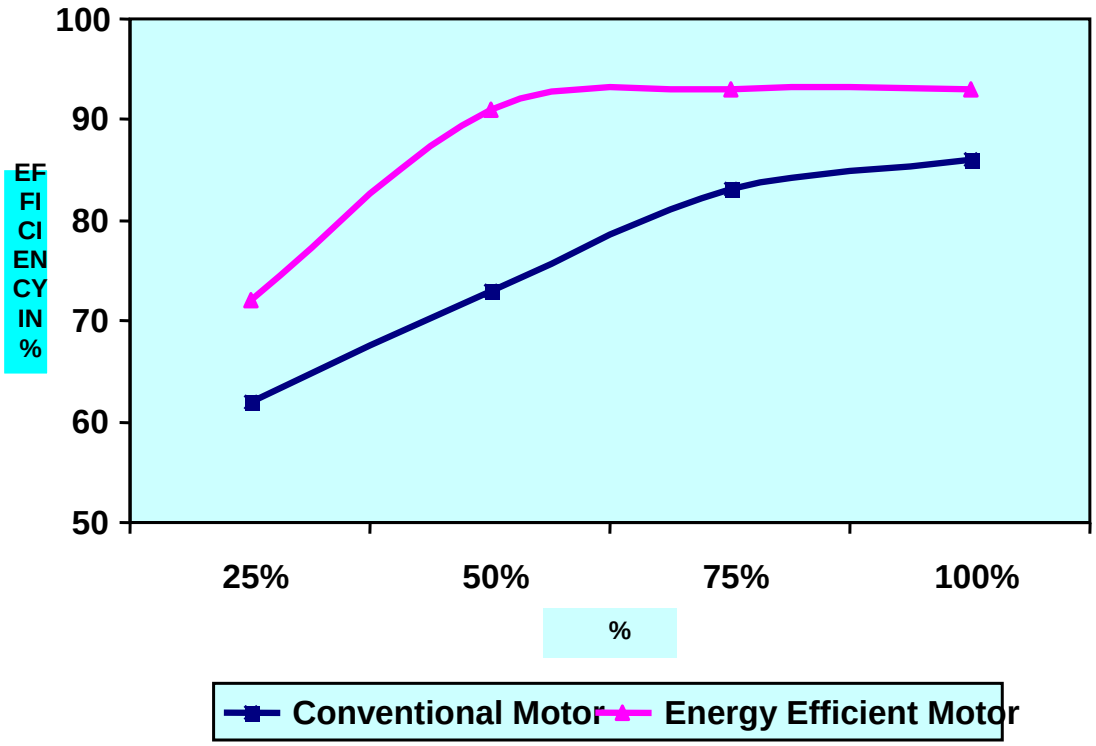
Background

Each and every Kolhu and Expellers motors were studied during visit, its instantaneous power measurement being taken at site to analyze the motors.

During the audit it was observed that the maximum of motors are re-winded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors.

Standard vs High Efficiency Motors

Efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.



3.4.1.2 Benefits of Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Advantages:-

- Less power consumption
- High efficiency
- Less losses
- Wide range with good efficiency
- Less starting torque

3.4.1.3 Life cycle analysis for Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Calculation

Installation of Energy efficient motors in place of re-winded motors will save the power, as Energy efficient motors (EEF1) have 4-5 % efficiency higher than standard motor. Higher efficiency lead to save lot of energy as all these motors are having large capacity of around 40-60 hp.

Equipment (50 hp)	Power consumption

Standard / Re-winded motor	32 kW
Energy efficient motor	30 kW
Saving potential	2 kW

Comparison of energy consumption between Standard and energy efficient motor

Saving	2 kW/motor
Running Hours	10 hrs/day 7000 hrs/year
Energy Saving	= 2 kW/Motor x 7000 hrs/yr X Rs. 4.8 / kWh = **Rs. 0.67 lakh/ year/motor**

As far as life cycle of Energy efficient motor is concerned, they are having long time than standard motor. Its life is approx 15-20 years.

3.4.1.4 Cost of Implementing Replacement of Re-winded Motors by Energy Efficient Motors

Cost of implementing this proposal varies in plant as per capacity and size of plant. Kolhu and Expeller motors require Energy efficient motors since almost plant load is by these motors. Total cost of implementation of Energy efficient motors for all the units in Alwar and Sawaimadhopur is approx. **Rs. 172.0 Lakhs**

3.4.1.5 Monetary Saving from Replacement of Re-winded Motors by Energy Efficient Motors

Installation of energy efficient motor gives a good energy saving potential and so money is saving. In almost all the units standard motors runs continuously which lead to increase in energy consumption of oil units. Energy efficient motors will save approx **14 Lakhs kWh** for Alwar and Sawaimadhopur units. Monetary Saving after installation of Energy efficient motors will be approx. **Rs. 70.0 Lakhs**

3.4.1.6 Simple payback period of Replacement of Re-winded Motors by Energy Efficient Motors

Installation of energy efficient motors in place of standard motors has payback of only 29 Months.

$$\text{Payback (Months)} = \frac{\text{Investment} \times 12}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation Replacement of Re-winded Motors by Energy Efficient Motors

Major issue in implementing this proposal is cost of implementation. All the technical and commercial aspects have been discussed with unit people. It is advisable to use Energy efficient motors at place of re-winded motors. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available.

3.4.2 Availability of technology / Product in local/ National / International Market

Now days when energy cost is high, it is poor practice to use re-winded motors. As far as technology is concerned Energy efficient motors are available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units. Local vendors can arrange energy efficient motors at order.

3.4.3 Availability of local service providers who can take up abovementioned proposals

Make - Kirloskar

Mr. Kamlesh Gupta

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Mob: +91 9414019126/ 09414019126

M/s Vijay Agency

Mr. Jagdish Agarwal

Opp Shiv Mandir, Station

Bazaria,Sawai-Madhopur

Tel 07462-220678 (O) 222577 (R)

C) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

PROVIDE TRANSLUCENT SHEETS IN PLANT AND AVOID ARTIFICIAL LIGHT DURING DAY TIME

Background

Artificial light consumes good amount of energy as it runs continuously for 8- 10 hours in daytime. This amount of energy can be reduced by installing translucent sheet for maximum utilization of natural light in the plant area. In plant section, there are many fluorescent lamps, incandescent lamps which can be replaced by translucent sheet. Not only has this but continuous running of lamps increased its failure rate, which again investment of money.

During day time there is a possibility of providing translucent sheets in the shed and avoid operation of these lamps during day time. This will result in two benefits:

1. Reduction in energy consumption
2. Reduction in failure rate of lamps

Installation of Translucent sheet will increase lux level in plant and will reduce the power consumption of plant.

Working of Translucent sheet:-

Translucent sheet convert the direct beam radiation from sun into diffused radiation. Diffused radiation are very good for seeing purposes and will not increase the temperature much because it will convert some of the heat energy of sun beam into light.

Its properties are its transparent and its thermoplastic nature gives alternative to glass.

3.4.1.2 Benefits of providing translucent sheets in plant and avoid artificial light during day time

Advantages:

- Good strength
- Low cost
- No harmful constituents
- Day light utilisation
- Improvement in lux level
- Weather and storm proof
- Easy to install
- Eco friendly and economical
- Corrosion resistant

3.4.1.3 Life cycle analysis for providing translucent sheets in plant and avoid artificial light during day time

Calculation

Installation of translucent sheet will save the power consumption of all incandescent as well as fluorescent lamp. Although these lamps are having low power consumption that is in range of 55 W -100 W, but these lamps are required in large quantity to provide light in plant. So cumulatively it saves lot of electrical energy.

Equipment	Power consumption
Incandescent lamp	100 W
Fluorescent lamp	55 W
Translucent sheet	Nil

Comparison of energy consumption between artificial light & translucent sheets;

Saving	100 W (Incandescent lamp)	55 W (Florescent lamp)
Running Hours	8 hrs/day 2400 hrs/year	8 hrs/day 2400 hrs/year
Energy Saving	=0.10 kW/lamp x 2400 hrs/yr X Rs. 4.8 / kWh = **Rs. 1150/ year/lamp**	= 0.055 kW/lamp x 2400 hrs/yr X Rs. 4.8 / kWh = **Rs. 650/ year/lamp**

As far as life cycle of translucent sheet is concerned, they are not having any moving equipments, so it last for very long time.

3.4.1.4 Cost of implementing proposal of providing translucent sheets in plant and avoid artificial light during day time

Cost of implementing this proposal varies in plant as per capacity and size of plant. Some of the units are not having facility to install translucent sheets, because of their RCC roof structure. Other than that plants can install translucent sheet to have good working condition as well as to reduce energy consumption. Kolhu division and Expeller division will require more numbers translucent sheet. Total cost of implementation of providing translucent sheet for all the units in Alwar and Sawaimadhopur is approx. **Rs. 0.6 Lakhs.**

3.4.1.5 Monetary saving from providing translucent sheets in plant and avoid artificial light during day time

Installation of translucent sheet gives a good energy saving potential and so money saving. As already said most of the units can install translucent sheet, it will lead to shut off all the lamps in day time. In almost all the units lamps runs continuously which lead to increase in energy consumption of oil units. Translucent sheet will save approx **16250 kWh** for Alwar and Sawaimadhopur units. Monetary Saving after installation of translucent sheet will be approx. **Rs. 0.8 Lakhs**

3.4.1.6 Simple payback period of implementing proposal of providing translucent sheets in plant and avoid artificial light during day time

Utilisation of Translucent sheet in place has very lucrative payback of only Nine Months.

$$\text{Payback (Months)} = \frac{\textbf{Investment x 12}}{\textbf{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of providing translucent sheets in plant and avoid artificial light during day time

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal does not require much capital for implementation, so could be implemented on priority basis. It is advisable to use translucent sheet and at day time and do not run the artificial lamps. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of translucent sheet are available.

3.4.2 Availability of technology / Product in local/ National / International Market

Now days when energy cost is high, it is poor practice to use lamps at day time. As far as technology is concerned translucent sheets are available in local/ national market. There are various technologies available to use natural day light in plant with no electricity. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up above mentioned proposals

M/s B.S. Fibres

Mr. Mahesh Khandelwal

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D) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

INSTALLATION OF T5 LAMPS IN PLACE OF 40 W LIGHT

Background

During Audit, study of lighting was carried out for energy saving. In plant area there are many lights of 40 w each, with electrical choke which are having losses of 15 watts/ballast. Energy efficient T5, 28 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power.

Reflector lamps are used when light is only desired to be emitted in a single direction, or when an application requires the maximum amount of light. T5 lamps deliver 2900 Lumens, which is more than 2000 lumens with 40 W tubes.

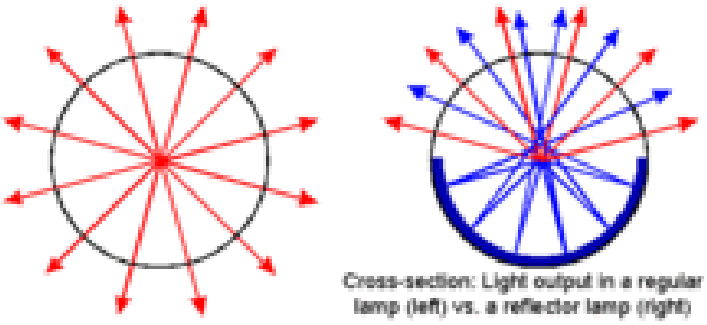
Operating principle of Fluorescent lamps:-

A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The fundamental means for conversion of electrical energy into radiant energy in a fluorescent lamp relies on inelastic scattering of electrons. An incident electron collides with an atom in the gas. If the free electron has enough kinetic energy, it transfers energy to the atom's outer electron, causing that electron to temporarily jump up to a higher energy level. The collision is 'inelastic' because a loss of energy occurs.

This higher energy state is unstable, and the atom will emit an ultraviolet photon as the atom's electron reverts to a lower, more stable, energy level. Most of the photons that are released from the mercury atoms have wavelengths in the ultraviolet (UV) region of the spectrum predominantly at wavelengths of 253.7 nm and 185 nm. These are not visible to the human eye, so they must be converted into visible light. This is done by making use of fluorescence. Ultraviolet photons are absorbed by electrons in the atoms of the lamp's interior fluorescent coating, causing a similar energy jump, then drop, with emission of a further photon. The photon that is emitted from this second interaction has a lower energy than the one that caused it. The chemicals that make up the phosphor are chosen so that these emitted photons are at wavelengths visible to the human eye. The difference in energy between the absorbed ultra-violet photon and the emitted visible light photon goes toward heating up the phosphor coating.

When the light is turned on, the electric power heats up the cathode to emit electrons. These electrons collide with and ionize noble gas atoms inside the bulb surrounding the filament to form plasma by a process of impact ionization. As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp. The lamp is more costly because it requires a ballast to regulate

the current through the lamp.



Cross-section: Light output in a regular lamp (left) vs. a reflector lamp (right)

T-5 Lamps

3.4.1.2 Benefits of Implementing T5 lamps in place of 40 W Light

Advantages:-

- Low mercury content
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches

- Reduces sick building syndrome
- Operates at low voltage
- High PF (0.99)
- Instant start up

3.4.1.3 Life cycle analysis for Implementing T5 lamps in place of 40 W Light

Calculation

Installed fluorescent lamps saves power consumption for lighting since it saves running power of light. In all units there are many tube lights with electrical choke, whose power consumption is higher than T 5 lamps which are with electronic choke.

Type of Lamp	Power Consumption including ballast
Conventional fluorescent lamp (40 W with electrical choke)	55 W / Tube
Energy efficient T5 lamp (28 W with electronic choke)	28 W / Tube

Comparison of energy consumption between 40 W lamp and T5 lamps;

Saving	25 W / lamp
Running Hours	5000 hrs/year
Energy Saving	= 0.025 kW/lamp x 5000 hrs/yr X Rs. 4.8 / kWh = **Rs. 600/ year/lamp**

Typically a fluorescent lamp will last between 10 to 20 times as long as an equivalent incandescent lamp when operated several hours at a time. The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labour is costly. Replacement of T5 lamps can be done on failure and replacement basis for any lamp.

3.4.1.4 Cost of implementing proposal of Installation of T5 lamps in place of 40 W Light

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of T-5 lamps lies in range of 600-700 each. All the units can replace existing 40 W tubes light with energy efficient T5 lamps of 28 W. Total cost of implementation of T5 lamps in place of 40 W tubes for all the units in Alwar and Sawaimadhopur is approx. **Rs. 3.0 Lakhs**.

3.4.1.5 Monetary saving from implementing proposal of Installation of T5 lamps in place of 40 W Light

Installation of T5 lamps gives a good energy saving potential and so money saving. As already said all units can install T 5 lamps, it will lead to save running power of 40 W tubes. In almost all the units 40 W tube runs continuously which lead to increase in energy consumption of units. Replacement of T5 lamps will save approx 42,660 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of eco ventilators will be approx. **Rs. 1.9 Lakhs.**

3.4.1.6 Simple payback period of implementing proposal of Installation of T5 lamps in place of 40 W Light

Installation of T 5 lamps in place of 40 W tubes has payback of only Eighteen to Ninteen Months

$$\text{Payback (Months)} = \frac{\text{Investment x 12}}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Installation of T5 lamps in place of 40 W Light

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use T5 lamps on failure and replacement basis. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to use electrical energy efficiently for lighting purposes. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up above mentioned proposals

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E) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF 250 W HPSV LAMPS BY (24 X 4) W T5 LAMPS

Background

During Audit, study of lighting was carried out for energy saving. In plant area there are many lights of 250 W, high pressure mercury vapor lamp. Energy efficient T5, 24 x 4 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power. HPSV lamps are mainly used for street lighting or in plant.

Reflector lamps are used when light is only desired to be emitted in a single direction, or when an application requires the maximum amount of light.

Operating principle of Fluorescent lamps:-

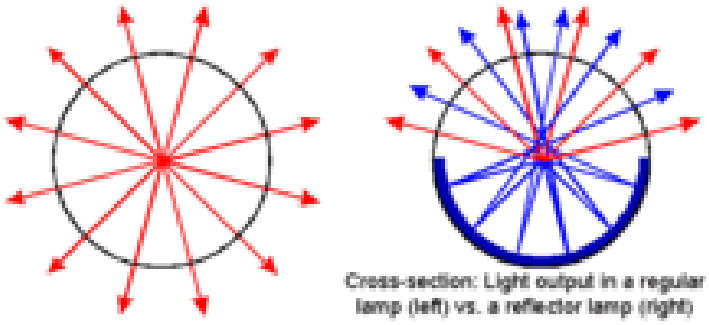
A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The fundamental means for conversion of electrical energy into radiant energy in a fluorescent lamp relies on inelastic scattering of electrons. An incident electron collides with an atom in the gas. If the free electron has enough kinetic energy, it transfers energy to the atom's outer electron, causing that electron to temporarily jump up to a higher energy level. The collision is 'inelastic' because a loss of energy occurs.

This higher energy state is unstable, and the atom will emit an ultraviolet photon as the atom's electron reverts to a lower, more stable, energy level. Most of the photons that are released from the mercury atoms have wavelengths in the ultraviolet (UV) region of the spectrum predominantly at wavelengths of 253.7 nm and 185 nm. These are not visible to the human eye, so they must be converted into visible light. This is done by making use of fluorescence. Ultraviolet photons are absorbed by electrons in the atoms of the lamp's interior fluorescent coating, causing a similar energy jump, then drop, with emission of a further photon. The photon that is emitted from this second interaction has a lower energy than the one that caused it. The chemicals that make up the phosphor are chosen so that these emitted photons are at wavelengths visible to the human eye. The difference in energy between the absorbed ultra-violet photon and the emitted visible light photon goes toward heating up the phosphor coating.

When the light is turned on, the electric power heats up the cathode enough for it to emit electrons. These electrons collide with and ionize noble gas atoms inside the bulb surrounding the filament to form a plasma by a process of impact ionization. As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp.

The lamp is more costly because it requires a ballast to regulate the current through the

lamp.



3.4.1.2 Benefits of Implementing Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

Advantages:-

- Low mercury content
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches
- Reduces sick building syndrome
- Operates at low voltage
- High PF (0.99)
- Instant start up

3.4.1.3 Life cycle analysis for Implementing Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

Calculation

Installing (24 x 4) lamps in place of 250 W HPSV lamps saves power consumption for lighting since it saves running power of light. In some units HPSV lamps are used for street lighting purpose. All street lighting can be replaced by 24 x 4 lamps whose power consumption is much lower than HPSV lamps.

Type of Lamp	Power Consumption including ballast
HPSV lamps (250 W)	250 W
Energy efficient T5 lamp (24 x 4 W)	96 W / assembly

Comparison of energy consumption between 40 W lamp and T5 lamps:

Saving	150 W / lamp
Running Hours	3000 hrs/year
Energy Saving	= 0.150 kW/lamp x 3000 hrs/yr X Rs. 4.8 / kWh = **Rs. 2160/ year/lamp**

The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labour is costly. Replacement of HPSV lamps by 24 x 4 W can be done on failure and replacement basis for any lamp.

3.4.1.4 Cost of implementing proposal of Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of 24 x 4 W lamps lies in range of 3500-4500 each. Some of the units are only having HPSV lamps for street lighting purposes, which can be replaced by 24 x4 W lamps. Total cost of implementation of 24 x 4 W lamps in place of HPSV lamps for all the units in Alwar and Sawaimadhopur is approx**. Rs. 0.8 Lakh.**

3.4.1.5 Monetary saving from implementing proposal of Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

Installation of (24 x 4)W lamps gives a good energy saving potential and so money saving. As already said only some of the units are having HPSV lamps which can be replaced by (24 x 4) W lamps. Replacment of HPSV lamps by 24 x 4 W T5 lamps will save approx 10,410 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of 24 x 4 W lamps will be approx. **Rs. 0.5 Lakh.**

3.4.1.6 Simple payback period of implementing proposal of Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

Installation of 24 x 4 W lamps in place of 250 W HPSV lamps has payback of only Eighteen to Nineteen Months

$$\text{Payback (Months)} = \frac{\text{Investment x 12}}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Replacement of 250 W HPSV lamps by (24 x 4) W T5 lamps

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use 24 x 4 W lamps in place of 250 W HPSV on failure and replacement basis.

One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to use electrical energy efficiently for lighting purposes. It is well proven technology which is adopted in many of the other similar and dissimilar units. In-fact some of the units in Alwar has already installed this lamps, and getting energy saving.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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F) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF 150 W HPSV LAMPS BY (14 X 4) W T5 LAMPS

Background

During Audit, study of lighting was carried out for energy saving. In plant area there are many lights of 150 W, high pressure mercury vapor lamp. Energy efficient T5, 14 x 4 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power. HPSV lamps are mainly used for street lighting or in plant.

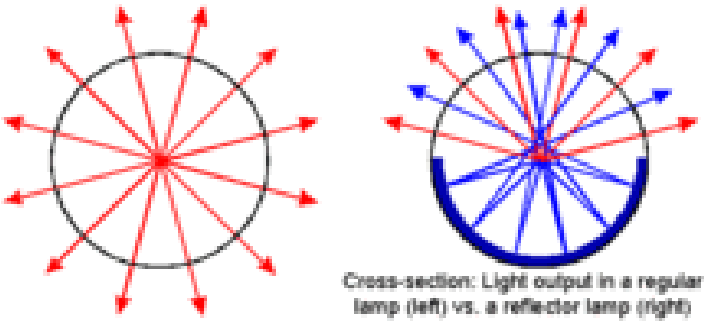
Reflector lamps are used when light is only desired to be emitted in a single direction, or when an application requires the maximum amount of light.

Operating principle of Fluorescent lamps:

A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The fundamental means for conversion of electrical energy into radiant energy in a fluorescent lamp relies on inelastic scattering of electrons. An incident electron collides with an atom in the gas. If the free electron has enough kinetic energy, it transfers energy to the atom's outer electron, causing that electron to temporarily jump up to a higher energy level. The collision is 'inelastic' because a loss of energy occurs. This higher energy state is unstable, and the atom will emit an ultraviolet photon as the atom's electron reverts to a lower, more stable, energy level. Most of the photons that are released from the mercury atoms have wavelengths in the ultraviolet (UV) region of the spectrum predominantly at wavelengths of 253.7 nm and 185 nm. These are not visible to the human eye, so they must be converted into visible light. This is done by making use of fluorescence. Ultraviolet photons are absorbed by electrons in the atoms of the lamp's interior fluorescent coating, causing a similar energy jump, then drop, with emission of a further photon. The photon that is emitted from this second interaction has a lower energy than the one that caused it. The chemicals that make up the phosphor are chosen so that these emitted photons are at wavelengths visible to the human eye. The difference in energy between the absorbed ultra-violet photon and the emitted visible light photon goes toward heating up the phosphor coating.

When the light is turned on, the electric power heats up the cathode enough for it to emit electrons. These electrons collide with and ionize noble gas atoms inside the bulb surrounding the filament to form plasma by a process of impact ionization. As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp.

The lamp is more costly because it requires a ballast to regulate the current through the lamp.



Cross-section: Light output in a regular lamp (left) vs. a reflector lamp (right)

3.4.1.2 Benefits of Implementing Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

Advantages:-

- Low mercury content
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches
- Reduces sick building syndrome
- Operates at low voltage
- High PF (0.99)
- Instant start up

3.4.1.3 Life cycle analysis for Implementing Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

Calculation

Installing (14 x 4) lamps in place of 150 W HPSV lamps saves power consumption for lighting since it saves running power of light. In some units HPSV lamps are used for street lighting purpose.

All street lighting can be replaced by 14 x 4 lamps whose power consumption is much lower than HPSV lamps.

Type of Lamp	Power Consumption including ballast
HPSV lamps (150 W)	150 W
Energy efficient T5 lamp (14 x 4 W)	56 W / assembly

Comparison of energy consumption between 40 W lamp and T5 lamps

Saving	94 W / lamp
Running Hours	3000 hrs/year
Energy Saving	= 0.094 kW/lamp x 3000 hrs/yr X Rs. 4.8 / kWh = **Rs. 1350/ year/lamp**

The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labor is costly. Replacement of HPSV lamps by 14 x 4 W can be done on failure and replacement basis for any lamp.

3.4.1.4 Cost of implementing proposal of Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of 14 x 4 W lamps lies in range of 3000-4000 each. Some of the units are only having HPSV lamps for street lighting purposes, which can be replaced by 14 x4 W lamps. Total cost of implementation of 14 x 4 W lamps in place of HPSV lamps for all the units in Alwar and Sawaimadhopur is approx. **Rs. 1.7 Lakhs.**

3.4.1.5 Monetary saving from implementing proposal of Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

Installation of (14 x 4)W lamps gives a good energy saving potential and so money saving. As already said only some of the units are having HPSV lamps which can be replaced by (14 x 4) W lamps. Replacement of HPSV lamps by 14 x 4 W T5 lamps will save approx 15625 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of 14 x 4 W lamps will be approx. **Rs. 0.75 Lakh.**

3.4.1.6 Simple payback period of implementing proposal of Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

Installation of 14 x 4 W lamps in place of 150 W HPSV lamps has payback of only Twenty seven Months

$$\text{Payback (Months)} = \frac{\text{Investment x 12}}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Replacement of 150 W HPSV lamps by (14 x 4) W T5 lamps

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use 14 x 4 W lamps in place of 150 W HPSV on failure and replacement basis.

One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to use electrical energy efficiently for ligthing purposes. It is well proven technology which is adopted in many of the other similar/other units. In-fact some of the units in Alwar has already installed this lamps, and getting energy saving.

3.4.3 Availability of local service providers who can take up above mentioned proposals

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G) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

INSTALLING SERVO VOLTAGE STABLISER FOR LIGHTING VOLTAGE AND OPERATE ALL LIGHTING CIRCUIT AT 210 V

Background

During Audit, study of lighting was carried out for energy saving. Some of units are not having voltage stabilizer for lighting purposes. Higher the plant voltage level, higher will be electrical losses.

In discharge lighting, the optimum voltage for lighting circuit is 210 V. A reduction in supply voltage by 10% results in;

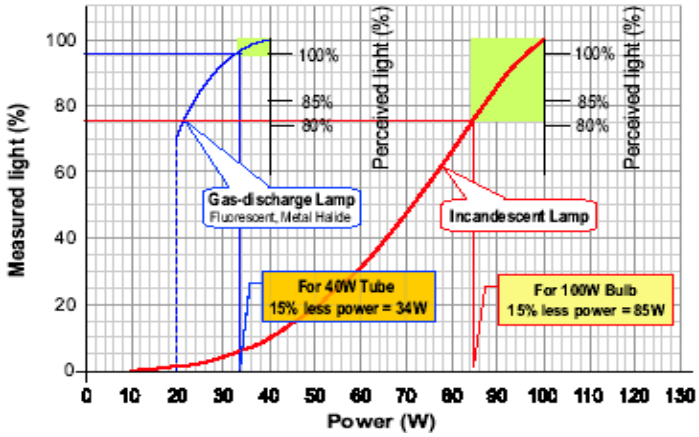
- Proportional drop in power consumption (10%)
- Insignificant drop in illumination level (1 - 2%)

During the energy audit, present operating voltage and power drawn in the lighting feeder was measured. The voltage reduction can be achieved by installing Servo stabilizers for the separate lighting feeder circuits & operate at 210 V Further, most of the lighting in the plant is of discharge type. The rated voltage for these types of lamps is 205-210V.

So, reducing voltage gives dual benefit:

- Reduction in power consumption
- Increased life of lamps

Operating principle of Lighting energy saver:-



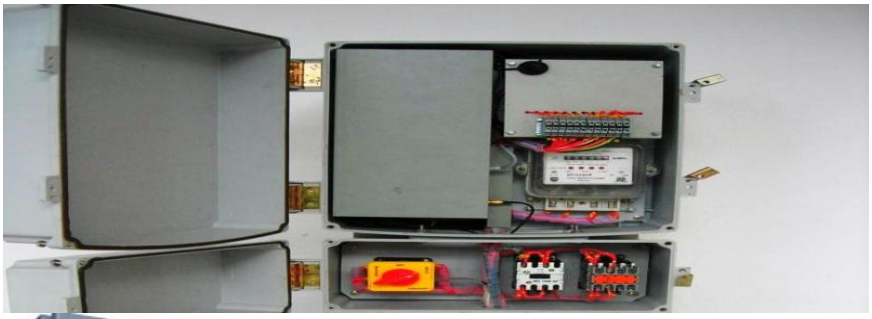


Figure 1– cooLite™ 150 to 400 kVA

3.4.1.2 Benefits of Implementing Installing servo voltage stabliser for lighting voltage and operate all lighting circuit at 210 V

Advantages:-

- Drop in power consumption
- Increases life of lamps
- Ultrafast voltage correction speed
- Good line isolation

3.4.1.3 Life cycle analysis for implementing servo voltage stabliser for lighting voltage and operate all lighting circuit at 210 V

Calculation

Installing servo voltage stabliser will save power by reducing voltage.

Type	Voltage level
Without voltage stabliser (Lighting)	240 V
With voltage stabliser (Lighting)	210 V

Comparison of energy consumption with and without voltage stabliser;

Saving	12% of light load
Running Hours	3500 hrs/year
Lighting load	Say 15 kW
Energy Saving	= 1.5 kW x 3500 hrs/yr X Rs. 4.8 / kWh = **Rs. 0.25 Lakh/ year**

Although the cost of installation is there but it will save running power of lighting wattage

3.4.1.4 Cost of implementing proposal of servo voltage stabliser for lighting voltage and operate all lighting circuit at 210 V

Cost of implementing this proposal varies in plant as per capacity and size of plant. Total cost of implementation of servo voltage stabilizer is for units in Alwar and Sawaimadhopur is approx. **Rs. 0.21 Lakh**.

3.4.1.5 Monetary saving from implementing proposal of servo voltage stabliser for lighting voltage and operate all lighting circuit at 210 V

Installation of servo voltage stabilizer gives a good energy saving potential and so money saving. Monetary Saving after installation of servo voltage stabilizer will be approx. **Rs. 0.21 Lakh.**

3.4.1.6 Simple payback period of implementing proposal of servo voltage stabilizer for lighting voltage and operate all lighting circuit at 210 V

Installation of servo voltage stabilizer has payback of only Twelve Months

$$\text{Payback (Months)} = \frac{\text{Investment} \times 12}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of servo voltage stabilizer for lighting voltage and operate all lighting circuit at 210 V

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use servo voltage stabilizer for lighting purposes. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of eco ventilators are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to reduce voltage such as Light energy saver. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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H) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

INSTALLATION OF AUTOMATIC POWER FACTOR CONTROLLER TO MAINTAIN UNITY POWER FACTOR

Background

During the audit of Alwar and Sawaimadhopur units, electrical distribution system survey was jointly carried out by the CII and the plant team for energy saving possibility. The state electricity board gives a flat rebate of 1.0 % of the monthly electricity bill for every 1 % improvement in the power factor above if the power factor (PF) is maintained above 0.95. The average PF maintained in the plant is low due to which units are not getting any incentives by the State Electricity Board. Improve power factor till 0.99 or unity to get maximum benefits in reduction in electricity consumption.

Theory

In a purely resistive AC circuit, voltage and current waveforms are in step (or in phase), changing polarity at the same instant in each cycle. All the power entering the loads is consumed where reactive loads are present, such as with capacitors or inductors, energy storage in the loads result in a time difference between the current and voltage waveforms. During each cycle of the AC voltage, extra energy, in addition to any energy consumed in the load, is temporarily stored in the load in electric or magnetic fields, and then returned to the power grid a fraction of a second later in the cycle. The "ebb and flow" of this nonproductive power increases the current in the line. Thus, a circuit with a low power factor will use higher currents to transfer a given quantity of real power than a circuit with a high power factor. A linear load does not change the shape of the waveform of the current, but may change the relative timing (phase) between voltage and current.

Circuits containing purely resistive heating elements (filament lamps, strip heaters, cooking stoves, etc.) have a power factor of 1.0. Circuits containing inductive or capacitive elements (electric motors, solenoid valves, lamp ballasts, and others) often have a power factor below 1

Power factor is the ratio of actual power (kW) to the apparent power (kVA). The apparent power (kVA) is defined by the following formula;

Apparent power = Sqrt (kW2 + kVAR2)

kVAr is the reactive power; from the above formula if less power factor indicates that supply of the reactive power is high compared to active power, which contributes useful work of the system. High reactive power indicates that higher reactive current and increases the I2R losses of the network. Capacitor is a device that generates reactive

current and consumes very less power. Installing capacitor will improve the power factor and will also reduce the KVA demand of the system and will increase the capacity of the network that is the network cables can be loaded further. Reduction in reactive current will result in reduction of I2R losses and efficiency of the system will improve.

Required KVAR = Load (kW) x [{tan (cos-1 PFi)} – {tan (cos-1 PFf)}]

1. Reactive Power Control Relay
2. Network connection points
3. Slow-blow Fuses
4. Inrush Limiting Contactors
5. Capacitors (single-phase or three-phase units, delta-connection)
6. Transformer Suitable voltage transformation to suit control power (contactors, ventilation)

An automatic power factor correction unit is used to improve power factor. A power factor correction unit usually consists of a number of capacitors that are switched by means of contactors. These contactors are controlled by a regulator that measures power factor in an electrical network. To be able to measure power factor, the regulator uses a current transformer to measure the current in one phase.

Depending on the load and power factor of the network, the power factor controller will switch the necessary blocks of capacitors in steps to make sure the power factor stays above a selected value

3.4.1.2 Benefits of Installation of Automatic power factor controller to maintain unity power factor

Advantages:-

- Reduction in I2R losses
- Improved voltage regulation
- Decrease in KVA loading
- Reduction in energy kWh consumption
- Rebate on electricity bill
- Avoidance of power factor penalty
- Reduction in Maximum demand
- Longer life of electrical distribution components such as switchgears, transformers, cables etc

3.4.1.3 Life cycle analysis for Installation of Automatic power factor controller to maintain unity power factor

Calculation

Installation APFC will save the power consumption So cumulatively it saves lot of electrical energy.

Electrical load	45 kW
Existing power factor	0.9
Proposed power factor	0.99
Installation of APFC	15 KVAR

Comparison of energy consumption with APFC

Saving	4% of monthly electricity bill
Running Hours	10 hrs/day 3000 hrs/year
Energy Saving	=0.04 x Electricity bill/month X 12 months/yr X Rs. 4.8 / kWh

As far as life cycle of APFC is concerned, it runs in good condition for at least 5 years.

3.4.1.4 Cost of implementing Installation of Automatic power factor controller to maintain unity power factor

Cost of APFC varies as per installed capacity of electrical system and size of plant. On an average cost varies from Rs 400 to Rs 600 per kvar. It all depends upon the existing facility available and required condition. Some of the units are maintaining good power factor and getting rebate from state electricity board.

Total cost of implementation of Installation of Automatic power factor controller to maintain unity power factor for all the units in Alwar and Sawaimadhopur is approx. **Rs. 9.1 Lakhs.**

3.4.1.5 Monetary Saving from Installation of Automatic power factor controller to maintain unity power factor

Installation of APFC gives a good energy saving potential and so money saving. As already said some of the units can are having poor power factor, which can be improved by installing APFC. APFC will save approx 212500 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of translucent sheet will be approx. **Rs. 10.2**

Lakhs

3.4.1.6 Simple payback period of implementing Installation of Automatic power factor controller to maintain unity power factor

Utilisation of APFC has payback of only Eleven Months

$$\text{Payback (Months)} = \frac{\text{Investment x 12}}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation Installation of Automatic power factor controller to maintain unity power factor

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal does not require much capital for implementation, so could be implemented on priority basis. It is advisable to use APFC to reduce I2R losses. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of APFC are available.

3.4.2 Availability of technology / Product in local/ National / International Market

Now days when energy cost is high, it is poor practice to work at low power factor, since it increases the electrical consumption. As far as technology is concerned APFC are available in local/ national market. There are various ways of improving power factor of plant. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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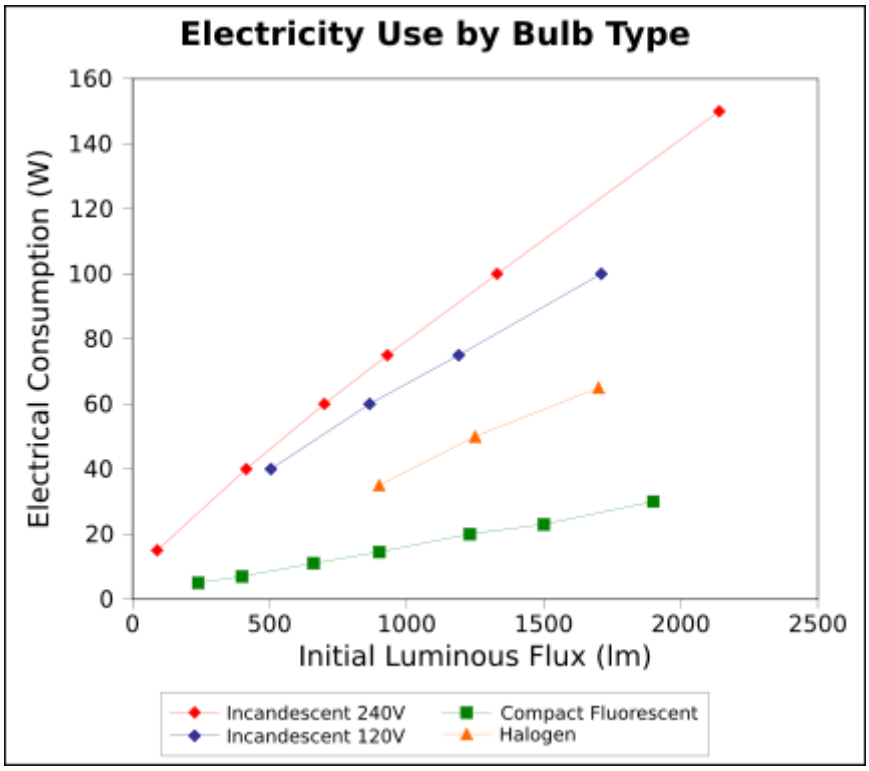
I) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF 100 W INCANDESCENT LAMPS BY 11 W CFL

Background

During Audit, study of lighting was carried out for energy saving. In some of the plant there are many incandescent lamp of 100 W. Energy efficient CFL of 11 W lamps are designed with special powder coating inside the lamp, hence gives same lumens with reduced power.

Compact fluorescent lamps (CFLs) are a quick, easy replacement for typical screw-base incandescent lamps. CFLs use about one-third as much energy as incandescent to deliver the same amount of light. They also save on materials and maintenance costs because they last ten times as long—an average of 8,000 hours compared to less than 1,000 hours for an incandescent bulb.



Operating principle of Compact Fluorescent lamps:-

A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The fundamental means for conversion of electrical energy into radiant energy in a fluorescent lamp relies on inelastic scattering of electrons. An incident electron collides with an atom in the gas. If the free electron has enough kinetic energy, it transfers energy to the atom's outer electron, causing that electron to temporarily jump up to a higher energy level. The collision is 'inelastic' because a loss of energy occurs.

This higher energy state is unstable, and the atom will emit an ultraviolet photon as the atom's electron reverts to a lower, more stable, energy level. Most of the photons that are released from the mercury atoms have wavelengths in the ultraviolet (UV) region of the spectrum predominantly at wavelengths of 253.7 nm and 185 nm. These are not visible to the human eye, so they must be converted into visible light. This is done by making use of fluorescence. Ultraviolet photons are absorbed by electrons in the atoms of the lamp's interior fluorescent coating, causing a similar energy jump, then drop, with emission of a further photon. The photon that is emitted from this second interaction has a lower energy than the one that caused it. The chemicals that make up the phosphor are chosen so that these emitted photons are at wavelengths visible to the human eye. The difference in energy between the absorbed ultra-violet photon and the emitted visible light photon goes toward heating up the phosphor coating.

When the light is turned on, the electric power heats up the cathode enough for it to emit electrons. These electrons collide with and ionize noble gas atoms inside the bulb surrounding the filament to form a plasma by a process of impact ionization. As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp.

The lamp is more costly because it requires a ballast to regulate the current through the lamp.

3.4.1.2 Benefits of Implementing Replacement of 100 W Incandescent lamps by 11 W CFL

Advantages:-

- Reduce your energy costs
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches
- Reduces sick building syndrome
- Reduce your energy costs
- Save up to 80% of energy
- Instant start up
- Long life 8 to 15 times incandescent lamp

3.4.1.3 Life cycle analysis for Implementing Replacement of 100 W Incandescent lamps by 11 W CFL

Calculation

Installing 11 W CFL in place of 100 W incandescent lamps saves power consumption for lighting since it saves running power of light. In some units incandescent lamps are used for lighting purpose. 100 W incandescent lamp can be replaced by 11 W lamps whose power consumption is much lower than incandescent lamps.

Type	Power Consumption including ballast
Incandescent lamps (100 W)	100 W
CFL	11 W

Comparison of energy consumption between 100 W incandescent lamp and 11 CFL;

Saving	89 W / lamp
Running Hours	3000 hrs/year
Energy Saving	= 0.089 kW/lamp x 3000 hrs/yr X Rs. 4.8 / kWh = **Rs. 1280/ year/lamp**

The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labor is costly. Replacement of incandescent lamps by 11 W CFL can be done on failure and replacement basis for any lamp.

3.4.1.4 Cost of implementing proposal of Replacement of 100 W incandescent

lamps by 11 W CFL

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of 11 W CFL lies in range of 80 to 100 each. Some of the units are only having incandescent lamps for lighting purposes, which can be replaced by 11 W CFL. Total cost of implementation of 11 W CFL in place of incandescent lamps for all the units in Alwar and Sawaimadhopur is approx. **Rs. 0.018 Lakh.**

3.4.1.5 Monetary saving from implementing proposal of Replacement of 100 W incandescent lamps by 11 W CFL

Installation of 11W CFL gives a good energy saving potential and so money saving. As already said only some of the units are having incandescent lamps which can be replaced by 11 W CFL. Replacement of incandescent lamps by 11 W CFL will save approx. 3140 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of 11 W CFL will be approx. **Rs. 0.151 Lakh.**

3.4.1.6 Simple payback period of implementing proposal of Replacement of 100 W incandescent lamps by 11 W CFL

Installation of 11 W CFL in place of 100 W incandescent lamps has lucrative payback of only Two Months

$$\text{Payback (Months)} = \frac{\text{Investment} \times 12}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Replacement of 100 W incandescent lamps by 11 W CFL

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use 11 W CFL in place of 100 W incandescent lamp on failure and replacement basis.

One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of CFL are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to use electrical energy efficiently for lighting purposes. It is well proven technology which is adopted in many of the other similar and dissimilar units. Infect some of the units in Alwar has already installed this lamps, and getting energy saving.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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Mr. Sachin
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Mr. Mahesh Khandelwal
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Add. Hope Circus
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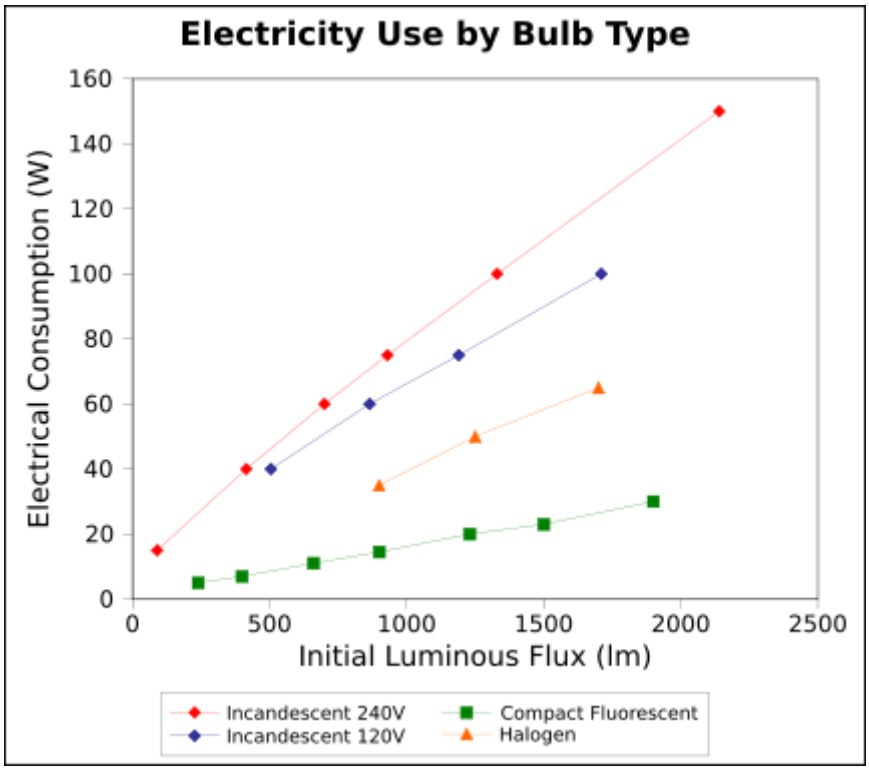
J) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

REPLACEMENT OF 500 W HALOGEN LIGHT BY 85 W CFL

Background

During Audit, study of lighting was carried out for energy saving. In some of the plant there are some 500 W halogen lamps. Energy efficient CFL of 85 W lamps are designed with special powder coating inside the lamp hence gives same lumens with reduced power.

Compact fluorescent lamps (CFLs) are a quick, easy replacement for typical screw-base incandescent lamps. CFLs use about half as much energy as halogen to deliver the same amount of light. They also save on materials and maintenance costs because they last ten times as long—an average of 8,000 hours compared to less than 1,000 hours for an incandescent bulb.



Operating principle of Compact Fluorescent lamps:-

A fluorescent lamp or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The fundamental means for conversion of electrical energy into

radiant energy in a fluorescent lamp relies on inelastic scattering of electrons. An incident electron collides with an atom in the gas. If the free electron has enough kinetic energy, it transfers energy to the atom's outer electron, causing that electron to temporarily jump up to a higher energy level. The collision is 'inelastic' because a loss of energy occurs.

This higher energy state is unstable, and the atom will emit an ultraviolet photon as the atom's electron reverts to a lower, more stable, energy level. Most of the photons that are released from the mercury atoms have wavelengths in the ultraviolet (UV) region of the spectrum predominantly at wavelengths of 253.7 nm and 185 nm. These are not visible to the human eye, so they must be converted into visible light. This is done by making use of fluorescence. Ultraviolet photons are absorbed by electrons in the atoms of the lamp's interior fluorescent coating, causing a similar energy jump, then drop, with emission of a further photon. The photon that is emitted from this second interaction has a lower energy than the one that caused it. The chemicals that make up the phosphor are chosen so that these emitted photons are at wavelengths visible to the human eye. The difference in energy between the absorbed ultra-violet photon and the emitted visible light photon goes toward heating up the phosphor coating.

When the light is turned on, the electric power heats up the cathode enough for it to emit electrons. These electrons collide with and ionize noble gas atoms inside the bulb surrounding the filament to form a plasma by a process of impact ionization. As a result of avalanche ionization, the conductivity of the ionized gas rapidly rises, allowing higher currents to flow through the lamp.

The lamp is more costly because it requires a ballast to regulate the current through the lamp.

3.4.1.2 Benefits of Implementing Replacement of 500 W halogen lamps by 85 W CFL

Advantages:-

- Reduce your energy costs
- High efficacy (Lumens / Watt)
- Environmental friendly (Low Hg content, 3-4 mg)
- Reduces work related headaches
- Reduces sick building syndrome
- Reduce your energy costs
- Save up to 80% of the energy
- Instant start up
- Long life 8 to 15 times incandescent lamp

3.4.1.3 Life cycle analysis for Implementing Replacement of 500 W halogen lamps by 85 W CFL

Calculation

Installing 85 W CFL in place of 500 W halogen lamps saves power consumption for lighting since it saves running power of light. In some units incandescent lamps are used for lighting purpose. All lighting of 500 W halogen lamp can be replaced by 85 W CFL whose power consumption is much lower than halogen lamps

So cumulatively it saves lot of electrical energy.

Type	Power Consumption including ballast
Halogen lamp	500 W
CFL	85 W

Comparison of energy consumption between 500 W halogen lamps and 11 W CFL

Saving	415 W / lamp
Running Hours	3000 hrs/year
Energy Saving	= 0.415 kW/lamp x 3000 hrs/yr X Rs. 4.8 / kWh = **Rs. 5976/ year/lamp**

The higher initial cost of a fluorescent lamp is usually more than compensated for by lower energy consumption over its life. The longer life may also reduce lamp replacement costs, providing additional saving especially where labor is costly. Replacement of halogen lamps by 85 W CFL can be done on failure and replacement basis for any lamp.

3.4.1.4 Cost of implementing proposal of Replacement of 500 W halogen lamps by 85 W CFL

Cost of implementing this proposal varies in plant as per capacity and size of plant. Cost of 85 W CFL lies in range of Rs. 600 to 700 each. Total cost of implementation of 85 W CFL in place of 500 W halogen lamps for all the units in Alwar and Sawaimadhopur is approx. Rs. **0.032 Lakh**.

3.4.1.5 Monetary saving from implementing proposal of Replacement of 500 W halogen lamps by 85 W CFL

Installation of 85 W CFL gives a good energy saving potential and so money saving. As already said only some of the units are having halogen lamps which can be replaced by 85 W CFL. Replacment of halogen lamps by 85 W CFL will save approx 6100 kWh for Alwar and Sawaimadhopur units. Monetary Saving after installation of 11 W CFL will be approx. **Rs. 0.29 Lakh.**

3.4.1.6 Simple payback period of implementing proposal of Replacement of 500 W halogen lamps by 85 W CFL

Installation of 85 W CFL in place of 500 W halogen lamps has lucrative payback of only Two Months

$$\text{Payback (Months)} = \frac{\text{Investment} \times 12}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation of Replacement of 500 W halogen lamps by 85 W CFL

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to use 85 W CFL in place of 500 W halogen lamp on failure and replacement basis. One of the barriers in implementing this proposal is vendors. Because of remote location very few suppliers of CFL are available. Lamps vendors are available in Local market, so plant people will not have to move far from local place.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. There are various technologies available to use electrical energy efficiently for lighting purposes. It is well proven technology which is adopted in many of the other similar and dissimilar units.

3.4.3 Availability of local service providers who can take up abovementioned proposals

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K) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

OPTIMISE IDLE RUNNING OF DG SET

Background

CII and plant team jointly studied DG Sets in detail for the identification of possible energy saving by modifying load pattern and optimum utilisation of generators. Some of big units are having DG Sets to cater power need of the plant at grid supply failure.

Presently trial /test run of DG sets are being carried out in every day for 05 to 10 minutes. During idle running of DG sets, fuel is consumed without any power output. Trial /test run fuel consumption of DG sets can be optimized by keeping the starting batteries healthy. It is better to charge batteries by battery charger rather than by idle running of DG sets. Frequent trials of DG sets can also be optimized by doing all preventive checks and maintenance regularly.

3.4.1.2 Benefits of Implementing Proposal of Optimize idle running of DG set

Advantages:-

- Reduction in diesel consumption
- Optimising trial time for DG

3.4.1.3 Life cycle analysis for Proposal of Optimise idle running of DG set

Calculation

Optimising idle running of DG can lead to reduction of idle running of DG So cumulatively it saves lot of electrical energy.

Type	Diesel Consumption
Idle running	Approx 200 Lit / month
Battery back up	Approx 100 Lit / month
Saving	50 % for idle running

3.4.1.4 Cost of implementing Proposal of Optimize idle running of DG set

Cost of implementing this proposal varies in plant, since only some of units are having DG. Total cost of implementation of is nil

3.4.1.5 Monetary saving from implementing Proposal of Optimize idle running of DG set

Optimizing idle running of DG will save approx 1200 Liter of oil for Alwar and Sawaimadhopur units. Monetary Saving after optimizing idle running of DG will be approx. **Rs. 0.38 Lakh.**

3.4.1.6 Simple payback period of implementing Proposal of Optimise idle running of DG set

Optimizing idle running of DG set has lucrative payback since it do not require any investment as plant already has batteries for this purposes.

3.4.1.7 Issues / barrier in implementation Proposal of Optimize idle running of DG set

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to keep the starting batteries charged by battery charger. For Preservation of Engine (If it is stand by for long time), run the DG set for 05 minutes once in a week.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units, since it requires only batteries which need to be connected.

3.4.3 Availability of local service providers who can take up abovementioned proposals

It requires only connection of battery with DG, which is already in plant.

L) 3.4.1.1 PROPOSAL DESCRIPTION INCLUDING TECHNOLOGY/PRODUCT SPECIFICATIONS FOR –

INSULATION OVER DG EXHAUST PIPE

Background

CII and plant team jointly studied DG Sets in detail for the identification of possible energy saving by modifying load pattern and optimum utilisation of generators. Some of big units are having DG Sets to cater power need of the plant at grid supply failure.

It was observed that exhaust pipes of DG set are not insulated. That increases ambient temperature near DG set due to heat radiation from un-insulated hot surface inside DG room. High ambient temperature has a very negative effect on efficiency and loading capacity of DG sets.

3.4.1.2 Benefits of Implementing Proposal of Insulation over DG exhaust pipe

Advantages:-

- Reduction in diesel consumption
- Reduction in ambient temperature of DG room
- Decrease in specific fuel consumption
- Longer life

3.4.1.3 Life cycle analysis for Proposal of Insulation over DG exhaust pipe

Calculation

Insulation over DG exhaust can lead to reduction of temperature of DG room. Since insulation reduces heat losses, which ultimately gives reduction in fuel consumption.

3.4.1.4 Cost of implementing Proposal of Insulation over DG exhaust pipe

Cost of implementing this proposal varies in plant, since only some of units are having DG. Total cost of implementation of is Rs 3000.

3.4.1.5 Monetary saving from implementing Proposal of Insulation over DG exhaust pipe

Insulating DG exhaust pipe will save approx 480 Liter of oil for Alwar and Sawaimadhopur units. Monetary Saving after optimizing idle running of DG will be approx. **Rs. 0.168 Lakh.**

3.4.1.6 Simple payback period of implementing Proposal of Insulation over DG exhaust pipe

Insulation over DG exhaust has lucrative payback since it require very low investment. It has simple payback of 3 Months

$$\text{Payback (Months)} = \frac{\text{Investment} \times 12}{\text{Monetary Saving}}$$

3.4.1.7 Issues / barrier in implementation Proposal of Insulation over DG exhaust pipe

There are no such hard and fast issues or barriers in implementing this proposal, since all the technical and commercial aspect being discussed with unit people. This proposal requires some capital for implementation, so could be implemented as per priority of plant. It is advisable to keep insulation over DG exhaust pipe.

3.4.2 Availability of technology / Product in local/ National / International Market

As far as technology is concerned it is available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units, since it requires only insulation which can reduce heat loss from exhaust pipe.

3.4.3 Availability of local service providers who can take up above mentioned proposals

It requires only insulation supplier.

Lloyd Insulation Ltd
Punj House M-13,
Connaught Place,
New Delhi-110001
Tel: 011-30882900-30882906

Fax: 011 – 30882894/30882895

3.5 IDENTIFICATION OF TECHNOLOGIES / EQUIPMENT FOR DPR PREPARATION

From energy use and technology audit studies carried out in Alwar Oil Mill cluster, it became apparent that the equipments/utilities installed are inefficient, inferior quality and consuming more energy. There is considerable potential in oil mill cluster units for energy conservation by replacing the old/obsolete technology/equipments with energy efficient technologies/equipments.

As the process and equipments are more or less similar in all cluster units in Alwar Oil Mill cluster, all the technologies/equipments identified can be replicated as per the requirement of the units and detailed project reports for the specific technologies prepared also can be replicated in different chemical units as per the capacity requirement. The following technologies/equipments were considered for preparation of detailed project report.

- There are many technologies / equipment available for DPR preparation
- Energy efficient motors for expeller
- Energy efficient motors for Kolhu
- Solvent extraction unit
- New expellers
- Poly V belt in transmission system

A) 3.5.1 JUSTIFICATION (E.G. POTENTIAL, REPLICABILITY, ETC. IN THE CLUSTER) FOR –

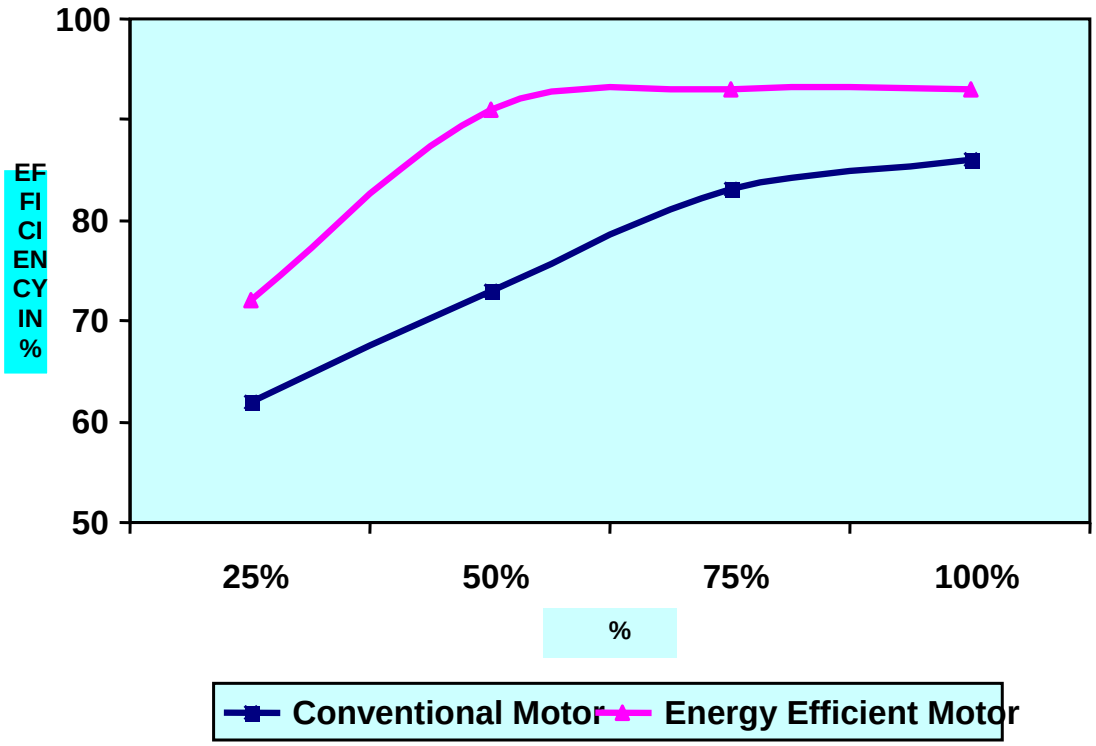
ENERGY EFFICIENT MOTORS FOR EXPELLER IN DPR PREPARATION

Theory

Each and every Expellers motors were studied during visit, its instantaneous power measurement being taken at site to analyze the motors. During the audit it was observed that the maximum of motors are rewinded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors.

Standard vs High Efficiency Motors

Efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.


100
80
70
60
50
EFFICIENCY IN %
25%
50%
75%
100%
%
Conventional Motor
Energy Efficient Motor

Potential

Replacement of energy efficient motor has very good energy saving potential, as this is equipment which runs continuously in all units. Replacement of energy efficient motors (EEF) will give approximately 7255200 kWh after combining each expeller motors in Alwar and Sawaimadhopur region.

Replicability

Replacement of energy efficient motor has very good energy saving potential, as this is equipment which runs continuously in all units. It is not applicable for only units in Alwar and Sawaimadhopur but for all oil mill units in India. This is applicable for all big as well as small units.

Energy saving = power consumption [(1/old efficiency)–(1/new efficiency)]

Being higher energy efficiency, it will reduce power consumption of motors, so can be easily applicable to all other units.

B) 3.5.1 JUSTIFICATION (E.G. POTENTIAL, REPLICABILITY, ETC. IN THE CLUSTER) FOR-

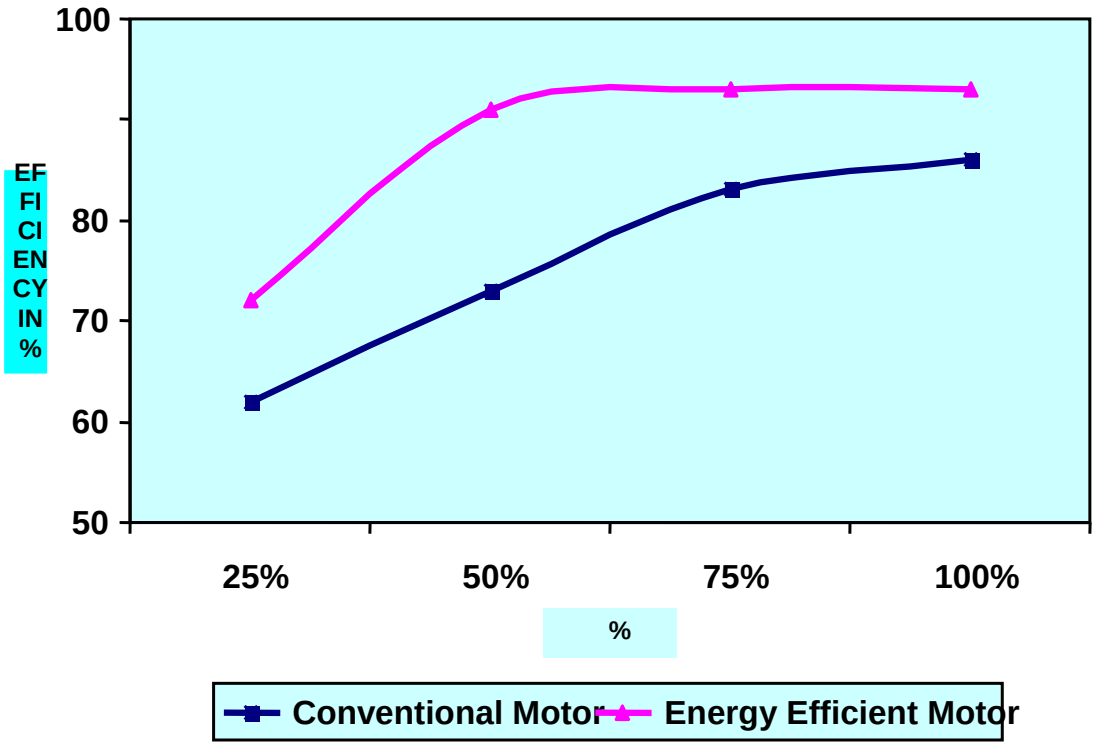
ENERGY EFFICIENT MOTORS FOR KOLHU IN DPR PREPARATION

Theory

Each and every Expellers motors were studied during visit, its instantaneous power measurement being taken at site to analyze the motors. During the audit it was observed that the maximum of motors are rewinded more than 5 times which leads to approx 2.5 times more power consumption and lower operating efficiency. These motors must be replaced by the Energy Efficient Motors which leads to higher working efficiency up to 4 % for the same working condition Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminium bars in the rotor, superior bearings and a smaller fan, etc. Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors.

Standard vs High Efficiency Motors

Efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.



Potential

Replacement of energy efficient motor has very good energy saving potential, as this is equipment which runs continuously in all units. Replacement of energy efficient motors (EEF) will give approximately 7555200 kWh after combining each kolhu motors in Alwar and Sawaimadhopur region.

Replicability

Replacement of energy efficient motor has very good energy saving potential, as this is equipment which runs continuously in all units. It is not applicable for only units in Alwar and Sawaimadhopur but for all oil mill units in India. This is applicable for all big as well as small units.

Energy saving = power consumption [(1/old efficiency)–(1/new efficiency)]

Being higher energy efficiency, it will reduce power consumption of motors, so can be easily applicable to all other units.

C) 3.5.1 JUSTIFICATION (E.G. POTENTIAL, REPLICABILITY, ETC. IN THE CLUSTER) FOR-

INSTALLATION OF ENERGY EFFICIENT NEW EXPELLER

Now a day in Indian market, there is various new technologies available in market for above said equipments which are not only energy efficient but also having good productivity. Technology up gradation can be done in every equipments and utilities which are installed. All the equipments which are installed are very old such as almost all the motors are re-winded many times, old expellers. Instead of using these old expellers, now in market energy efficient expellers are available.

Equipments	Old Technologies	New Technologies	Saving Potential
Expellers	60 HP motor on 48" x 8"	50 HP motor on 48" x 8"	15 %
Gear box		Tested alloy steel. Induction and oil quenching hardness to gears for long life	Longer life

Potential

Approximately there is 15% of potential for energy saving in all units for oil extraction.

Replicability

It can be implemented in all units which are working with old expellers. For establishment of new plant, only new expellers must be purchased. Its running cost is lower than old expeller and so gives energy saving.

D) 3.5.1 JUSTIFICATION (E.G. POTENTIAL, REPLICABILITY, ETC. IN THE CLUSTER) FOR –

POLY V BELT IN TRANSMISSION SYSTEM FOR DPR PREPARATION

Advantages:

- Compact Drive, Poly-V belt is highly flexible and hence can be used with smaller pulley diameters to give a lighter and compact drive.
- Higher Power, 40% higher power rating per unit width compared to conventional V-belts.
- Zero Slippage Almost eliminates the slippage due to maximum wedge contact on the pulleys.
- Energy Saving Maximum returns with energy saving upto 6%.
- Rear Side Drive Being thinner the rear side can be used to drive additional accessories / idlers without affecting life.
- Higher Bearing Life Lesser static tension gives higher bearing life.
- Silent Drive Gives vibration and noise free power transmission in every application.
- Single Belt Eliminates the necessity to use multiple / matched set belts.
- Longer Life Gives lesser wear and longer life to the pulleys due to lesser static tension and belt slippage.
- Low Downtime & Replacement Cost Reduces downtime and also belt replacement cost.

Potential

With poly V belt, it saves energy up to 6% which is good potential in terms of energy. In all units of Alwar and Sawaimadhopur, replacement of belt gives energy saving.

Replicability

This proposal can be implemented in all oil mill units.

CHAPTER 4

ENVIRONMENTAL BENEFITS

As oil mills are not producing any pollutants, it is not having direct relation to benefits to environment. Although improvement in energy efficiency will give lot of indirect benefits to environment, as reduction in electricity consumption will lead to saving of environment. 1000 units generation will give saving of 0.86 tones of CO2

4.1 Reduction in waste generation

In oil mill units, there is only waste in form of oil cake, which unit people which can be reduced by installing solvent extraction plant. Improving energy efficiency will not only saves the energy but also help in having higher production of oil as well as reduces waste.

4.2 Reduction in GHG emission such as CO2, NOx

All proposed energy conservation measures will have less energy consumption or fuel consumption compared to conventional/existing system; this automatically leads to reduction of GHGs emissions. Reduction of GHGs emissions leads to improved environment and better compliance with environmental regulations.

Major GHGs emission reduction due to saving of grid electricity and fuels is CO2, reduction of other GHGs are negligible. Annual GHGs reduction potential identified in cluster is around 1750 tonnes of CO2. Reduction in formation of SOx will lead to improved environment condition. This reduction of CO2 will be at power plant which supplies electricity to electricity board.

4.3 Reduction in emission such as SOx

As implantation of above proposal will give reduction in electrical energy consumption, it will directly lead to reduce formation of SOx gases. In all units of Alwar and Sawaimadhopur, there is potential to reduce approximately 20, 36,450 kWh.

It will lead to reduce SOx emission, since for power production there is generation of sulphur dioxide. Reduction in formation of Sox will lead to improved environment condition. This reduction of SO2 will be at power plant which supplies electricity to electricity board.

CHAPTER 5

CONCLUSION

After making complete study of Oil mill units in Alwar and Sawaimadhopur region it is found that, all units have taken good energy efficiency steps, which further can be improved after making implementation of said energy saving proposals. Combining every energy saving proposals for Oil mil cluster gives approximately saving of **Rs. 95.76Lakhs**

5.1.1 SUMMARY OF ALL ENERGY SAVING PROPOSALS/MEASURES IDENTIFIED FOR THE CLUSTER

S. No.	Energy Saving proposal
1	Installation of Eco Ventilator in Place of Exhaust Fan
2	Replace Re-winded Motors by Energy Efficient Motor
3	Replace 40 W Light by T5, 28 W Light
4	Provide Translucent Sheets in the Cleaning Section Area and avoid Artificial Light during Day Time
5	Optimize lighting voltage to 210 V by installing voltage stabilizer
6	Replace 250 W HPSV lamps by 24 x 4 W
7	Replace 150 W HPSV lamps by 14 x 4 W
8	Installation of APFC to maintain unity power factor
9	Replace 500 W halogen lamps by 85 W CFL
10	Optimise idle running of Diesel Generator
11	Insulate DG exhaust pipe

5.1.2 SUMMARY OF ALL TECHNOLOGY GAP ASSESMENT FOR ALL ENERGY SAVING PROPOSALS / MEASURES IDENTIFIED FOR THE CLUSTER

S. No.	Present System	Proposed System
1	Exhaust Fan system for removing oil fumes	Installation of Eco ventilator for removing oil fumes
2	Re-winded Motors for Kolhu and Expeller	Energy Efficient Motor for Kolhu and Expeller
3	40 W Light for plant lighting	T5, 28 W Light for plant lighting
4	Artificial Light during Day Time	Translucent Sheets in the plant Area and
5	Lighting voltage on higher side	Optimize lighting voltage to 210 V by installing voltage stabilizer
6	250 W HPSV lamps	24 X 4 W lamps
7	150 W HPSV lamps	14 X 4 W lamps
8	Low Power factor	Installation of APFC to maintain unity power factor
9	500 W halogen lamps	85 W CFL
10	Idle running of Diesel Generator	Optimize idle running of Diesel Generator
11	Un insulated DG exhaust pipe	Insulate DG exhaust pipe

5.1.3 SUMMARY OF TECHNO ECONOMICS (COST SAVING AND SIMPLE PAYBACK PERIOD) FOR ALL ENERGY SAVING PROPOSALS/MEASURES IDENTIFIED FOR THE CLUSTER

S. No.	Energy Saving proposal	Annual Savings	Invest. Require	Simple Payback
		Rs. Lakhs	Rs. Lakhs	Months
1	Installation of Eco Ventilator in Place of Exhaust Fan	10.91	2.34	3
2	Replace Re-winded Motors by Energy Efficient Motor	69.65	172	30
3	Replace 40 W Light by T5, 28 W Light	1.9	3.0	19
4	Provide Translucent Sheets in the Cleaning Section Area and avoid Artificial Light during Day Time	0.8	0.6	9
5	Optimize lighting voltage to 210 V by installing voltage stabilizer	0.21	0.21	12
6	Replace 250 W HPSV lamps by 24 X 4 W	0.5	0.8	19
7	Replace 150 W HPSV lamps by 14 X 4 W	0.75	1.7	27
8	Installation of APFC to maintain unity power factor	10.2	9.1	11
9	Replace 500 W halogen lamps by 85 W CFL	0.29	0.032	2
10	Optimise idle running of Diesel Generator	0.384	-	-
11	Insulate DG exhaust pipe	0.168	0.03	2
	Total	**95.76**	**189.8**	**23**

5.1.4 SUMMARY OF BARRIERS IN IMPLEMENTATION OF IDENTIFIED ENERGY SAVING PROPOSAL

S. No	Barriers
1	Availability of vendors
2	Remote location
3	Financial issues
4	Labor dependency
5	Technology awareness

5.1.5 SUMMARY OF SHORTLISTED TECHNOLOGY PRODUCTS FOR DPR

S. No	Technology products
1	Energy efficient motors
2	Advanced expeller
3	Poly V belt

5.2 SUMMARY OF LEVEL OF AWARENESS ON ENERGY EFFICIENCY AND ENERGY EFFICIENT PRODUCTS IN CLUSTER

S. No	Energy efficient uses
1	Two expeller running with single motor
2	Use of agro waste in boiler
3	Star delta starter
4	Eco ventilators
5	APFC
6	Energy efficient lighting

CHAPTER 6

SMALL GROUP ACTIVITIES/TOTAL ENERGY MANAGEMENT

1. Introduction

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development. In this situation Energy Conservation (EC) is the critical needs in any countries in the world.

Following two factors are of Special importance of Energy Conservation;

(1) Economic factors
(2) Environmental impacts

1.1 Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability. Notably, the wave of energy conservation had struck the Indian intelligentia 3 years earlier when a Fuel Policy Committee was set up by the Government of India in 1970, which finally bore fruits three decades hence in the form of enactment of the much awaited Energy Conservation Act, 2001 by the Government of India. This Act made provisions for setting up of the Bureau of Energy Efficiency, a body corporate incorporated under the Act, for supervising and monitoring the efforts on energy conservation in India.

Brief History of energy efficiency movement in India and associated major milestones are as follows;

- 1974: setting up of fuel efficiency team by IOC, NPC and DGTD (focus still on industry)
- 1975: setting up of PCAG (NPC main support provider) : focus expanded to include agriculture, domestic and transport
- 1978: Energy Policy Report of GOI: for the first time, EE as an integral part of national energy policy – provided detailed investigation into options for promoting EE
- Post 1980, several organizations started working in EC area on specific programs (conduct of audits, training, promotion, awareness creation, demonstration projects, films, booklets, awareness campaigns, consultant/product directories)
- Some line Ministries and organizations like BICP, BIS, NPC, PCRA, REC, Ministry of Agriculture, TERI, IGIDR, CSIR, PETS (NPTI)
- State energy development agencies
- Industry associations
- All India financial institutions

The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002

under the provisions of the Energy Conservation Act, 2001. The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors.

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets and that is good for the national trade balance, too.

1.2 Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. The problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHG). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

2. Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the cumination of zero break-downs, zero defects, and zero waste. Enterprising employees identify the problem, be it in "man, material, method, or machine," and develop cost-effective and practical methods for solving the problem.

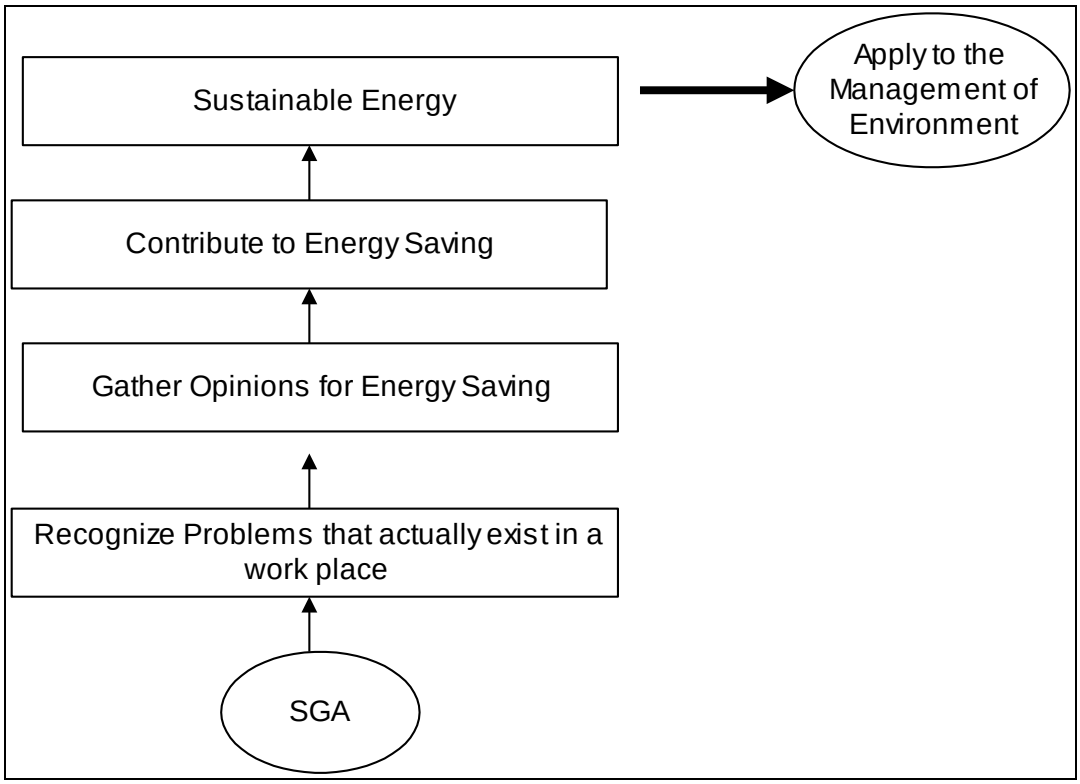
2.1 Importance of SGA

SGA are activities by group of employees at operator (working Group) level. They aim to solve problems that occur at the place taken care of by each employee and put emphasis on participation and team work. Factories can apply small group activities to many kinds of work along with normal work or other measures that are already underway. The burden on employees will not increase because of small group activities. They are not only bringing benefits to factories but also boosting the knowledge and ability in performing jobs of employees, improving communication among employees, increasing creativity, and make it possible to express their own proposal with less hesitation to management. As a result, employees will start to think “This is our problem.” This SGA can be applied to Energy Conservation, too, with successful results, as shown in Figure 13.

2.2 How SGA leads to Energy Conservation?

An excellent example of organizational structure that promotes energy management emphasizing participation is that they form overlapping small groups as in figure 14. The feature of this structure is that a small group for energy management is distributed to various sections as in figure 15, which is a recipe for success of Total Energy Management (TEM) and makes various communications and management of activities

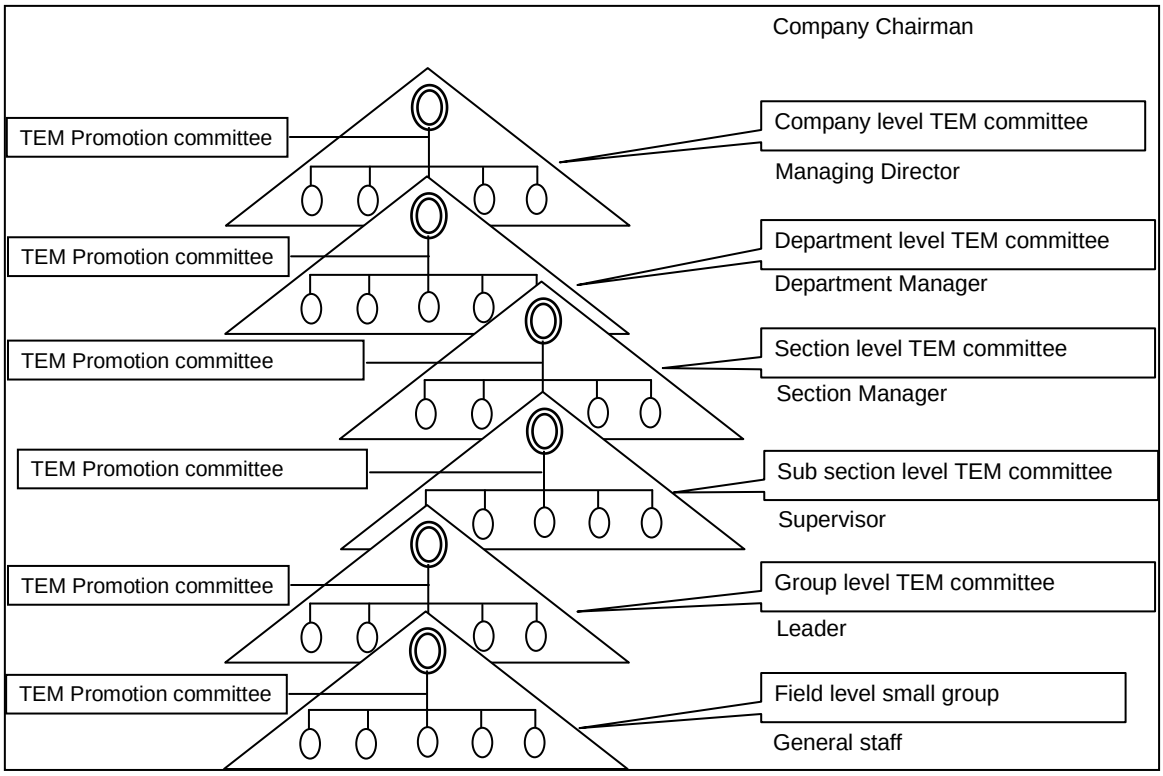
more efficient and effective.



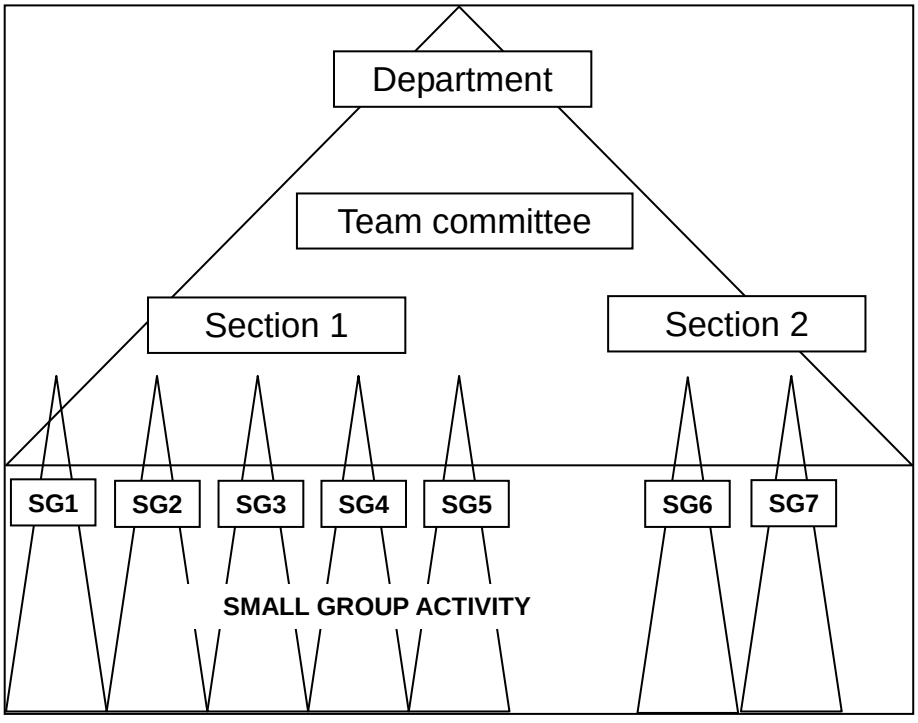
Relationship of SGA and energy saving

Small group activities for total energy management (TEM) are the activities in which employees of all levels in production or management, starting from the top to the bottom, participate in order to reduce loss related to their own job by improving their job. In order for the activities to succeed, management of all levels must provide support in necessary training and equipment, communication of policies, and the setting of problems to solve.

Small group activities for TEM can be divided into 4 or 5 levels depending on the scale of the organization. This division is in order to emphasize the fact that everyone must improve in their job under the responsibility to each other. It also enables us to make improvement without overlapping. The following example shows utilizing the existing job-related organization as much as possible, as already mentioned in Part 2, 2."Strategy for Improving the Efficiency of Energy Usage further", Step 2 Proper EC Organization including Assignment of Energy Manager (page 12).



Example of Organizational Structure with Overlapping



Positioning of SGA in Main Job Structure

2.2.1 Executives level

- Define the policy and target for Total Energy Management
- Follow-up and manage activities to make sure that activities are implemented according to the policy
- Consider opinions and suggestions from the promotion office
- Consider reports from promotion committee from various levels

2.2.2 Level of Total Energy Management promotion office

- Make sure that whole activities are done in the correct direction, without delay and smoothly
- Find a suitable method that makes it possible to implement activities continuously and without slowdown
- Listen to opinions and suggestions from small groups in order to use for improving
- Provide advice for Total Energy Management to various groups
- Persons in charge of the office must be those with good personal relationship, friendly, and with spirit of good service

2.2.3 Medium level

- Define the policies of each department that are consistent with the policy of the Total Energy Management and the target of the company
- Define numerical targets to sub-groups apart from the target of the company as a whole
- Follow-up the progress in order to provide to sub-groups
- Report the progress along with suggestions and opinions to upper level committee periodically

2.2.4 Workers/Operators level

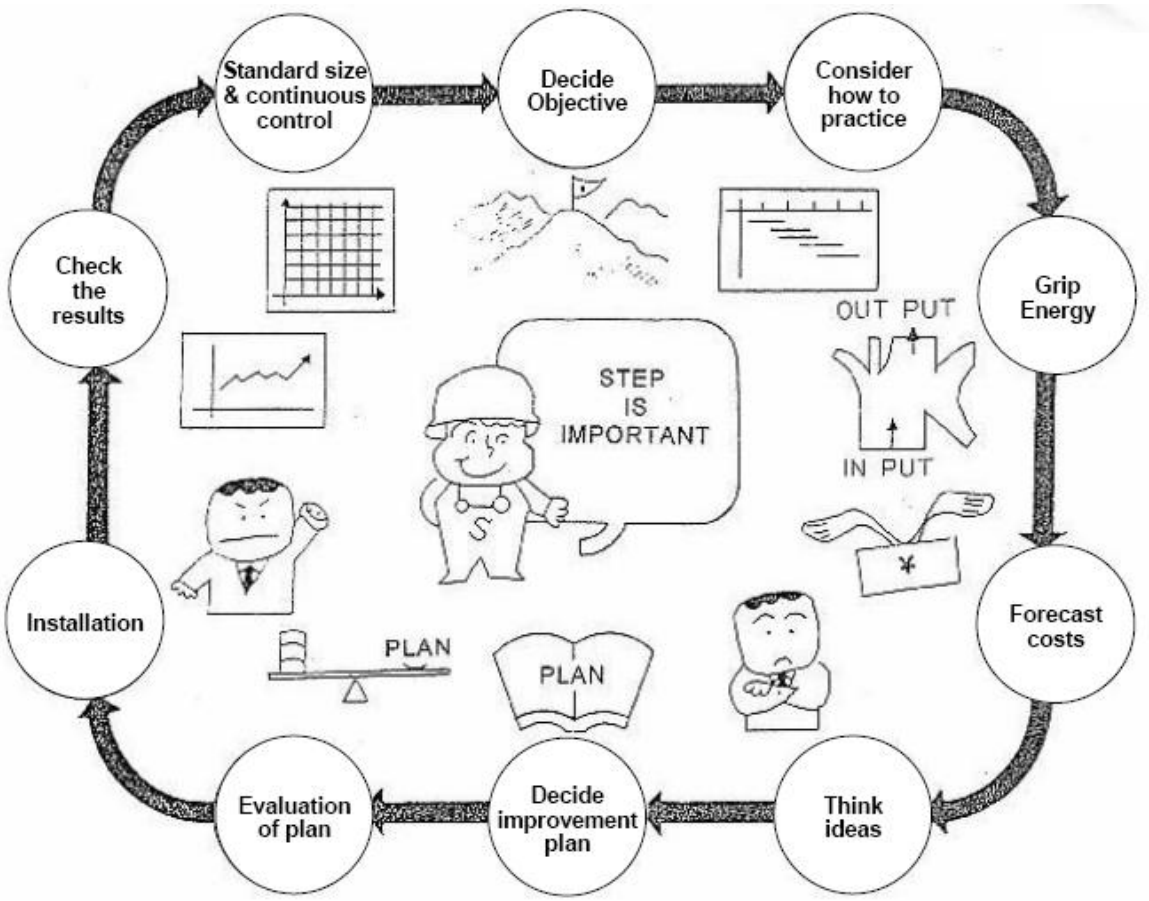
- Implement small group activities with various themes and achieve target
- Report progress and problems encountered during implementation to upper level committee periodically
- Ask for support, suggestions, and opinions from upper level committee

2.2.5 Responsibility of Energy Conservation committee

- Gather and analyze information on costs related to energy every month
- Analyze and solve problems related to energy
- Find a method for energy conservation
- Prepare energy conservation plan
- Follow-up the result of implementing the plan
- Perform activities such as public relationship for encouraging employees to participate
- Offer training to small group in each department

2.3 Steps of Small Group Activities for Energy Conservation

Small group activities for Energy Conservation can be done by using "10 Stages for Success", based on "PDCA Management Cycle", as shown below and in pictorial forms

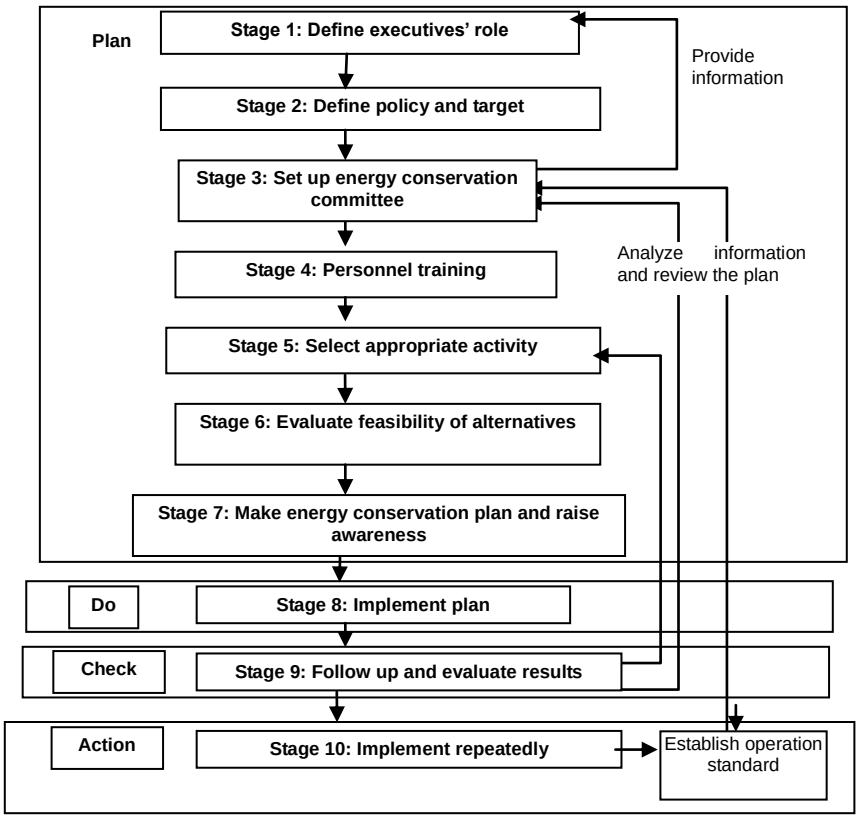


- Plan: Make an efficient plan in order to improve operation
- Do: Implement according to the plan
- Check: Check if implementation was according to the plan
- Act: Judge what to improve, what to learn and what to do from what we have checked

SGA circle

Please note that these stages are substantially the same as "Key Steps" explained earlier, but put more stress on utilization of SGA. So readers could

read and use either method up to their preference.



10 Stages for Success

2.3.1 Stage 1: Define Executive's Role

In promoting small group activities, support must be provided such as basic environmental support. Therefore, executives must provide follow up support to employees of their companies.

- Establish a special unit that provides support to small group activities
- Prepare a system for managing small group activities in the company
- Prepare annual plan for small group activities
- Prepare a venue for meeting, consultation, advice or suggestion
- Establish a system for giving rewards to high achieving employees
- Establish a reporting system starting from informing what to do until reporting of the results
- Establish a fair system for evaluating results
- Establish a system for providing support and training to employees

2.3.2 Stage 2: Define Policy and Target

- Executives must announce a policy of supporting small group activities.
- Energy conservation committee must act as an advisor in order to set a numerical target that is consistent with total energy management (TEM) policy

and the target of the organization. Specific targets must be set for each group.

We can see that responsibilities in stages 1 and 2 are mainly those of executives and committee. Responsibility of employees will become clearer from stage 3 and afterwards.

2.3.3 Stage 3: Set up Energy Conservation Committee

The principle of small group activities (SGA) is to divide into groups based on the scope of responsibility. The size of the group will depend on the size of organization. However, size of the group should not be too large. Usually a size of 5 to 10 persons is considered appropriate. It is important to define responsibilities clearly so that every member of the group can have their responsibility and participate in the activities.

2.3.4 Stage 4: Personnel Training

This stage will help employees to have more knowledge and understanding, have new ideas, and have more belief in their own responsibility.

2.3.5 Stage 5: Select Appropriate Activity

In doing small group activities, each member must be able to think, express their own ideas, and make decisions based on reality and by investigating electrical equipment, machines, and office equipment that exist in the area of their responsibility. Items to consider include size, number, where to use, situation of usage, current situation, and the number of hours usage per day. By this we can evaluate the current situation of energy usage. Also by judging if there are more machines than needed, we can choose suitable activities and real problems for the organization.

2.3.6 Stage 6: Evaluate feasibility of alternatives (Analyze problems and decide on the measures and activities in each point)

Each group will gather ideas on the reasons for the problems, obstacles, and how to solve problems in order to decide on the problems, measures, and importance of activities and thus evaluate on the feasibility of activities to do based on advice from department manager. Basically, the following activities are not suitable for small group activities.

- Highly technical issues
- Issues that require a long time or many people to implement

We have identified the following problems through small group activities.

- Issues on material quality or production that influence energy usage
- Behavior on energy usage
- Efficiency of machines or equipment that uses energy
- Awareness toward environment and energy usage
- Safety costs for energy conservation

2.3.7 Stage 7: Make Energy Conservation Plan and Raise Awareness

Each group must prepare its activity plan. Generally, implementation for small group activities takes 6 months to 1 year. Activities to be implemented should correspond to the objectives of each group. Besides, it might help to listen to opinions of all organizations in order to receive support from all other organizations.

2.3.8 Stage 8: Implement Plan

Implement according to the plan of each group.

2.3.9 Stage 9: Follow Up and Evaluate Results

After implementing the plan, each member of small groups will follow up and evaluate the result by analyzing result, search for strong and weak points of activities, find a way to improve the activities and report on general achievement.

2.3.10 Stage 10: Implement Repeatedly

Energy conservation is an activity that must be implemented repeatedly. Therefore, it is necessary to implement each activity repeated and make improvement to each activity. If we are satisfied with the results, by achieving the objectives of activities, we should provide rewards in order to give motivation for continuing the small group activities and implement creative activities.

Dos and Don'ts in Energy Conservation

- Don't Emphasize the mistakes in the past. It is better to talk about the present.
- Don't Be worried about the theory or principles. Don't spend too much time in discussion or analysis of problems in meeting rooms.
- Don't Think that an activity can be done perfectly from the beginning. It is necessary to do the job continuously by having experiences and judging by ourselves.
- Do Start with an activity that requires small amount of investment.
- Do Raise awareness so that all employees understand the necessity and importance of energy conservation and participate in it.
- Do Start the activity now without postponing to tomorrow.

2.4 Tools that are Used Often for Small Group Activities for Energy Conservation

2.4.1 5S

5S is a contraction derived from the Japanese words **Seiri, Seito, Seiso, Seiketsu, and Shitsuke.** It is simple methodology that is also extremely useful in practical and realistic life. 5S is a set of actions to be followed through every day activities to advance the operational surroundings and circumstances. 5S is made in order to provide fortification to every personage in diverse profitable and industrialized fields. 5S is an extremely practical contrivance and skill set for anyone who wants to generate a more prolific environment within the workplace or who wants to make it their profession to make other people's businesses more proficient and productive. 5S occupy a list of products including eyewear, ear protectors and safety gears. Look into these different products that make up the significance of an industrialized security supply. Lean Six Sigma experts promise or guarantee for the efficiency of 5S as an enlightening

enhancement to better working surroundings in an association. If you dig up Six Sigma guidance that is paid for by your company, you will be in a position to work for your company and make things better for you as well as for everyone. 5S is very useful in lots of industries and job markets, but can often fail simply because of the lack of recognition concerning changes in the office.

5S consists of five steps that are crucial for the completion of 5S. The 5S steps are described as follows-

1.Seiri / Sort- This is very logical term in, which identification of the contents take place, data base of the products have been created and, then any kind of sorting take place just to arrange the products and removal of unwanted items. Classification of the products is necessary, which is called Red Tagging. It is important just to identify factors, right from whether it is needed, existing amount obligatory amount, occurrence of necessity, and so on.

2.Seito / Systemize- This step in 5S process consists of removal of unwanted items permanently and one more task that to be take place is decision that means you have to decide that what is required to be in what place. Place the items in such manner that you could retrieve them within 30 seconds of requirement.

3.Seiso / Brush away/ Sweep- Examine al the items on the daily basis. The process is not that much time consuming, but essential to clean up your workplace and most required in 5S. The conscientiousness to keep the office clean should be circulated between everyone in the group.

4.Seiketsu / Homogenize- This important step of 5S involves the visual control, which is important to keep your organization well- organized and clean. It is a complete evaluation to improve the working conditions.

5.Shitsuke / Self Control- This step is quite essential, but critical because it involves all the discipline to ensure the 5S standards, it also takes charge of dedication and commitment.

2.4.2 QCC (Quality control circle)

QCC (Quality control circle) means controlling quality through group activities. For this, it is necessary to work hand in hand and achieve objective quality or customers' request. With this, we can find weak points, find the cause of problems, gather ideas for problem solving and systematically prepare quality and thus, solve problems such as material loss, production costs, working hours, or productivity. This is also a very useful tool to tackle with Energy Conservation problem. So many factories or institutions are encouraged to utilize this tool.

Annexure 1

DETAILED TECHNOLOGY ASSESSMENT REPORT

Most of the Oil industries in Alwar Oil Mill cluster has these characteristics, those are 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 different types of Oil units in Alwar Oil 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 Oil units as under technology audit studies and these may be due to lack awareness on the technologies available, quantum of energy loss and its monetary benefit, lack of awareness among workforce etc.
- There is tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the management, they 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 energy efficiency and energy conservation projects in Oil units in Alwar Oil 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 energy efficiency and conservation places no financial and administrative burden as no separate manpower is required and only training of operation and maintenance of the technologies adopted is envisaged
- The return on investment is attractive with lower pay back periods.

From technology audit studies conducted in Alwar Oil cluster, below mentioned areas were identified for technology up gradations; those are:

- Conventional Expellers
- Conventional Kolhus
- Conventional Lighting

Annexure 2

DETAILS OF TECHNOLOGY / SERVICE PROVIDERS IN ALWAR OIL CLUSTER

Energy Conservation measure	Source of product	Details of Local vendor / service provider
1. Improve plant power factor through APFC pannel	ABB Ltd	Mr. Neeraj Verma ABB Ltd Power Product SCO-13-14-15 Sector-34A Chandigarh Phone: 0172-4321845 Telefax: 0172-2601618 Mobile: 09878613484 email: neeraj.verma@in.abb.com
2.Energy Efficient Motors	Kirloskar Brothers Ltd	Mr.Kamlesh Gupta Station Road Alwar Tel. : +91 (144) 2700226 Mob. : +91 9414019126/ 09414019126
3.Energy Efficient Motors, Automatic Power Factor Controllers	Havells, Epcos	Mr.Sachin Hope Circus ,Alwar -301001 Tel. : +91 (144) 2337886 (o) (R) 0144-2330971
4. Energy Efficient Motors	Vijay Agencies	Mr.Jagdish Agarwal Opp Shiv Mandir ,Station Bazaria,Sawai-Madhopur Tel 07462-220678 (O) 222577 (R)
5.Transreluctance Sheet	B.S.Fibres	Mr.Mahesh Khandelwal Plot No.G-890 ,Badharna,Road No.14 VKI Area Jaipur 09413837371

5. Improve plant power factor through APFC pannel	ABB	Neeraj Verma Power Product SCO-13-14-15 Sector-34A Chandigarh Phone: 0172-4321845 Telefax: 0172-2601618 Mobile: 09878613484 email: neeraj.verma@in.abb.com

APPENDIX-5: NAME AND ADDRESSES OF UNITS IN CLUSTER
ALWAR & SAWAIMADHOPUR

Mr.Om Prakash Goyal Krisna Industries G-1- 19 Industrial Area Khirthal , Alwar – 301404 M.No- 094142 - 16094	Mr.Lokesh Jain Jain Oil Mill G-1-16 Industrial Area Khirthal , Alwar -301404 M.No-094144-33428
Mr.Chandan Ravi Industries G-1-1 Industrial Area Khairthal , Alwar- 301404 M.No -094130-36415	Mr.Ashok Haryana Dal & Oil Mill G-1-22 Industrial Area Khairthal , Alwar - 301404 M.No- 094130-35941
Mr.Mukesh Goyal Shankar Oil Industries G-29 Industrial Area Khirthal , Alwar – 301404 M.No- 094148-55730	Mr. Kaluram Vikas Oil Mill G- 26- 27 Industrial Area Khairthal ,Alwar - 301404 M.No-094147- 90980
Mr.Daulatram New Malik Industries G-1- 20 A Industrial Area Khairthal Alwar – 301404 M.N0- 094140-20400	Mr.Ramesh G-2-3 Industrial Area Khirthal Alwar - 301404 M.No- 094142- 61148
Mr.Vikram Jai Vaisnav Industries G- 46 Industrial Area Khairthal Alwar – 301404 M.No-097838-20000	Mr.Lalit Garg Singhania Oil Mill F- 60 Industrial Area Khairthal Alwar - 301404 M.No-098292-15415
Mr.R.K.Gupta R.K.Industries F- 69 Industrial Area Khairthal Alwar - 301404 M.No-092145 - 81754	Mr.Hari Om Sharma Hari Om Industries G-1-108 Industrial Area Khairthal Alwar – 301404 M.No- 094142- 31611

Mr.Sachin Goyal Ravi Industries H- 3 New Anaj Mandi Alwar – 301404 M.No- 094140-19698	Mr.Ajay Agarwal Shri Shakuntla Oil Products ITI Road,Old Industrial Area Alwar- 301404 M.No-09414018101
Mr.K.V.Methew Lalit Hons Protiens Pvt.Ltd. A- 316 – 318 MIA Alwar- 301404 M.No - 09460131559	Mr.Virendra Agarwal Alwar Manufactureres Pvt.Ltd. E-168 Matsya Industrial Area Alwar- 301404 M.No-094140-17671
Mr.Raman Devda Delight Agro Products F- 51 MIA Alwar – 301404 M.No-094140-17180	Mr.Jitendra Mahaveer Oil Mill Taj Mandi Sadar Thana Alwar – 301404 M.No-094142-31904
Om Prakash Goyal Om Industries GI – 90 Industrial Area Kherda ,Sawai – Madhopur M.No-094611- 00462	Mr.Giriraj Prasad Singhal Giriraj Udhyog GI – 89 Industrial Area Kherda ,Sawai – Madhopur M.No-094142 - 70475
Mr.Hari Om Gupta Narayani Oil Industries H-116 Industrial Area Kherda , Sawai – Madhopur M.No-07462-221318	Mr.Ramesh Khandelwal Industries GA- 97- 98 RIA Gangapur City Sawai- Madhopur M.No – 094140-32047
Mr.Om Prakash Goyal Krisna Industries G-1- 19 Industrial Area Khirthal , Alwar – 301404 M.No- 094142 - 16094	Mr.Lokesh Jain Jain Oil Mill G-1-16 Industrial Area Khirthal , Alwar -301404 M.No-094144-33428

Mr.Ramkumar Yogesh Industries G-78- RICCO Industrial Area Saloda,Gangapur City Sawai – Madhopur M.No- 094140-32099	Mr.Balram Goyal Vishnu Products Plot No- G-90 Industrial Area Gangapur City Sawai – Madhopur M.No- 092521- 62488
Mr.Rajesh Chaturbhuj Oil Mill Saroliya Pala Sawai – Madhopur M.No-094626-21921	Mr.Ram Prasad Lokesh Kumar Devki Nandan Oil Mill Purani Anaj Mandi Sawai – Madhopur M.No – 094609 - 89073
Mr.Mukesh Kumar Yadav Oil Products Near T.V.Tower Aalanpur Sawai – Madhopur M.No- 094146 - 46538	Mr.Nathulal Jain Jain (Sanjay) Oil Mill Aadarsh Nagar Baba Tea Stall Sawai – Madhopur M.No – 094149-10729
Mr.Purusottam Goyal Agarwal Oil Mill Saloda Industrial Area Gangapur City Sawai – Madhopur M.No-098874 - 54458	Mr.Shital Ram Aadarsh Oil Mill 94 Jawahar Nagar Sawai – Madhopur M.No-094140-30638
Mr.Satya Prakash Jain Satya Industries Main Road Kherda Sawai – Madhopur M.No- 094142- 03474	Mr.Sobajmal Sunil Industries Chetak Park Bajaria Sawai – Madhopur M.No-094143- 46324
Mr.Vimal Chand Goyal Vimal Chand Goyal Oil Industries Purani Jail Road Sawai – Madhopur M.No – 094130 - 84559	Mr.Rakesh R.K.Udhyog New Anaj Mandi Gangapur City Sawai – Madhopur M.No-092520-03333

Mr.Mukesh Kumar Krisna Oil Industries Shed Road Gangapur City Sawai – Madhopur M.No – 094135 - 04926	Mr. Uma Shankar Goyal G.S Industries G-1,10-11 RIICO Industrial Area Khirthal , Alwar – 301404 M.No-098290-22438
Mr. Ram Babu Gupta Trivani Vanaspati Products F- 201-204 Industrial Area Saloda , Gangapur City Sawai- Madhopur M.No- 094135- 03515	Mr.Santosh Kumar Vinod Kumar Santosh Kumar Oil Mill (Madhav Plastic Industries) Industrial Area ,Saloda , Gangapur City Sawai- Madhopur M.No- 096670- 32422
Mr. Sandeep Choudhary Nirmal Industries C- 161 Matsya Industrial Area Alwar M.No- 09414019629	Mr.Jagdish Prasad Jagdish Industries H-72 A Industrial Area Khairthal Alwar M.No-09460368476
Mr.Mukesh Gupta Mukesh Oil Mill Pvt.Ltd. E- 59,Industrial Area Khairthal Alwar M.No-09414907756	Mr.Vijay Mamariya Shri Balaji Oil Products Old Industrial Area Alwar M.No-09829215415
Mr.K.C.Shukla Saurabh Agro Tech Old Industrial Area Alwar M.No-09829099914	Aashish Udhyog Mr.Naval H-111-113 Saloda Industrial Area Gangapur City Sawai- Madhopur M.No-094140-32108

Confederation of Indian Industry
Since 1895

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes.

CII is a non-government, not-for-profit, industry led and industry managed organisation, playing a proactive role in India's development process. Founded over 115 years ago, it is India's premier business association, with a direct membership of over 8100 organisations from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 90,000 companies from around 400 national and regional sectoral associations.

CII catalyses change by working closely with government on policy issues, enhancing efficiency, competitiveness and expanding business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for sectoral consensus building and networking. Major emphasis is laid on projecting a positive image of business, assisting industry to identify and execute corporate citizenship programmes. Partnerships with over 120 NGOs across the country carry forward our initiatives in integrated and inclusive development, which include health, education, livelihood, diversity management, skill development and environment, to name a few.

CII has taken up the agenda of “Business for Livelihood” for the year 2010-11. Businesses are part of civil society and creating livelihoods is the best act of corporate social responsibility. Looking ahead, the focus for 2010-11 would be on the four key Enablers for Sustainable Enterprises: Education, Employability, Innovation and Entrepreneurship. While Education and Employability help create a qualified and skilled workforce, Innovation and Entrepreneurship would drive growth and employment generation.

With 64 offices and 7 Centres of Excellence in India, and 7 overseas in Australia, China, France, Singapore, South Africa, UK, and USA, and institutional partnerships with 223 counterpart organisations in 90 countries, CII serves as a reference point for Indian industry and the international business community.

Business enterprises worldwide are increasingly focusing on enhancing production and improving quality, while reducing costs. In such a scenario, it is important for small and medium enterprises (SMEs) to remain competitive.

The CII - AVANTHA Centre for Competitiveness for SMEs was established in 2004, with a view to providing SMEs in India with a one-stop consultancy service. There are more than 11.86 million SMEs in India, which contribute nearly 40 per cent of the country's total industrial output. If the country's economy is to be strengthened, it is imperative that these SMEs receive tactical support to remain competitive.

The Chandigarh-based CII - AVANTHA Centre for Competitiveness for SMEs aims to build competitive and visionary SMEs. The Centre offers consultancy services on a wide range of critical issues such as manufacturing excellence, energy management, cost management, human resource development, etc. Although the Centre does provide services to individual companies, it encourages the formation of groups or clusters of SMEs. A number of companies, which share the same location, sector or even OEM vendor, are allocated to these clusters. This approach encourages SMEs to form, share and draw from a common knowledge pool.

The CII - AVANTHA Centre for Competitiveness for SMEs has successfully established such clusters at Mohali, Gurgaon and Jalandhar and is running parallel clusters across the country at Jaipur, Faridabad, Lucknow, Pune, Kolkata, Chennai and various other locations. Apart from offering consultancy services, the Centre is also committed to helping SMEs remain abreast of contemporary issues through seminars, conferences and training programmes.

The Centre offers the following services

- Clusters for Competitiveness
- Energy Audit and Management
- Manufacturing Excellence
- Total Cost Management
- Human Resource Management
- Corrosion Management
- New Product Development

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