

Capacity Building workshop  
**Energy Efficiency and Renewable Energy  
Technologies**

16<sup>th</sup> January 2018 at Thangadh

Under the project  
Capacity Building of Local Service Providers (LSPs)

Supported by  
GEF-UNIDO-BEE Project  
Promoting Energy Efficiency and Renewable Energy in selected  
MSME clusters in India





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# Workshop summary

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## Overview of workshop

Capacity Building workshop of Local Service Providers (LSPs) on Energy Efficiency and Renewable Energy Technologies was organized by TERI on 16<sup>th</sup> January 2018, Tuesday in association with Panchal Ceramic Association Vikas Trust under GEF-UNIDO project. Total 36 participants were present during the workshop and for the industry visit, which was organized after the workshop. Agenda of the workshop and list of participants are attached in the annexure 1 and annexure 2 respectively.

## Summary of points discussed in the meeting

Mr. Ashwin Bhai Maru welcomed the participants and thanked BEE, TERI and UNIDO for organising the capacity building workshop. He briefed the necessity of new and energy efficient technologies in the sanitaryware manufacturing industries. He told that Thangadh is one of the largest sanitaryware manufacturing clusters in India which is also a leader in export. Thus cluster required to implement the innovative technological option in order to optimise manufacturing cost. This will not only enable industries to reduce the operational/manufacturing cost, but also help to remain competitive in the international market. He urged LSPs to acquire the knowledge on new technologies such as low thermal mass furniture, energy efficient burners & control system, etc. and support industries to implement the same.

Mr P Vora gave a brief background of the GEF-UNIDO-BEE project activities in Thangadh ceramic cluster and also explained the objective of the workshop. He told that there is enormous potential to improve the industries by implementation of energy efficient technologies and UNIDO is committed to support this mission.

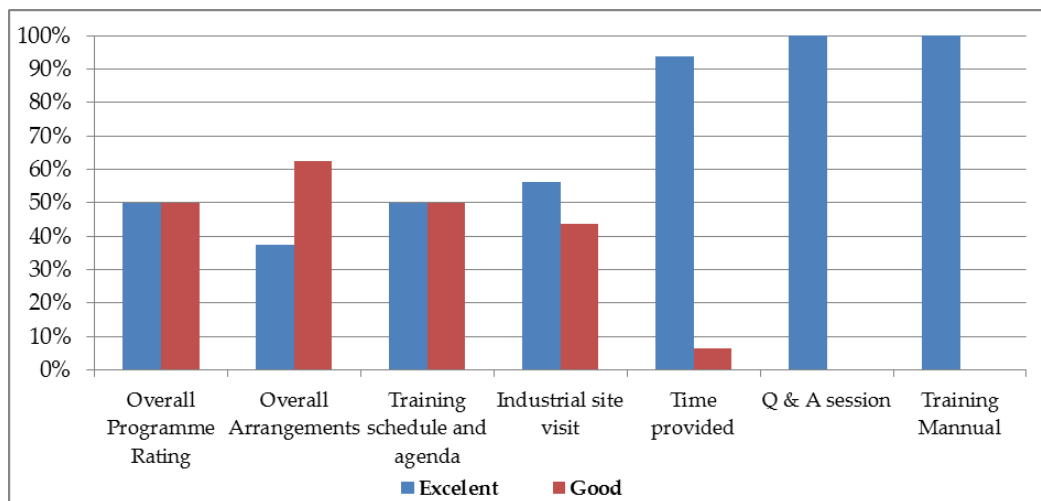
Mr. Vivek Sharma presented the energy conservation opportunities in the existing ceramic manufacturing process in Thangadh. He included the major energy consuming equipment related to process (such as grinding, drying and kiln) and utility (such as air compressor, motors and lighting). He explained the reasons which may affect the performance and efficiency of the various systems and how to improve performance using good practices, which eventually results in significant amount of energy savings. He also shared various case studies on air compressors, motors and burners.

Mr. Pawan Tiwari gave presentation on new and energy efficient technologies for ceramic industries which includes the automation of furnace combustion system, seamless compressed air distribution network & low thermal material in kiln furniture and various renewable energy options. He explained that combined use of low thermal furniture and kiln combustion system optimization may reduce the thermal cost significantly.

After the lunch, the participants were taken to Sunrise Pottery Works, Thangadh to get hands on training on practical aspects of energy efficiency in ceramic industries. Selected photos of the workshop and site visit are attached in the annexure 3.

## Feedback forms

Based on the analysis of the feedback forms received from the participants, it is observed that workshop was well received by the participants and 60% participants were satisfied with site visit, Q&A session and training module provided to them. About 50% participants have rated overall program as “excellent” while rest of them have rated it as “good”. More than 75% of participants were satisfied with arrangements made, training schedule and agenda of the program. Few sample feedback forms are attached in the annexure 4.



Analysis of feedback forms

## Suggestions by participants

Some participants have made suggestions as follows;

- 1) This type of program should conduct periodically
- 2) Duration of program should be more
- 3) Detailed training program on low thermal mass furniture in Kiln

## Learning's by participants

Some of the topics learned by the participants and mentioned by them are listed below;

- 1) New technologies which may help to reduce operational cost
- 2) Knowledge on compressed air distribution system
- 3) Solar rooftop

# **Annexures**





# Annexure 1: Agenda of the program



## Capacity building workshop Energy Efficiency and Renewable Energy Technologies

Tuesday, 16<sup>th</sup> January 2018  
Auditorium, PCAVT Building, Thangadh

Under the project:  
**Capacity Building of Local Service Providers (LSPs)**

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### Agenda

10:00 – 10:30	Registration
10:30 – 10:45	<b>Welcome Address</b> Mr Ashwin Bhai Maru, Panchal Ceramic Association Vikas Trust
10:45 – 11:15	<b>About the project and Overview of Thangadh cluster</b> Mr Pramod Vora, UNIDO Cluster Leader - Thangadh
11:15 – 12:00	<b>Overview of Energy Conservation Opportunities in Ceramics Industry</b> Mr Vivek Sharma, TERI
12:00 – 12:45	<b>Potential of EE/RE Technologies in Ceramics Industry</b> Mr Pawan Tiwari, TERI
12.45 – 13:00	Q&A
13:00 – 14:00	Lunch
14:00 – 16:00	Site Visit / On-site training
16.00 – 16: 30	Feedback from participants
16:30 – 16:45	<b>Vote of thanks</b> Mr Kalpesh Bhai, Panchal Ceramic Association Vikas Trust

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**Panchal Ceramic Association Vikas Trust**



## Annexure 2: List of participants

S.No	Name	Organization	Mobile No	Email ID
1.	Pradip Vora	UNIDO/ BEE	9824384234	cl.thangadhcluster@gmail.com
2.	Hitesh Pokiya	Sinox power	9099642846	sinoxpower@gmail.com
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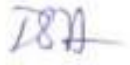



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Capacity building workshop  
Energy Efficiency and Renewable Energy Technologies






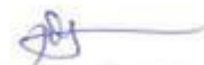



Tuesday, 16 January 2018  
Auditorium, PCAVT Building, Thangadh

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42					
43					
44					



## Annexure 3: Selected photographs of the event





# Annexure 4: Sample feedback forms



**Capacity building workshop  
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Tuesday, 16 January 2018

Auditorium, PCAVT Building, Thangadh

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Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

**Evaluation Sheet for Participants**

Feedback Form for Participants			
Parameter	Feedback		
	Excellent	Good	Average
How would you rate the overall programme?	✓		
How would you rate overall arrangements?	✓		
How was the training schedule and agenda?	✓		
How was the industrial site visit?	✓		
Do you think that adequate time was provided for each topic?	Yes [ ✓ ]	No [   ]	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes [ ✓ ]	No [   ]	
Do you think that the background training manual is informative and useful enough?	Yes [ ✓ ]	No [   ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [ ✓ ]	No [   ]	
<b>Suggestions &amp; Recommendations for improvement:</b>			
<b>Name two learning, which from this programme you will be able to implement in your plant?</b>			
Signature: <i>Uday Sakaria</i>			
Name of participant: <i>Uday Sakaria</i>			
Organization: <i>Uday Sakaria's</i>			
Mobile No: <i>9825716016</i>			
Email ID:			

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Do you think that adequate time was provided for each topic?	Yes [ ✓ ]	No [   ]	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes [ ✓ ]	No [   ]	
Do you think that the background training manual is informative and useful enough?	Yes [ ✓ ]	No [   ]	
Do you think that the discussion on EE/RE will help you in your work?	Yes [ ✓ ]	No [   ]	
<b>Suggestions &amp; Recommendations for improvement:</b>			
<b>Name two learning, which from this programme you will be able to implement in your plant?</b>			
Signature: <i>Smit</i>			
Name of participant: <i>Smit Sakaria</i>			
Organization: <i>Somnath Pottery Thangadh</i>			
Mobile No: <i>7405115295</i>			
Email ID: <i>Sakaria.Smit@gmail.com</i>			

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Do you think that adequate time was provided for each topic?	✓ Yes [ ]	No [ ]	
Do you think that satisfactory answers were given to your questions during the training programme?	✓ Yes [ ]	No [ ]	
Do you think that the background training manual is informative and useful enough?	✓ Yes [ ]	No [ ]	
Do you think that the discussion on EE/RE will help you in your work?	✓ Yes [ ]	No [ ]	
Suggestions & Recommendations for improvement:			
Name two learning, which from this programme you will be able to implement in your plant?			
Signature: <i>[Signature]</i>			
Name of participant: <i>गुणेश गुणेश गुणेश गुणेश</i>			
Organization: <i>श्री. विश्व गुणेश गुणेश गुणेश</i>			
Mobile No: <i>98765 43210</i>			
Email ID: <i>[Blank]</i>			

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The Energy and Resources

Panchal Ceramic Association Vikas Trust



**Capacity building workshop  
Energy Efficiency and Renewable Energy Technologies**

Tuesday, 16 January 2018


Auditorium, PCAVT Building, Thangadh

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GEF-UNIDO-BEE Project

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India

**Evaluation Sheet for Participants**

Feedback Form for Participants			
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Do you think that the discussion on EE/RE will help you in your work?	Yes [ ✓ ]	No [   ]	
<b>Suggestions &amp; Recommendations for improvement:</b>			
<b>Name two learning, which from this programme you will be able to implement in your plant?</b>			
Signature: 			
Name of participant: <i>Himanshu Agaria</i>			
Organization: <i>Sinox power</i>			
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Email ID: <i>info@sinoxpower.com</i>			

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# Annexure 5: Copy of presentations

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## Potential of EE/RE Technologies in Ceramics Industry

Capacity building workshop  
Energy Efficiency and Renewable Energy Technologies  
Tuesday, 16 January 2018  
Thangadh

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The Energy and Resources Institute  
&  
Panchal Ceramic Association Vikas Trust

## Content

- Induction Motors and Associated Auxiliaries
  - IE3 motors
  - Poly cogged belt
  - Auto Star-delta starters
- Compressed air system
- Kiln
  - Air to fuel ratio controllers/Burner
  - Insulation
  - Low thermal mass cart
- Lighting
- Solar roof top

Electrical Utility

## **INDUCTION MOTORS AND ASSOCIATED AUXILIARIES**

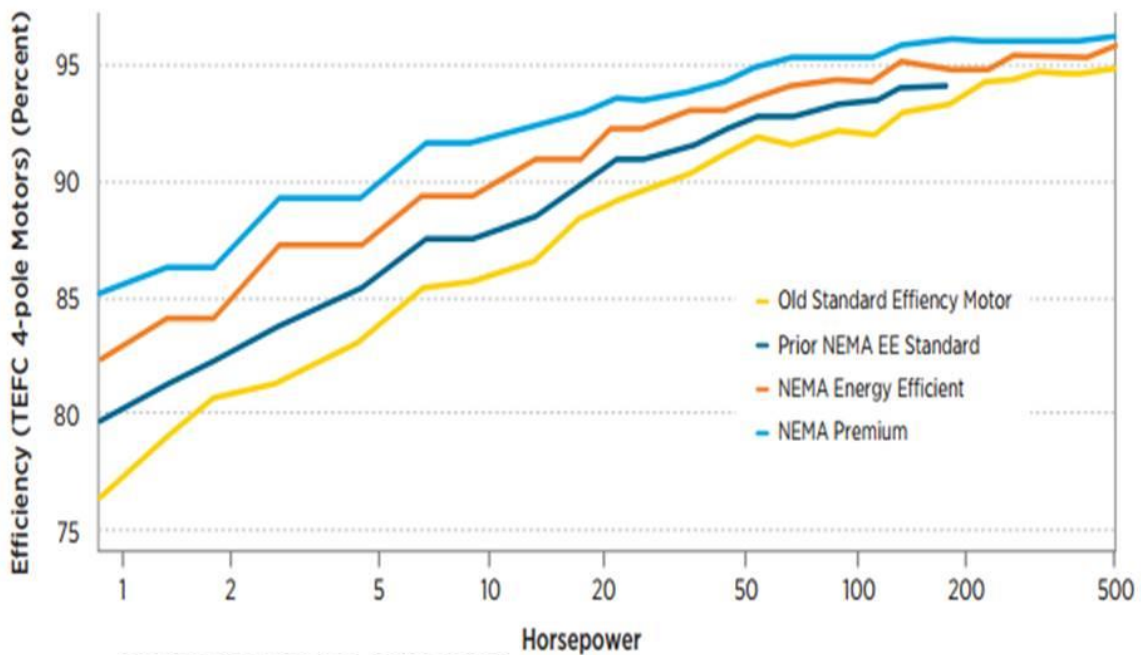
### **Why EE Motors**

- More than 300 million motors are used in industry
- About 30 million new electric motors are sold each year for industrial purposes alone.
- Electric motor driven systems in industry are estimated to be responsible for 69% of industrial electricity consumption.
- Most of the motors installed in Indian industries are standard efficiency class (IE-1 or Non IE)
- Approximately 16% motors are rewinded multiple time

# Electric motor driven systems



## Premium Efficiency Class Motor (IE3)



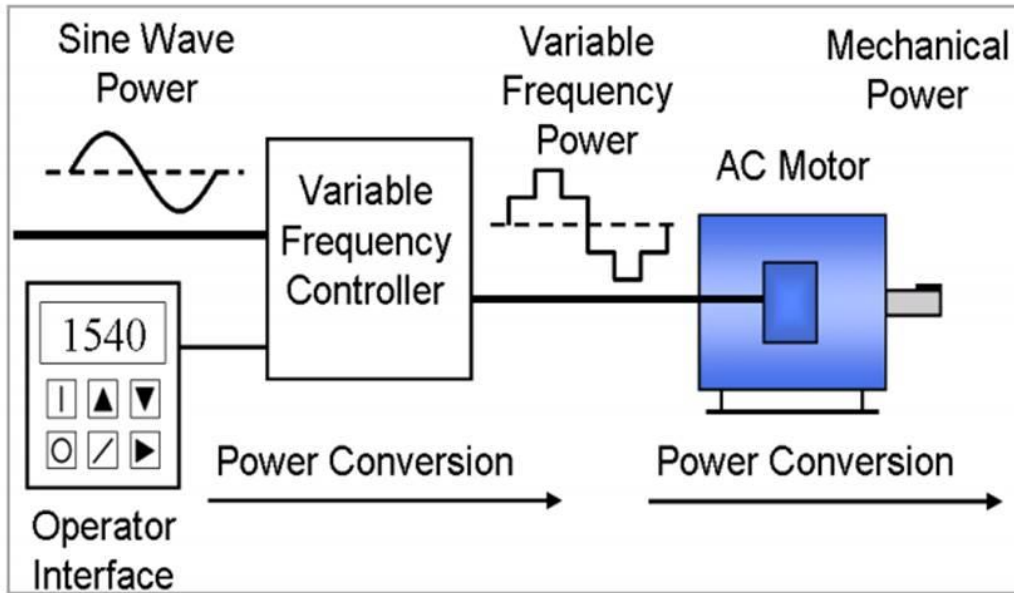
## Motors Not Covered by IE3

- Single-phase motors
- DC motors
- Two-digit frames (48-56)
- Multi-speed motors
- Medium-voltage motors
- Totally enclosed nonventilated (TENV) and
- Totally enclosed air over (TEAO) enclosures
- Motors with customized
- OEM mountings
- Intermittent duty motors
- Submersible motors
- Encapsulated motors
- Motors that are integral with gearing or brake
- where the motor cannot be used separately
- Design D motors
- Partial motors

## Variable loads and VFD or ASD

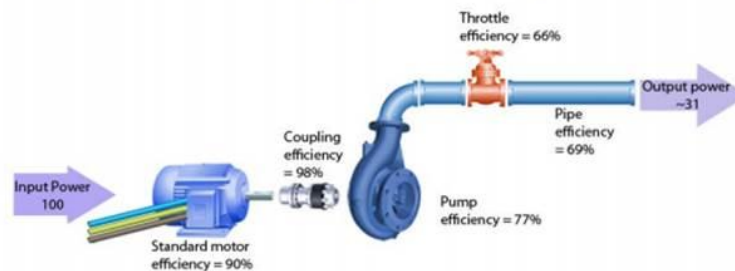
- Many motor applications have high operating hours but variable loads.
- VFD/AD helps in adapting motor speed and torque to the required load.
- Largest benefit comes with pumps & fans in closed loops for which power consumption varies as a cubic power of their rotational speed.
- In air-conditioning systems, the temperature and flow control of pumps and fans can be achieved with VSDs, reducing on/off cycles and providing a more stable indoor climate

# Schematic variable-frequency drive

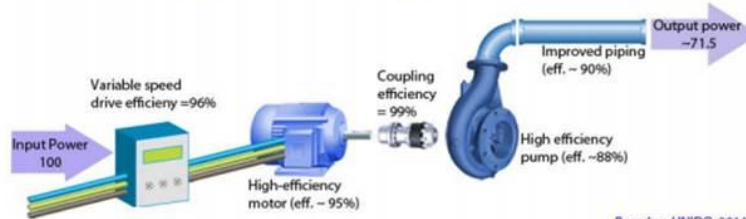


# Application of VFD

Conventional Pumping System (Efficiency ~ 31%)



Efficiency Optimized Pumping System (Efficiency ~ 72%)



Based on UNIDO, 2011.



## Gears and transmissions

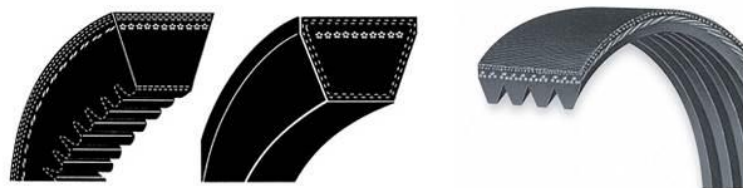
- Gears are used in some applications to convert motor speed to the required speed.
- Some types of gears (worm gears with very high gear ratios) can be very inefficient
- Gear losses come from tooth friction and lubrication churning.
- Losses tend to be between 2% and 12% higher in new gears until the teeth are smoothed.
- High gear losses can be avoided by using a motor with a pole number and respective speed closer to the desired rpm of the driven equipment.
- If the gear is not used to provide maximum torque at low speed, a VFD can be used instead.

## Gear efficiency

Gear type	Normal ratio range	Pitch line velocity (m/s)	Efficiency range
Spur	1:1 - 6:1	25	98% - 99%
Helical	1:1 - 10:1	50	98% - 99%
Double helical	1:1 - 15:1	150	98% - 99%
Bevel	1:1 - 4:1	20	98% - 99%
Worm	5:1 - 75:1	30	20% - 98%
Crossed helical	1:1 - 6:1	30	70% - 98%

## Poly cogged belt

- V-belt drives can have a peak efficiency of 95% due to slippage occurrence
- Poly cogged belt will have 98% peak efficiency due to less slippage compared to V-belt
- Also they run cooler and are durable hence last longer



Electrical Utility

## AIR COMPRESSORS

## Overview and Applications

- Compressors are used in the following three electric motor-system applications:
  - air compressors for compressed air,
  - liquid natural gas, gas transport, etc.;
  - cooling compressors; and heat pumps.
- Compressor technology uses reciprocating, rotary screw and centrifugal systems.
- Many compressor systems run in an efficiency range of only 5% to 10%

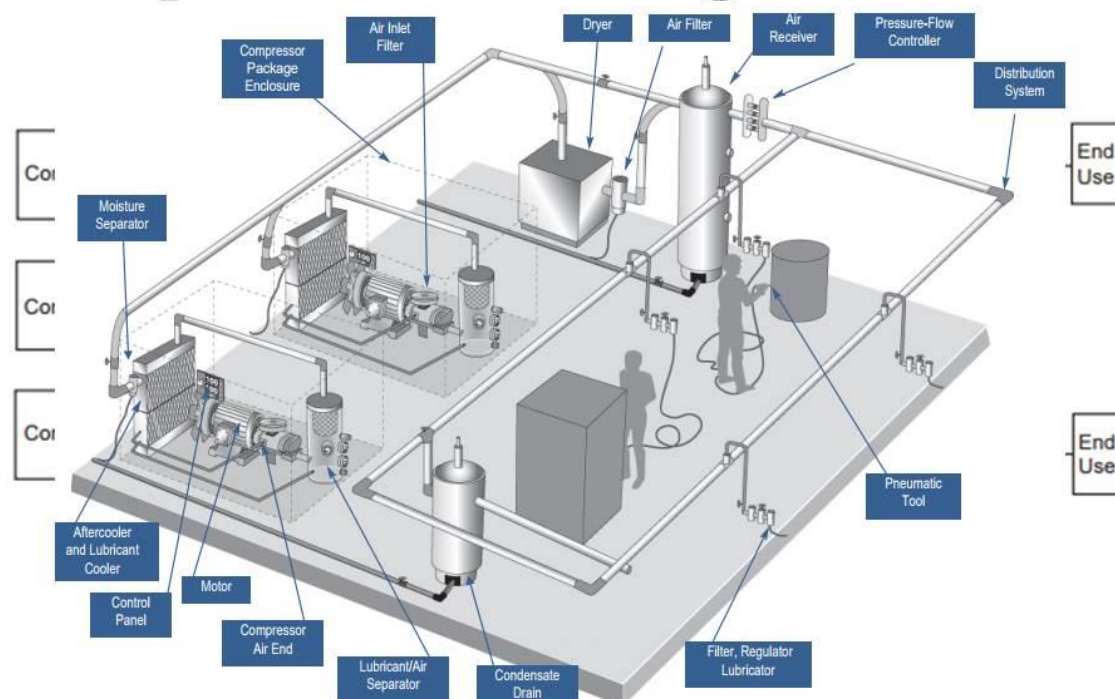
## Losses in a compressed-air system

Source of power loss	Transferred "useful" power (kW)	Power loss (kW)
Electrical power input	100	
Air from compressor	10	90 (heat)
Treatment	9	1 (e.g. filter pressure drop)
Leakage	6	3 (leakage)
Distribution system	5.5	0.5 (e.g. excess pressure drop)
Over-pressure	5.0	0.5 (heat)

Source: Falkner and Slade, 2009.



## Simplified block diagram



## Rotary Compressors

- Compact size and complete package
- Economic first cost
- Vibration-free operation does not require special foundation
- Part-load capacity control systems can match system demand
- Suitable for variable speed control with improved performance at part load)
- Routine maintenance includes lubricant and filter changes.

**Use of Variable frequency drives for screw air compressors**

## **Membrane-type dryers**

- Low installation cost
- No electrical consumption
- Can be installed outdoors
- Can be used in hazardous atmospheres
- No moving parts

## **Ring loop air distribution piping**

- Balanced air pressure in the plant
- Reduction in pressure loss
- Avoid underground air piping in the plant
- Tapping should always be taken from the top of the main header line
- Drainage points should be provided at the bottom of each tapping
- Automatic drain valve should be installed at the receiver for regular water drain from the tank
- Timer frequency should be changed as per the season, more frequent draining in the rainy season

# Air guns, spray guns/nozzles

Use of small diameter air guns, spray guns/nozzles



Arresting air leakages in air distribution systems

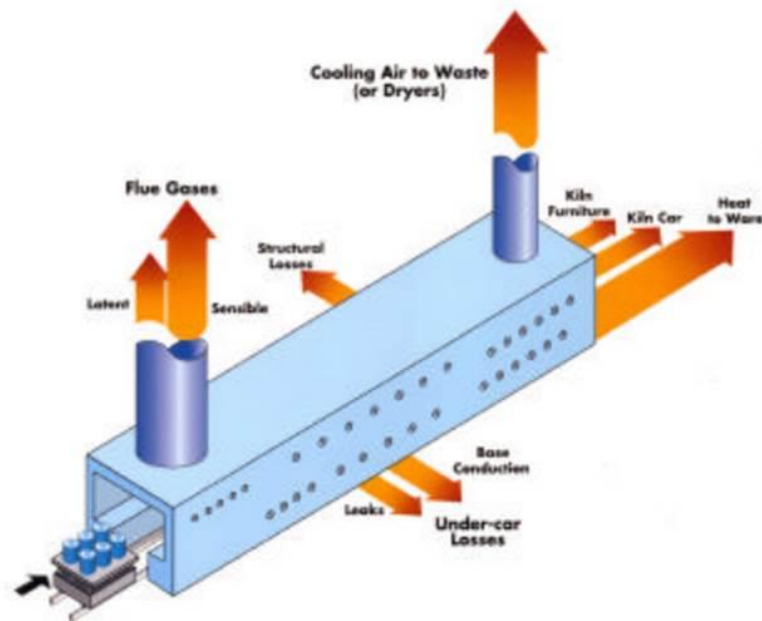
- Use of crimped joints instead of clip joints
- Use of quick release coupling (QRC)



Thermal Utility

**KILN**

# Energy Balance



## Energy efficient Kiln

- Energy efficient engineering
  - Design
  - Material Movement
  - Draft system
- Energy management system and burners
- Integrated process control
- Internal heat re-use
- The development of low thermal mass (LTM) materials and ceramic fibres has improved kiln efficiency
- Minimising non-payload throughput



## Solar roof top



## Lighting





**Thanks for you kind support**

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# Overview of Energy Conservation Opportunities in Ceramics Industry

Capacity building workshop  
Energy Efficiency and Renewable Energy Technologies  
Tuesday, 16 January 2018  
Thangadh

Organised By



**The Energy and Resources Institute  
&  
Panchal Ceramic Association Vikas Trust**

## Content

- Material Preparation and Grinding
  - Electric Motors
  - Belt
  - Ball Mill (Grinding media)
- Moulding and Drying
  - Drying (Fans)
  - Air Compressors
- Glazing
- Kiln
- Other Areas

## Material Preparation and Grinding

- Electric Motors
- Belt
- Ball Mill



## Electric Motors

- Motor Rating 30 kW for 6 Ton Ball Mill to 90 kW for 20 Ton Ball mill

### Approach

- Motor loading, %
- Power factor, PF
- Power consumption, kW

### Parameters to be measured/monitored

- Motor power, kW
- Power factor, PF
- Current drawn, Amps
- Rewinding history



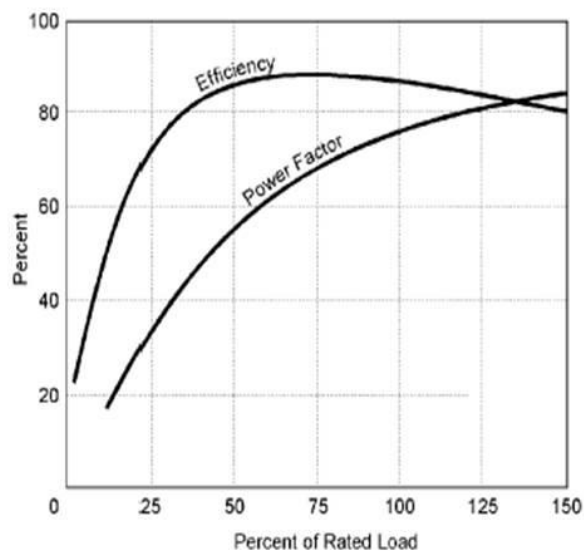
# Electric Motors

## Factors that influence efficiency

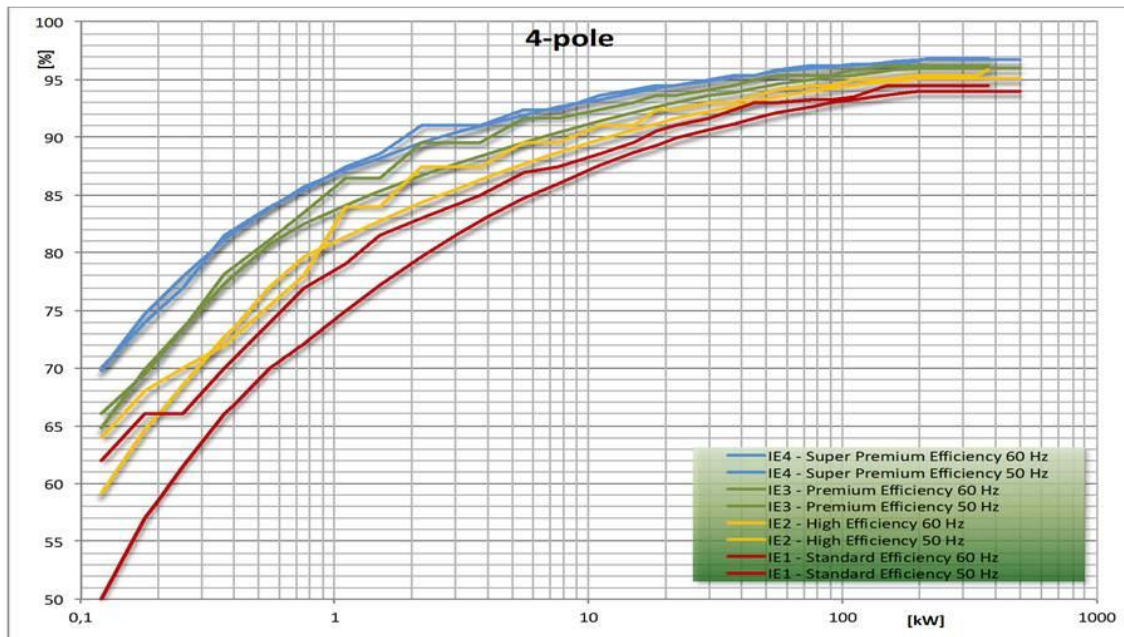
- Age
- Capacity
- Speed
- Type
- Temperature
- Rewinding
- Load

# Electric Motors

EFFICIENCY/POWER FACTOR vs LOAD  
(Typical 3-Phase Induction Motor)

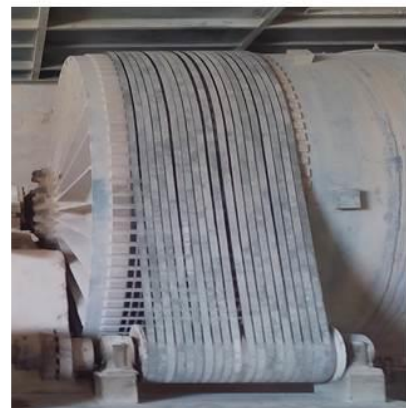


# Electric Motors



# BELTS

- V- belts are use for transmission in Ball Mill
- Cogged V-belts are more efficient in drives compared to V-belts



## Ball Mill

❑ Ball Mill grinds materials by rotating a cylinder with steel grinding balls.

### ❑ Approach

- Calculation of specific energy consumption - kWh per tonne
- Optimized charging
  - Dimensions of charging material
  - Sequence of charging
- Rejection percentage

## Moulding and Drying

### Air Compressor

- In Moulding process slurry is filled in mould boxes by air pressure.
- To open mould boxes also air pressure is required.
- Hence air compressor is required to generate air pressure upto 5 to 7 bar.
- Currently Reciprocating compressor and screw compressor is used to cater the air pressure requirement in the units
- Replacement of old reciprocating compressor with EE screw compressor
- Based on loading percentage VFD can be retrofitted in existing screw compressor

## Moulding and Drying



## Moulding and Drying

### Drying (Fans)

- Currently 80/75 Watts ceiling fans are used
- Replacement of old inefficient fans by new EE Fans 28 Watts





## Glazing

- **Spray Guns:**
- Pneumatic air is required for spraying in glazing operation for surface finish of Sanitaryware
- Efficient sprays guns can minimize pneumatic air requirement



## Kiln

- Kiln is the most energy consuming area in ceramics units
- Most of Kiln are Natural gas fired/ using gasifier gas



## **Kiln**

### **Energy conservation opportunities in kiln are:**

- Complete combustion with proper air to fuel ratio
- Ensuring capacity utilization upto 95% of kiln by proper design
- Proper heat distribution
- Operating the kiln at designed temperature
- Use of EE self recuperative high velocity burners
- Control of Chimney draught and kiln pressure
- Reducing heat losses from opening
- Minimizing wall losses by improving kiln insulation.
- Waste heat recovery from flue gases

## **Lighting**

- Switching from CFL bulbs to LED bulbs
- Switching from T-12 FTL to LED FTL
- Switching from MVL/MH to LED highbay/floodlamp or to Magnetic Induction Lamp



# LIGHT

